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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

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INDEX TO VOLUME L

January 1 to June 30, 1919

EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†), and new shop equipment as described in the departments "Shop Equipment News" and "Condensed Clipping Index of Equipment" with a double dagger (‡). Book reviews are listed under the heading "New Publications." Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader, but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and Fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference. The plural of any given item may not necessarily follow the singular immediately, as the items are listed in alphabetical order. All articles written by any given author are listed directly under his name in the special author's index which starts on page 21. Articles that are not credited to any author may be found under the heading "No author credited," listed under "N" in the Author's Index.

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Grinding Operations on "Caterpillar" Tractor Parts

By FRANK A. STANLEY

The grinding operations conducted on the "Caterpillar" tractor include the finishing of a great variety of gears, bushings, shafts, piston pins, case covers, etc. Details are given of wheels, limits of accuracy, etc.

THE purpose of this article is to give in detail the data pertaining to the methods followed in the grinding department of the Holt Manufacturing Co.'s plant at Stockton, Calif. An earlier article was devoted to the manufacture of gears at this plant and the practice of the company in respect to grinding the bore of various kinds of gears.

Some of the illustrations in this treatise are included to show something of this grinding work. In this connection the headpiece should be of interest, as it represents a number of gears of various kinds and sizes ready for chucking and grinding. The greater part of this work is handled in Heald internal-grindin g machines, and in Fig. 2 one of them is shown with a spur gear undergoing finishing in the bore. This gear has a bore 3.874 in. in diameter, is 2.5 in. long, and the allowance permitted in the grinding of the bore is only 0.001 in. from specified size and that must be on the plus side of the dimension.





FIGS. 2 AND 3. FINISHING THE BORE OF A GEAR IN THE INTERNAL-GRINDING MACHINE AND GRINDING TRUCK-WHEEL GUDGEONS

Like so many others finished by the same method this gear is of mild steel casehardened, and the wheel used on the internal-grinding-machine spindle is a Norton alundum, 46-K or 46-L. The wheel is 3 in. in diameter and is operated at a speed of about 5500 r.p.m. The amount of material left for grinding out with the wheel runs from about 0.015 to 0.030 inches.

The work is rotated at 120 turns per minute and the wheel is traversed through the work at a rate equivalent to about 24 in. per minute. The metal removed per pass of wheel runs say two or three thousandths, and the rate of production is eight gears per hour ground to micrometer measurements and held within the limit of 3.874 to 3.875 inches.

Another and larger gear has a bore of practically the same diameter as the one described, but as the width of the gear is only 2 in. better time of production is obtained, the number of gears of this size finished per hour being 10. The same grade of wheel is used as for this gear and the same rate of feed and speed of rotation employed as for the previous one. The greater output on the narrower gear is precisely in proportion to its length of cut as compared with the other gear width. In another gear of 3.748 in. bore by 4 in. wide the rate of grinding is five per hour or half that on the gear having a 2-in. face. A change-speed gear with a clutch is handled on the same type of grinding machine. This gear is of 1.939-in. bore, and is ground out with a 1¾-in. wheel rotating at somewhere near 5000 ft. peripheral speed per minute. The depth of the hole to be ground is nearly 4 in., but the diameter is only half that of the last example cited and the rate of grinding is eight per hour.

There are various sizes of bevel gears to be ground out in this manner. A typical example has a bore diameter of 2.187 in. and a depth of 3 in. The wheel speed and feed, allowance for grinding and limit of accuracy correspond to the data already given.

The large bevel gears shown stacked high in Fig. 1 are other interesting examples of internal grinding. They are 10.67 in. outside diameter and the bore is 4.175 in. in diameter by $2\frac{5}{8}\frac{1}{4}$ in. long. An allowance of 0.003 in. is permissible in sizing this bore and the work is turned out at the rate of five per hour.

The counter main sprocket is a heavy steel piece ground internally on an engine lathe with carriage fitted up with an internal grinding-machine spindle; a 36-K alundum wheel is used. The hole is 5.225 in. in diameter and the sprocket $2\frac{3}{8}$ in. thick. Four of these sprockets are ground per hour, the amount of metal removed by the wheel ranging from 0.020 to 0.030 inches.

The gudgeon for "Caterpillar" tractor truck wheels is made of rolled stock casehardened and is a plain, straight piece of work nearly 2 in. in diameter by $16\frac{3}{16}$ in. long, turned to within about 0.020 in. of finished size. After casehardening it is taken to the grinding machine for sizing.

The piece is shown in Fig. 3 in the Norton No. 10 x 36-in. grinding machine with the operation just starting at the end. A 24-combination-L alundum wheel 20 in. in diameter by 5-in. face is used. The wheel spindle is driven at 1150 r.p.m. The work is rotated at 120 turns per minute corresponding to a surface speed of 60 feet.

These gudgeons are ground to the size required at the rate of 25 per hour, or in a little less than $2\frac{1}{2}$ minutes each. A limit of 0.002 in. is permissible in the sizing of the gudgeon, which probably aids in keeping up the rate of production, although with the broad-faced wheel there is relatively little wear and the work can be held closely to size with a minimum of effort.

A piece handled in large numbers in the grinding machine is the piston pin, or wrist pin, made of seamless-steel tubing casehardened and ground to finished size. This tubular part is of fairly heavy section through the walls, having over $\frac{1}{4}$ in. of metal at each side. It is turned down to within 0.012 to 0.015 in. of finished diameter, and then put into the grinding machine for finishing.

Here again a 24-combination-L alundum wheel driven at 1350 r.p.m. is employed, the wheel diameter being 18 in. so that the surface speed is about 6250 ft. per minute. The work is rotated at 120 turns per minute or at a rate of about 60 ft. surface speed per minute.

The hollow piece is mounted on an arbor for grinding. It is held lightly, as only 0.0005 in. is allowed from standard size. The piece has to be sized to two different diameters as indicated. The larger, or main, size is secured by setting the stop to bring the wheel to position for sizing the body of the pin at one pass across the wheel surface. Then with stop thrown out the wheel is fed straight in to give the smaller diameter which is only $1\frac{1}{4}$ in. long, the wheel face in this case being $2\frac{1}{2}$ in. wide. The pins are finished at the rate of 16 per hour, a lot of them being shown in the tote pan in front of the grinding machine in Fig. 4.

The reverse shaft is made from a drop-forging and

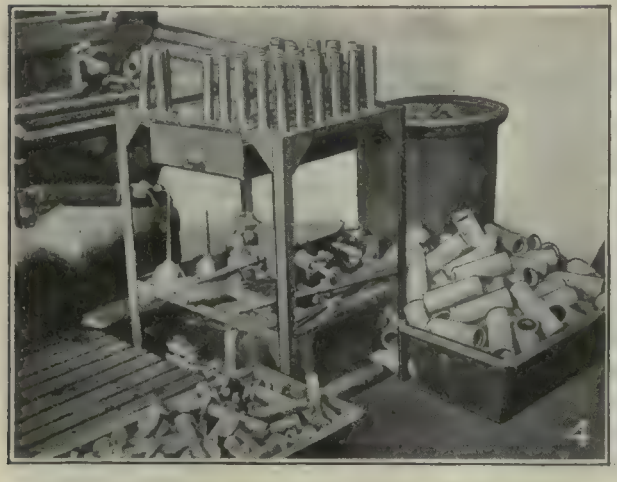


FIG. 4. PISTON PINS AND OTHER WORK NEAR GRINDING MACHINE



FIG. 5. INTERMEDIATE SHAFTS FINISHED IN THE GRINDING MACHINE

finished by grinding to a limit of 0.001 in. for a length of about 20 in., the diameter being 2.437 in., on an alundum wheel, 24-combination-L 20 in. in diameter by 5 in. face. The wheel is driven at 1200 revolutions or 6000 ft. peripheral speed. The work is run at 100 r.p.m., equivalent to about 75 ft. surface speed. The metal to be removed ranges from 0.030 to 0.060 in., and so two operations are made for each shaft. The lot of shafts are run through the rough-grinding process, then the wheel reset and the entire lot passed through the machine again for a finishing cut. The same wheel is used for both rough and finish grinding. The first grinding operation removes the metal to 0.006 to 0.010 in. of size and the work is handled through this process at the rate of 18 per hour or say one in $3\frac{1}{2}$ min. In the second, or finish, grinding operation 12 per hour are turned out, the time being increased to 5 min. each, owing to the necessity for holding the work to the limit specified.

Intermediate Shafts

The shafts shown on the floor in Fig. 5 are part of a lot of such members made from nickel steel. They have a body diameter of $2\frac{3}{4}$ in. and a total length of $23\frac{3}{4}$ in. The ends are reduced somewhat for a distance of about 5 in. The piece is known as an intermediate shaft and has to be ground all over.

The work is handled in a Norton 14 x 50-in. plain grinding machine. The wheel used is an alundum 24-combination-L, 20 in. in diameter by 5 in. face. It is driven at 1050 revolutions, 5500 ft., per minute. The work is run at 100 revolutions, or 80 ft. surface speed. The depth of metal removed averages 0.030 in., and about 0.004 in. is taken off at each pass across the wheel. The rate of traverse of the work is about 72 in. per minute.

The time required for grinding the body and both ends complete is 15 minutes.

A gear and sleeve is ground on a Norton 10 x 36-in. machine, as shown in Fig. 6, with a 20 x 5-in.-face alundum wheel, 24-combination-L, run at the same speed as given for the shaft above, namely, 5500 ft. peripheral speed per minute. The work is driven at 85 r.p.m., or for the 3¼-in. diameter approximately 80 ft. surface speed.

Here, as before, the allowance for reduction by grinding is from 0.020 to 0.030 in., and the time in grinding is about 10 min. each.

The work, having a $2\frac{5}{16}$-in. hole clear through the sleeve, is mounted on an arbor for placing between the grinding-machine centers. It is held to within 0.001 in. limit of accuracy.

Chilled-Iron Cams

The cams for these motors are made of chilled iron with special foundry appliances that will be described later. A cam detail is reproduced in Fig. 7, which shows all of the dimensions of importance and gives an idea of the form to be finished by grinding.

These cams are handled on a Landis machine with cam-grinding attachment, the wheel used being a crystolon 46-K running at 6000 ft. per minute. The work is driven at 50 r.p.m., or practically 35 ft. circumferential speed.

As the cams are cast in chills there is ordinarily little variation in the size of the work as it comes to the grinder. The amount generally left for removal by grinding from the casting is from 0.040 to 0.050 in. The limit to which the ground work is held is 0.003 inches.

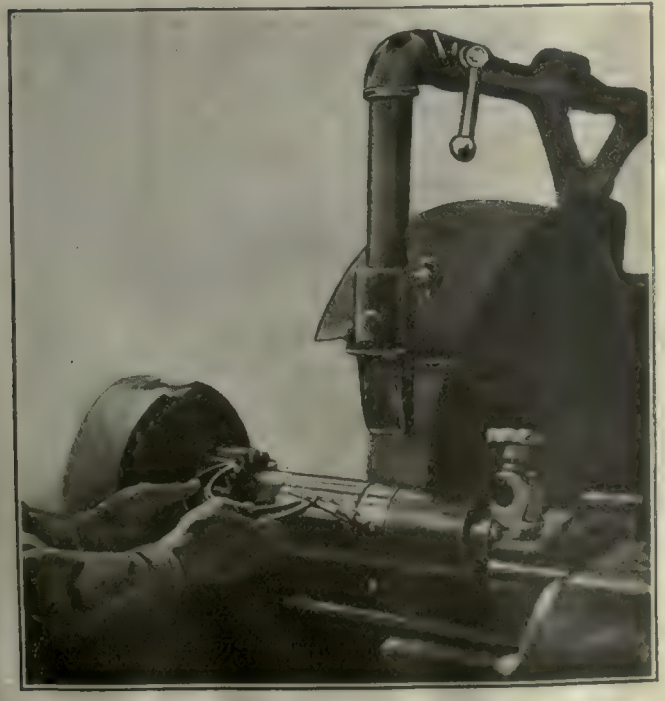


FIG. 6. GRINDING THE LONG SLEEVE GEAR

The wheel is applied by feeding in to the stop for depth and then feeding straight across the cam surface. The time required for grinding each cam is 3½ min. only.

Another job finished on the Landis grinding-machine is a casehardened mild-steel thrust-bearing washer 7½ in. in diameter by 0.325 in. thick, the limit of

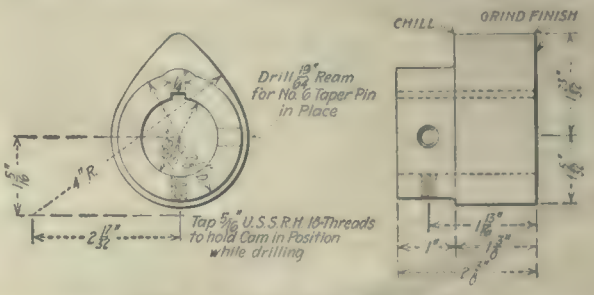


FIG. 7. CHILLED IRON CAMS

accuracy in thickness called for by the blueprint giving 0.003 in. leeway or a maximum thickness of 0.328 inch.

The washer is ground on the faces only. It is held on a magnetic chuck and a 14-in. wheel with 1¼-in. face applied. The wheel is a 36-K alundum run at 6000 ft. per minute. The work is driven at 150 revolutions per minute.

The total amount of stock to be ground from the face is about $\frac{1}{32}$ in. The wheel removes 0.003 in. at each pass across the face and the job is completed at the rate of five washers an hour, or in 12 min. each.

A great many bushings of phosphor bronze, manganese bronze, etc., are finished in the grinding-machine department. A bushing for the small end of a connecting-rod is of manganese bronze. It is finished to 2.812 or 2.813 in., the limit being 0.001 in. It has a length of $3\frac{1}{16}$ in. and is placed for grinding in a Norton 6 x 32-in. plain grinding machine.

In turning these bushings $\frac{1}{32}$ in. of metal is left for removing with the wheel, and this is done very rapidly, the bushings coming from the grinding machine at the rate of 60 per hour, or 1 min. apiece.

A 36-K crystolon wheel is used, the wheel having a diameter of 14 in. and a thickness of 2 in. This wheel is operated at a surface speed of 5500 ft. per minute corresponding to a velocity of 1550 r.p.m. The work is rotated at 100 turns per minute or at a surface speed of 75 feet.

Another bushing 2.692 in. in diameter and 4 in. long, of phosphor bronze, is ground under practically the same conditions and at the same rate. It is a bushing for the truck wheels of the "Caterpillar" tractor, and here again only 0.001 in. limit is allowed in finishing the piece. Sixty-five are ground in an hour.

A longer bushing is also held to the limit of one thousandth of an inch. This piece of work has a length of $8\frac{13}{16}$ in. and a diameter of 3.432 in., so its total surface area figures out at almost exactly three times that of the connecting-rod bushing referred to above. The time required for grinding is in exact proportion, or 3 min. each.

It is ground with a 14 x 2-in. crystolon 46-K wheel operated at 1650 r.p.m., or at a surface speed of 6000 ft. The metal to be ground off averages from 0.015 to 0.035 in. and the wheel removes about 0.003 in. at each pass.

The small bushing 1.501 in. in diameter by 1.75 in. long is ground with a 46-L crystolon wheel of the same size as given above. It is run at about 5000 ft. per minute and removes from 0.015 to 0.025 in. of metal. The stop is set and the wheel position then remains unchanged except when dressed. One pass is made across with the work and the bush sized at the one cut. Although the piece is held to the limit of 0.001 in. the bushings are ground at the rate of 110 per hour.

The final operation to be taken up is the method of finishing cast-iron gear-case covers on the Pratt & Whitney vertical spindle surface grinding machine. A 24-H crystolon wheel is used here, which is run at 1150 r.p.m., and the wheel, having a diameter of 14 in., the peripheral velocity is about 4400 ft. per minute.

The castings have about $\frac{1}{16}$ in. to be removed in the grinding operation and are passed three or four times under the edge of the ring wheel in the machining process. The table is operated at the rate of six forward and backward movements per minute, so that only about a minute is consumed in the actual surface-grinding operation.

This department has many other details of interest, particularly in the grinding of crankshafts, cylinders and pistons. These operations will be described in other articles.

Grinding Round Work Without Centers

SPECIAL CORRESPONDENCE

In machine building today such accuracy is required in many small rollers, bushings, shafts and other parts that grinding is necessary, and if they could be produced without centers a considerable saving in time would result. This article describes a new grinding machine which handles these parts as fast as they can be fed to it without the necessity for centering them.

WITHIN the past few years a method has been developed for grinding the small cylindrical parts used in gas engines, roller bearings, etc., in the shape in which they are produced by automatic screw machines.

The machine for doing this work is built by the Detroit Tool Co., Detroit, Mich., and for some time was used almost exclusively in its own shop, where this class of work was handled as a jobbing proposition. The company having changed its policy the machines are now sold to manufacturers, making its capabilities of interest to managers and foremen in general.

From a casual inspection this grinding machine appears very similar to an ordinary tool-grinding machine, but there are certain features of the wheel itself and of the grinding guides which are unique. In the first place the wheel is dressed at an angle of from 3 to 6 deg. with its axis, causing it to assume the shape of the frustum of a cone. The part to be ground is held in a jig or guide block along which it slides until it comes into contact with the wheel. From this point forward the work is rotated by frictional contact with the wheel, but by virtue of the varying velocities of different parts of the wheel surface and the fact that the guide stands at a slight angle from a horizontal position the speed of rotation is much slower than would be derived from a direct nonslip contact. The angular position of the guide serves also to feed the work past the wheel much as the traverse movement of the regular form of grinding machine would do.

Should the wheel have been dressed parallel to its axis this angular position of the work would have the effect of making an apparent convex surface of the wheel, but as the latter is dressed by a diamond which slides in the same guide block (already adjusted to the angle) the wheel presents a parallel surface to the work, though it would show a pronounced concavity if tested with a straightedge in a line parallel to the wheel axis. An alteration of the guide block is made for rough grinding, in which the angle is slightly changed, with the result that a progressive cut is taken as the work moves across the face of the wheel, otherwise all of the cutting would occur at the first point of contact, which is not desirable. The guide, however, is set back to its original position for finish-grinding, since this last cut removes but a small amount of material. A general idea of the arrangement of the guide block and its relation to the wheel may be obtained from Fig. 1.

There is a difference in the type of guide used for rough and for finish-grinding, a section through the center of the first being shown in Fig. 2 and of the latter in Fig. 3. Considerable difference in the general arrangement will be noticed particularly in the position of the top guide strip.

The removal of the entire grinding allowance cannot

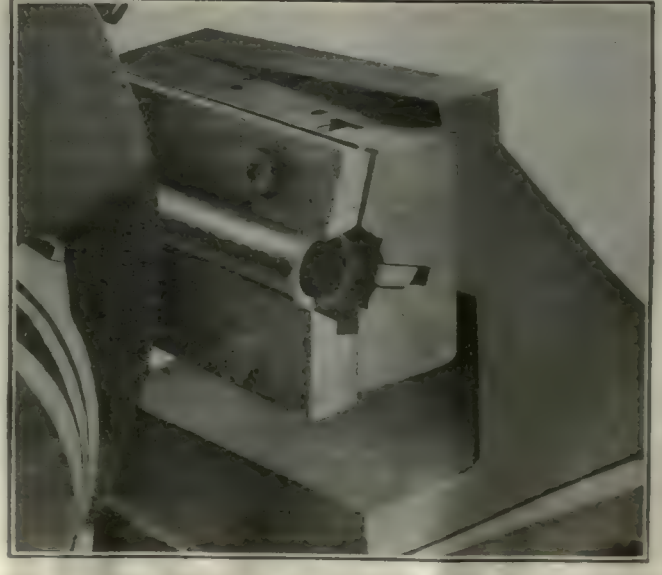


FIG. 1. ARRANGEMENT OF GRINDING WHEEL AND GUIDE

be effected in one passage of the work across the face of the wheel because of the tendency of the work to jam under the heavy pressure, resulting in stoppage of the rotative movement and the grinding of a flat spot the whole length of the work. Even though the work could be kept revolving the wheel would be rapidly worn away and it would be impracticable to maintain a definite size of work. If, for example, a roller was to be ground, on which there was a grinding allowance of 0.020 in., six cuts would be made, the first, second and third being roughing cuts, each removing 0.005 in.; the fourth a semifinishing cut taking off 0.003 in., and the fifth and sixth finishing cuts of 0.001 in. each. These last cuts are so light that the wheel wear between the first and last piece of a batch is imperceptible and all pieces are of practically the same diameter. The several cuts are in a way analogous to the grinding of a shaft in a standard grinding machine where the feed is advanced at each traverse of the table, the feed movements growing successively less each time the wheel

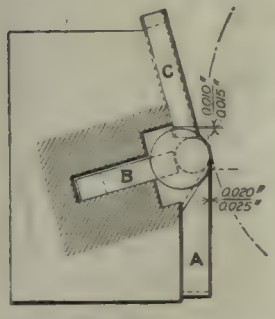


FIG. 2



FIG. 3

FIGS. 2 AND 3. SECTION THROUGH CENTER OF GUIDES USED FOR GRINDING

Fig. 2—The guide for rough-grinding. Fig. 3—Guide for finish-grinding

makes a pass over the work until the final advances are very small in proportion as the finished diameter is approached.

In order to overcome any inclination of the work toward chattering, the center of the guide is located somewhat below the level of the wheel axis, so that the wheel pressure will have an added tendency to hold the work in contact with the hardened strips *A* and *B*.

One of the essential elements to good work with this machine is the care with which the three guides strips *A*, *B* and *C*, Figs. 2 and 3, are ground and adjusted. The strips *A* and *C* are not subjected to much wear, particularly strip *C*, because it is not in close contact with the work. The strip *B* receives the greatest amount of wear, which is principally due to the grit from the grinding wheel. The point of contact of the work with this strip is below the center line of the latter, as may be seen by reference to Fig. 3, and when the wear has become appreciable at this point the strip is turned over, presenting a fresh surface. Reversing the strip in the holder provides still two other surfaces; thus four wearing points are furnished for each regrinding of the strip.

Some varieties of the work done on this machine are illustrated in Fig. 4. It should be understood that the work is both rotated and fed forward solely by contact with the grinding wheel, and therefore when pieces like *A* and *B* are being put through, means must be provided for separating each piece from the one following to prevent interference. This can be done by flat washers, but in one case it was accomplished by large steel balls, which served the purpose admirably.

There are several ways of feeding the work into the fixture. Large and long pieces are fed individually by hand. Shorter pieces are sometimes fed through a V-shaped groove, while very short pieces, such as those shown at *C* and *D*, are fed through a tube or magazine. A number of these tubes may be provided, part of them being used for feeding the work in and the remainder used at the other end of the guide to receive the pieces as they come through.

Where the quantity of work warrants the employment of several of these machines they may be so arranged that successive cuts are taken by a series of machines, and in this case where the magazine feed is used the tubes are transferred from the receiving side of the first to the feeding side of the second machine, making it necessary to load the tubes but once for each complete cycle of operation.

The use of a grinding solution is very necessary in this process, the solution serving not only to hold down the temperature of the work but also to some extent to lubricate it as it revolves in the guide before the wheel. A compound of soda and oil, to which is added a certain

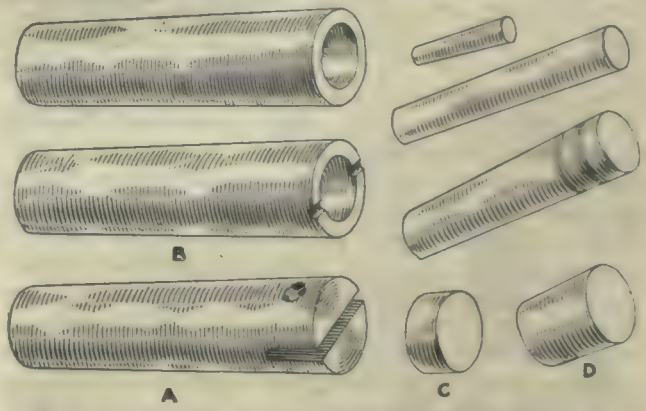


FIG. 4. SAMPLES OF WORK GROUND BY THIS PROCESS

amount of soap powder, is used, which acts as a lubricant and gives a free turning movement to the work in the guide. For heavier work more soap powder must be added to the solution in order to increase its lubricating properties and to make sure that the work does not stick.

A chart covering a number of years and showing the average rate of production has been prepared by the makers of this machine. While it is too involved to warrant reproduction in these columns it may be briefly stated that the output of these machines runs as high as 1600 pieces an hour in finishing rollers $\frac{9}{16}$ in. in diameter and $\frac{1}{4}$ in. in length.

The rough-grinding, as would naturally be expected, shows a lower production rate on all sizes than the finishing operation, but a peculiarity of the process is that the operation time is not relative to the diameter, the highest rate of production being on pieces of $\frac{1}{2}$ and $\frac{9}{16}$ in. in diameter, decreasing in varying proportion as the pieces are smaller or larger than this size. The proportion of production to length of pieces is fairly constant. The chart was compiled upon a basis of steel rollers free from burs and showing a hardness of 60 to 80 on the scleroscope.

Service for Women in the Gisholt Shops



By J. V. Hunter, Western Editor, American Machinist

Recently when the dearth of labor was felt many industrial organizations turned to recruiting among women to fill the vacancies in their shops. In this article the procedure followed by a large Middle Western machine-tool company in training their newly found help is described. Their experience has proved to them that it is easier to introduce women workers into machine shops than many shop managers have believed possible.

IN THEIR endeavor to create skilled labor out of unskilled labor many mistakes have been made by shop executives, the chief one probably being their failure to train the unskilled help first in the fundamentals of the work it is to perform, the assumption being that it knows them. When the Gisholt Machine Co., Madison, Wis., began to study the problems arising out of training women for war work in its shops, it had no mistaken suppositions of this kind, for the reason that it knew that women as a rule are not familiar with shop terms and practices. With this in view the short course of schooling given them has been so arranged that the knowledge obtained will give an advantage even over many men, and the simplicity of the method of training should be of interest to manufacturers who are considering the employment of this class of workers.

It is well known that the average foreman looks with disfavor upon innovations, particularly in the help furnished to him, and when such changes compel him to exert greater effort to properly train his help he feels still further imposed upon. It is therefore remarkable on asking numerous foremen of machine shops how they viewed the introduction of women among their help to hear them say that after a short trial they almost unanimously approved it—this at a time when they were occupied both with their regular duties and with seeing that the new workers were being carefully trained. One foreman, for instance, replied: "They are better than the men we are hiring nowadays," and another, "Good! They are doing fine." The first one had found out to his sorrow that the men it is now possible to hire for general shop work are floaters who never remain anywhere long enough to do anything well, and who cannot acquire any degree of mental application, while the women are eager and willing to learn, and when once taught correctly continue to work the way they were taught.

The Gisholt school for training women machine-shop workers, like the Gisholt Service School for men, is far different from the usual training school. Both are the creation of the same general executive board, and both hold to the opposite extremes of training. Those who read the series of articles in the *American Machinist* describing the Service School for Men will remember that it was designed as a course in intensive training to bring up to the highest standard mechanics who desire to specialize in a particular branch of machine-tool work. The school for women on the other hand at pres-



FIG. 1. PRACTICE WITH THE MICROMETER



FIG. 2. EXPLAINING THE DIVISIONS ON THE SCALE

ent is covering only the most elementary subjects. It is in fact a kindergarten for training women, who have only little information on such units as the inch, and so enables them to absorb the knowledge of the shop. It is succeeding so well in its aims that the management purposes to expand the school and give more detailed machine-shop training to the workers before sending them to the shops.

In some training schools that fit women for machine-shop work the women are taught to operate only one single-purpose machine (such as are found in time-fuse shops). Other schools are based on the vocational-training and the apprenticeship systems, and they contain machine tools such as are generally found in the shop. The length of the course in the former schools rarely exceeds 10 days, but in the vocational or apprenticeship schools a longer tuition is required.

Length of the Course

The course of training in the shops of the Gisholt Machine Co. lasts only three days, and the women then go into the shop to become producers. The school does not perform the functions that most of the others are designed to do; it makes no pretense of furnishing experienced mechanics. Its sole duty is to train in the fundamentals.

What are these fundamentals? They are: measuring accurately with scale, caliper and micrometer, and practice in the reading of elementary drawings and blueprints. In this way the sponsors of the school assume that the student will quicker assimilate the general methods of machine-tool work and that they will not be so crude when they go into the shops.

Do you, as a shopman, think that such schooling is nonsense? If so, step into your own machine shop and, outside of the toolmakers and higher grade machinists, determine for yourself how many can caliper a shaft to within a sixty-fourth of an inch. Then of those who have passed this test find out how many can use a micrometer caliper and read it correctly. The percentage will not be high.

One of the girls running a lathe was asked how she liked to work. "Fine," she replied, "and, do you know, I can use the 'mike' on my work and that man over there has been running a lathe all his life and cannot?"

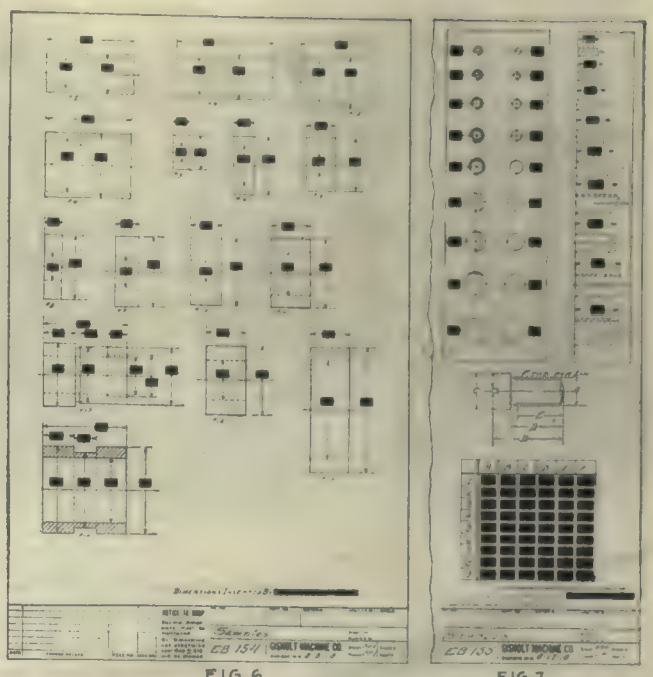


FIG. 6 FIG. 7

FIGS. 6 AND 7. CHARTS FOR RECORDING MEASUREMENTS AND VARIOUS DIMENSIONS

This is a fair illustration of the pride they feel in the work they are doing.

Wages in these shop are based on the premium system, with a guaranteed hour rate and a premium for increased production. After eight weeks or less the girls enter the premium-earning class and, at the same rates that the men receive, get premium checks for exceeding the basic rate of production. This shows what may be accomplished with women in the machine shop without extensive training, and if other managements could know the ease with which women are introduced in the shop they would follow this example. The idea that many managers have of elaborate training-school methods used by some firms has perhaps done much to cause them to hesitate, feeling that they had neither the space nor the time to devote to such experiments.

A view of one of the tables in the schoolroom is shown in Fig. 1. The equipment is simple—plain tables, chairs, an assortment of machinists' scales, inside and

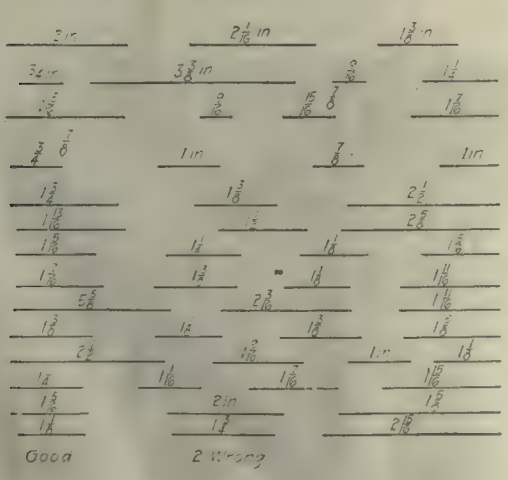


FIG. 3

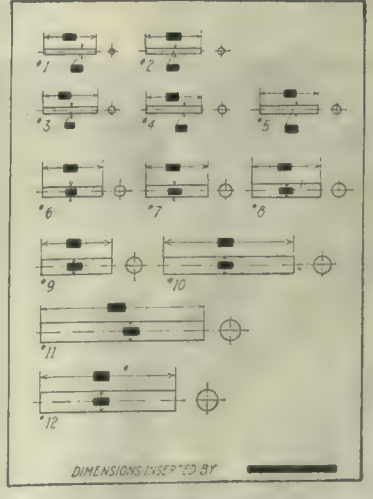


FIG. 4

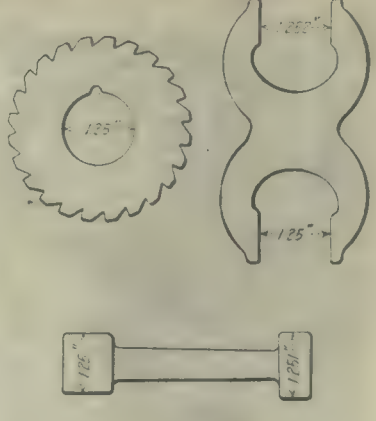


FIG. 5

FIGS. 3 TO 5. MEASURING, RECORDING AND SKETCHING

Fig. 3—Example of line measuring. Fig. 4—Chart for recording measurements. Fig. 5—Sample of work in sketching



FIG. 8. LECTURE ON READING SIMPLE DRAWINGS



FIG. 9. MAKING THE PIECES

outside calipers, micrometers and plug and limit gages. Two of the students from the earlier classes, having shown capabilities as instructors, are now in charge of the class room. The lessons of instruction follow:

Step 1.—Explanatory lecture on the scale.
Step 2.—Drawing lines and measuring same within limits of 1/16 inch.
Step 3.—Drawing lines and measuring same within limits of 1/32 inch.
Step 4.—Measuring cold-rolled stock for lengths and diameters, using both scale and calipers. Limits 1/64 inch.
Step 5.—Measuring sample pieces, getting length, bore and outside diameters in sixty-fourths, using scale, inside and outside calipers.
Step 6.—Lecture on micrometer; handling of same on work and reading the scale.
Step 7.—Practice in measuring cold-rolled stock, using scale and micrometer, and inserting dimension on blueprints provided.
Step 8.—Measuring sample of irregular-shaped pieces, using scale for length, calipers and micrometers for inside and outside diameters.
Step 9.—Sketching plug gage, milling cutter and snap gage; inserting dimensions in thousandths; use of thickness feelers.
Step 10.—Measuring standard threads; calipering drill sizes; gaging tapped holes and selecting machine screws to fit same; using depth gage; inserting dimensions as indicated on drawing.
Step 11.—Lecture and practice in reading drawings; display and lecture on machinists' hand tools, the uses of files, etc.

Few women know anything about fractions of the inch below quarters and many do not know even this. The instructor at the blackboard, Fig. 2, explains how the first chalked figure *A* represents one inch on the wooden scale which she holds in her hand, and that in this instance the inch is divided into halves. Further explanation regarding the charts *B*, *C*, etc., is given in respect to quarters, eighths, etc., and they are then practiced individually on fractions of an inch from the chart. The classes never exceed more than five girls.

Various stages of work at the tables in learning to use the machinists' measuring tools, interspersed with lectures, follow. Lesson 2, Fig. 3, is on ruling 50 lines on a piece of paper, and measuring their lengths; the work is checked by the instructor and the mistakes corrected by the student. This lesson is followed by exercises in the use of calipers and similiar devices for measuring the length, diameter, etc., of pieces of cold-rolled stock. These measurements are recorded by the student on a blueprint having blank spaces for the figures, Fig. 4, and which is a standard shop blueprint form. This practice, amplified by suitable explanations, affords the student knowledge of reading a blueprint.

A lecture on the use of and on reading the micrometer caliper is the sixth step, after which comes practice in using the micrometer, checking the measurements with a scale at the start, and transferring measurements made with the inside calipers to the micrometer for reading.



FIG. 10. GRINDING REAMER BLADES

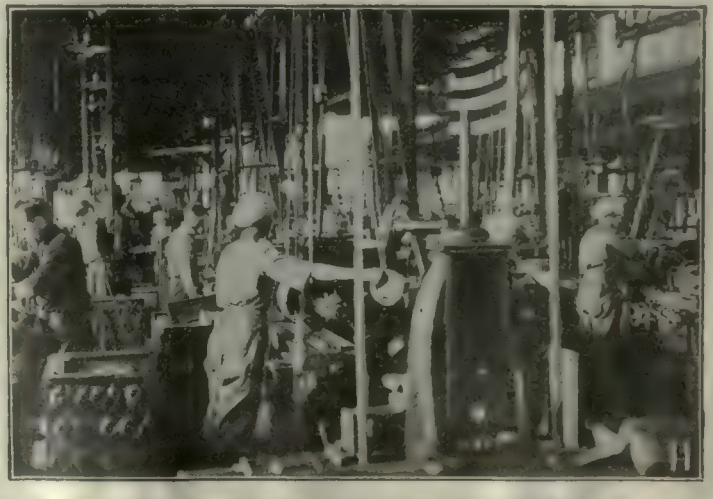
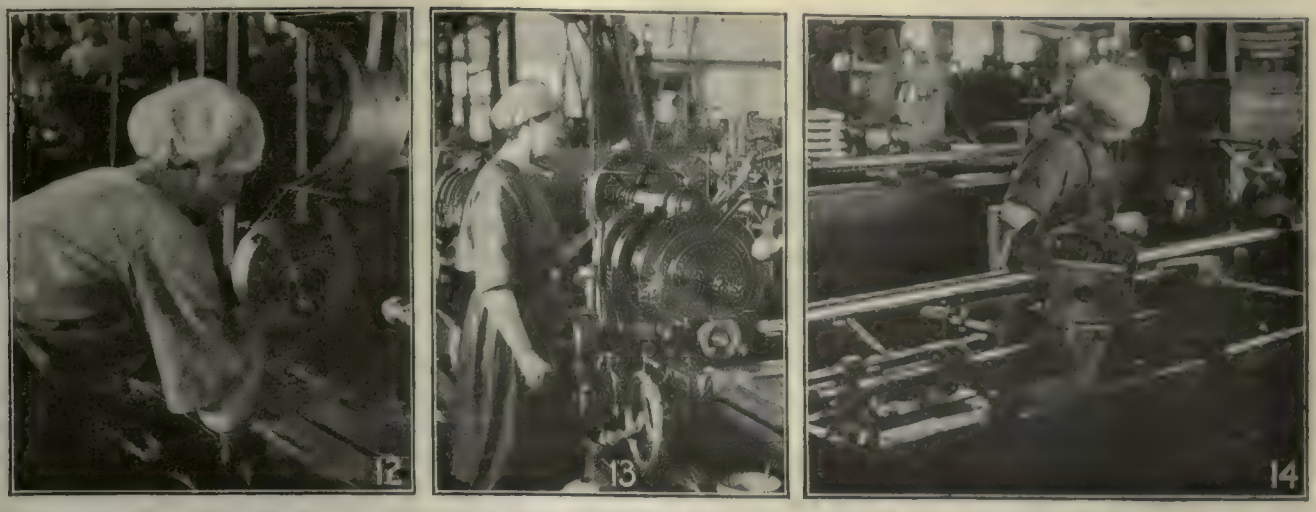


FIG. 11. TOOL-GRINDING DEPARTMENT



FIGS. 12. TO 14. WORK ON THE GRINDING MACHINE, LATHE AND TURRET LATHE

Sketching and dimensioning a few simple parts, as shown in Fig. 5, is given to gradually increase the student's knowledge of reading drawings. Another set of simple machine parts, Fig. 6, is provided for measuring more complex pieces, as well as practice in the use of thread gages and sorting machine screws to fit the different sizes and depths of holes; this is covered by the measurement chart shown in Fig. 7. Instruction in the use of the bevel protractor has lately been added to the course, and is intended for the use of those who will become shop inspectors. Between the lessons are lectures on reading standard shop drawings, Fig. 8, and it has been found advantageous to use samples of the parts that they represent together with the drawings so as to insure a clearer understanding.

Kinds of Shop Work Performed

Women were first used in the main shop office to replace the men who were called by the draft, after which it was but a short step to extend their services to the offices of the various foremen and inspectors throughout the shops as timekeeper and for crediting finished work for premium payments. Women had been employed in these positions for some time before the school was started for training the shop workers.

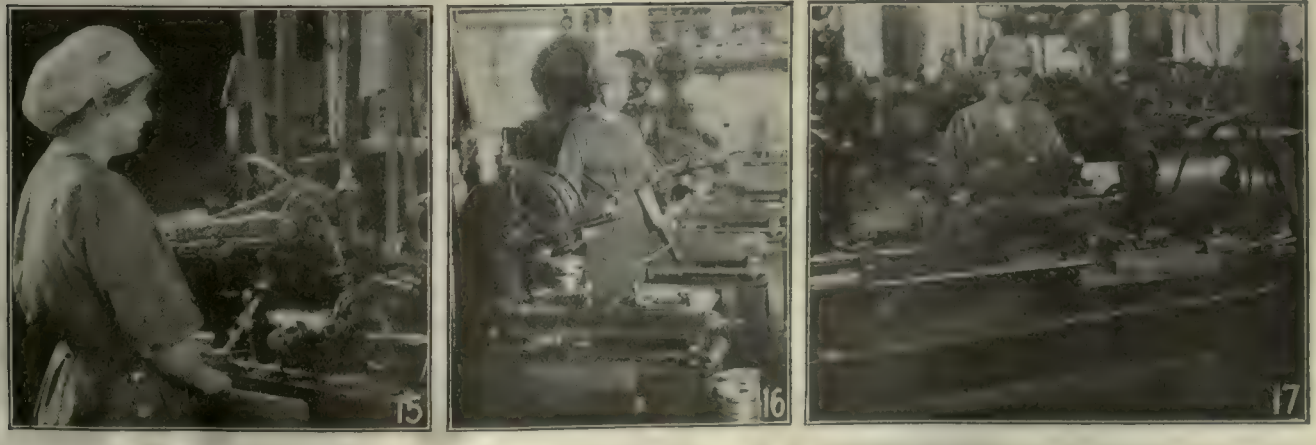
It has been more convenient to introduce women into the machine work of some of the shops than it has been into others; Fig. 9 illustrates a department having the largest percentage of women. They are employed on the simple engine-lathe and milling-machine operations.

One of the toolrooms employs a number of women on light grinding operations, much of the work being repetitive. The reamer blades being ground in the machine shown in Fig. 10 are an example of this kind. On this job two machines are working side by side, one grinding one face and the other finishing the parts.

A general view of the shop where many of these tool-grinding operations are done is shown in Fig. 11 and proves that the work that the women do is not confined to simple parts. Some of them are operating internal grinders. The one working on this type of machine, Fig. 12, is grinding a clutch part, each of which she must center in the chuck; in this case she is using a piece of chalk to mark the high side.

A machine for milling the rack on chuck jaws, Fig. 13, is also operated by a woman, who incidentally is earning about as good a premium as a man, although she has only been on this work a short time. The scrolls for these chucks are cut on a Gisholt turret lathe, which is also woman operated, Fig. 14. It is evident that while the women are not afraid of the cutting oil which is necessary for these machines, they keep themselves neater than a man would under similar circumstances, by providing themselves with an oil-proof apron which prevents the oil getting on their clothing.

A woman is cutting the teeth in the chuck bevel pinions, Fig. 15, and as these machines are semiautomatic she is able to take care of the whole battery. Others



FIGS. 15 TO 17. GEAR-CUTTING AND LATHE OPERATIONS

are likewise engaged in gear-cutting, Fig. 16, their work being supervised by a subforeman who checks it from time to time and when necessary makes adjustments and setups of the machines, the same as would be done were men of similar skill working on them.

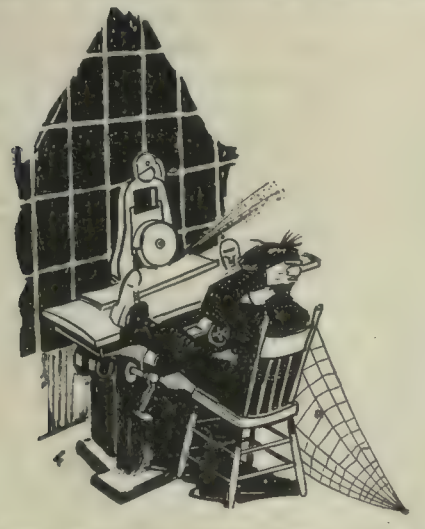
One would naturally expect to find in the Gisholt shops that women were being used on their own line of turret lathes; this is indeed a fact. Examples of these are shown in Fig. 17 and in the headpiece, the setup in each case involving the use of several kinds of tools. The woman working on the machine shown in the headpiece is handling a rather heavy piece and is using the micrometer in calipering it for width of flange, thus utilizing the knowledge which she gained in regard to the micrometer during her school period.

Hand Versus Power Feeds

By Harry Senior

On page 901, Vol. 49, Donald Baker takes toolmakers to task for not knowing the grains and grades of wheel to use on certain work, and further he says (in effect) that they would not use this knowledge to advantage if they possessed it, for they would set the wheel in too deep and turn on a fine feed, which would give them "plenty of time to sit back and rest."

It would seem to me that while they were "resting" there would be a fine opportunity for the foreman,



who of course knows all about these things, to instill into the minds of these poor, benighted fellows the information they lack to make them toolmakers.

The knowledge of grains and grades and their relations to various classes of work is especially easy to obtain. Several large manufacturers of grinding wheels and machinery maintain elaborate testing plants and laboratories and expend large sums of money to acquire information of this sort, and when it is obtained instead of bottling it up for their own delectation they spread it broadcast throughout the world in their catalogs, and not infrequently in the columns of the *American Machinist*.

Anybody who has the time and the price to attend a moving-picture show even for one evening, if he will send one-third of the price of admission (for postage) to any of these manufacturers, whose addresses he will find in the advertising columns of the aforementioned journal, and spend a little time studying the books and pamphlets he will receive in return, will not need to have the power feed taken off his grinding machine because he does not know how to use it.

I am inclined to suspect when I hear of shops that are obliged to adopt unusual or drastic methods to combat the ignorance of their men that the ignorance is not altogether confined to the fellows in apron or overalls. I certainly should not expect a wise foreman in charge of a gang of high-priced toolmakers to take away from them a most efficient mechanical means of expediting their work in order to make them do more.

If the measures adopted in the shop mentioned by Mr. Baker are correct, why not take the feeds off the lathe and other tools where they might be susceptible to misuse? Why not take off the lead screw? Some fool mechanic might gear up the lathe wrong and spoil his job. This reasoning is going to lead us right back to the "stone age," when the only tool known was a paving block with a handle on it, and even then some foreman might want to take the handle out so the workman could not rest his arm while pounding.

I have never had the opportunity to become closely acquainted with any of those toolmakers who do not know the rudiments of their business. To be sure I have seen many fellows who *said* they were toolmakers, especially during the last three or four years, but if I believed everything that anybody told me (particularly salesmen) I might be curator of the greatest museum of obsolete mechanical devices in the world—if the money held out.

I have had charge of the activities of men, even toolmakers, for some years, and I have learned to distrust the applicant for work whose former employer was a "d——d fool" or a "son-of-a-gun," for I am pretty certain that I am going to qualify for one or both of these classes myself if I hire him. On the other hand if I were looking for a foreman I should hesitate before employing one who had never had other than "ignorant," "careless" and "sloppy" workmen under his supervision, for fear that my fellows ("my" is an expression of comradeship, not ownership) who now constitute quite an intelligent and painstaking bunch would degenerate into ignorance, carelessness and sloppiness until they had reached the level of mediocrity that marked the upper range of the new foreman's mental vision. I have known many toolmakers who are ignorant of some of the things that make a man a toolmaker; indeed I have at times suspected that there were points that had escaped my own observation, but when I come across one who evinces a desire to add to his knowledge I try to teach him what I can and learn from him some of the things I have overlooked.

If the men in a shop are not up to the mark in efficiency or if that mark is set too low it is the duty of the foreman to take his feet off the desk, lay aside his cigar and teach them. In the case under discussion it was plainly the foreman's duty to instruct them in the proper use of grinding machines, not to partly disable the machines and leave the men to find out why. If the foreman was unable to do this he was not a foreman, no matter what they called him. I am a firm believer in the aphorism attributed either to Napoleon or somebody else—I don't remember which—"Incompetent armies are commanded by incompetent generals."

Efficiency in the Core Room

By J. B. CONWAY

It is the purpose of this article to set forth facts established by experiment and practice in the hope that the small foundry operator may benefit by them. Those who are having difficulties in the core department may find helpful ideas to assist them in solving their problems. The conclusions reached are the result of an investigation into conditions of efficiency and production in a Southern factory and the remedies applied.

CONDITIONS prevailing in a Southern factory, which included among its departments both iron and brass foundries, each having its own core room and other supplementary departments, compelled my being called to investigate them. About 250 men were employed in the plant, and the foundry and core departments required 25 workmen, including the foremen. On the whole the factory was new, modern and thoroughly equipped, but particular attention had been given the machine shop while the foundry had been somewhat neglected. This was discovered after a careful investigation and was the cause of the foundry not being able to properly produce the material necessary to supply the machine shop. Another serious drawback was labor trouble, which had been encountered some time previously when the management endeavored to put the department on piece work. This was later overcome as will be explained further along.

Conditions in the foundry were adjusted to enable it to secure greater production, but it was soon found that the core department was unable to supply a sufficient quantity of cores to maintain long runs without interruption. A survey disclosed a general lack of supervision.

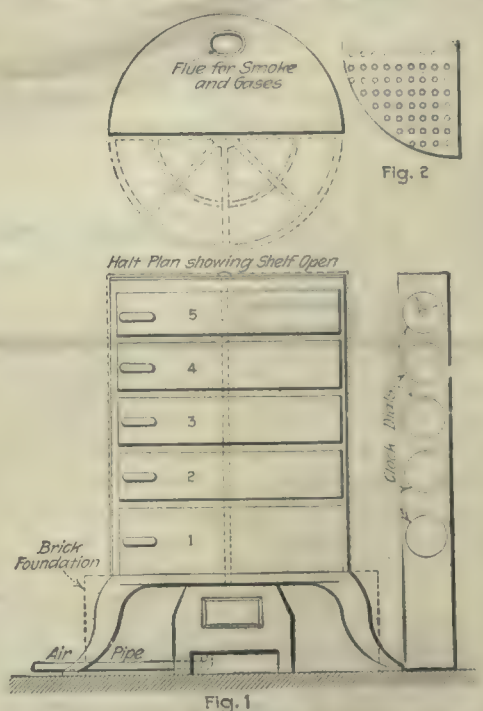
Divided Responsibility

The foundries were trying to operate under two foremen, one of whom was foreman of the iron foundry and pattern shop as well as part of the core room. There was no systematic method of making, baking, handling or storing cores; congestion was everywhere in evidence, and there were no adequate checking and recording facilities. There was also insufficient small equipment and oven capacity for baking the cores. The employees were careless and there was constant labor agitation by those affiliated with unions.

These evil effects were manifested in delays due to shortage of cores and bad work generally. There was antagonism between the workmen and foremen of the core room and foundry, and ill feeling on the part of the molders, who were often compelled to stand losses due to improperly made cores whereas the core makers received payment for everything marked up on their job tickets.

Although contrary to the usual procedure in such cases the first measure taken was to establish piece prices, and while this task was rendered more difficult by the fact that the deplorable conditions upon which the successful operation of the wage payment system depended were not given first attention, success finally rewarded our efforts. Much detail study was given to the various jobs, a half day sometimes being devoted to analyzing the several elements entering into the making of a core the actual making time of which was only ½ min. As the rate setting progressed a considerable saving was being effected, in some instances as much as 50 to 75 per cent. When the workmen had become accustomed to the new prices there was a tendency to rush the work unnecessarily, resulting in poorly made cores, but this trouble was eventually overcome.

It soon developed that one of the foremen was not in sympathy with the policies of the management and was distrustful of efficiency work in general. His antagonism was carried to such an extent that workmen reported that they had been instructed to hold back when time studies were being taken, and on entering the core room in the morning after the night crew had left I found conditions chaotic. Quite often the cores made the previous day, and which were sorely needed, were damaged until unfit for use. Curiously enough the foreman could never account for the damage nor did he make any endeavor to prevent its recurrence.



FIGS. 1 AND 2. THE CORE OVEN AND A SECTION OF DRIER PLATE

Prior to starting a night crew the cry went up for new core ovens, as it was contended that the ones in use were not large enough to meet the demand put upon them and that it would be necessary to work a night shift. There were three of these ovens of the type shown in Fig. 1, which is familiar to all foundry men. The management was reluctant to purchase new equipment at that time, and some of us were of the opinion that the trouble was due not so much to the lack of capacity as to the lack of something else.

Procuring a recording pyrometer it was determined to test whether the ovens were being fired properly and to ascertain the temperature at which the cores were baked. At this time the attendant whose duty it was to place the green cores in the ovens also attended to the firing when he thought it was required. As coke was used for fuel and a forced draft was necessary it frequently happened that the fire under one or more of the ovens died out, the rekindling of which was attended with loss of time and production.

The pyrometer terminal was located about 12 in. above the bottom shelf and the results of the first few days of the test are shown in the following table:

Date	Average Deg. F.	Tender
Feb. 14	406	Regular attendant
Feb. 15	405	Regular attendant
Feb. 16	495	Special attendant
Feb. 17	515	Special attendant
Feb. 19	565	Special attendant
Feb. 20	555	Special attendant
Feb. 21	535	Special attendant

The average daily temperature without a special tender for firing was 405.5 deg. for the first two days, and for the five succeeding days with a special tender the average was 537.7 deg. A noticeable fact was that the daily fuel consumption was less for the last five days than for the first two.

On the first day of the test a plate containing 147 cores of a certain type was placed on the lower shelf next the fire box, and one hour was required for drying them. On the third day the same number of the same type was placed on the second shelf, 14 in. from the direct heat of the fire, and they were dried in 55 min., although the lower shelf was loaded at the time. In the first case a temperature of 350 deg. was obtained, and in the second 525 deg. A gain of 8.33 per cent. in time was effected, which was later increased to 33.3 per cent.

On another job which required 4.72 min. for making the core 12 were baked in 35 min., proving that they could be baked faster than they could be made. This particular job was continually falling down because of the alleged insufficient number of drier plates. After this test there were no more delays on that account.

Rectangular drier plates were employed, and the maximum capacity of the shelves, on account of their semicircular shape, could not be realized. A casting of the shape indicated in Fig. 2 was made and used for certain types of cores, the character of which permitted them. These new-style plates were perforated to allow better ventilation and circulation of the hot air. Compared with the total available shelf area the old plates of the largest size gave only 553 sq.in. of baking area, whereas the new style provided 721 sq.in., or an increase of 30.4 per cent. in capacity.

On several parts an increase in production of from 10 to 110 per cent. was obtained. Another saving was effected by the less frequent trips to and from the oven. The results obtained thus far warranted delay in the purchase of new ovens. They also indicated that the limit had not yet been reached and that further investigation was needed.

The next measure was to conserve and utilize the heat that escaped from the fire box by radiation from the sides. A glance at Fig. 1 will disclose the possibilities. A brick foundation, outlined by the dotted lines in the figure, was built around the fire box and up to the oven, inclosing the box on three sides, the front being left open to permit firing. The outside of the ovens and the top were covered with metal lath and on this was placed a ½-in. coating of asbestos. By this improvement a temperature of 800 deg. was obtained and held with comparative ease, and 1000 deg. could have been reached had the fire box, which was of cast iron, been able to withstand the intense heat necessary. However, as 800 was sufficient for the purpose, it was not deemed advisable to go to further expense. The cost of the work on the ovens was approximately $30 an oven.

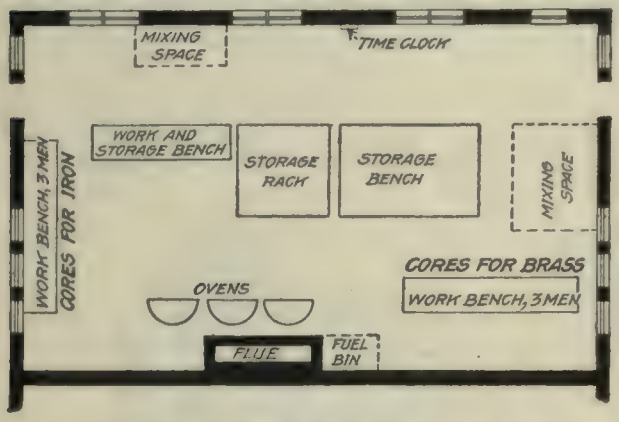


FIG. 3. FIRST LAYOUT OF CORE ROOM

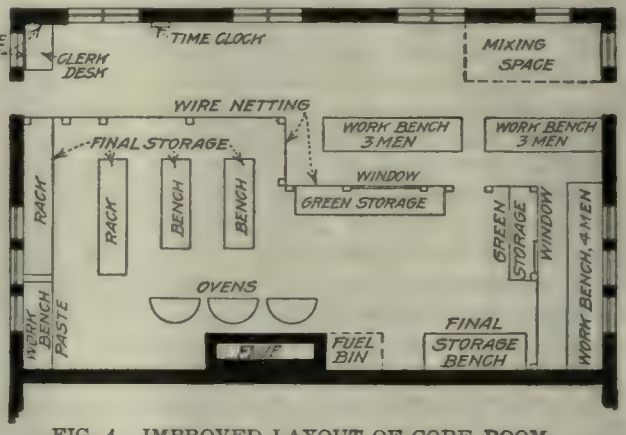


FIG. 4. IMPROVED LAYOUT OF CORE ROOM

Fuel Consumption Reduced

About 200 lb. of coke a day of 10 hours had been required per oven, which amount was now reduced by 50 per cent. At the same time the temperature was increased 35 to 40 per cent. and maintained between 500 and 650 deg. on the lower shelf during the entire day. The recording pyrometer faithfully registered every change in temperature and also acted in a measure as a check on the attention given by the tender.

In order to assist the oven tender a timing device was constructed and is shown at the right of the oven in Fig. 1. It consisted of sheet metal painted black, with white hands on the dials and white figures. The time indicated was that at which the cores were due to be dried sufficiently for use, and was obtained from tabulated records, an analysis of these records proving beyond question that the baking could be paid for on a premium or bonus basis. It was then being handled on a day-work basis.

At the time these investigations and observations were being conducted other conditions demanded attention. Mention has been made that there was lack of system. The reader's attention is invited to the layout of the department shown in Fig. 3. This was the general arrangement at the beginning, minus a miscellaneous collection of empty barrels and boxes, scrap

DAILY CORE REPORT

This report to be made daily and workmen paid from this record after approval of Foreman of Department.

Clock No.	Part No.	No. per Plate	No. of Plates	Pcs. Made	Pcs. Good?	Pay For	Cause of Defects: Handling	Broke in Oven	Too Green	Burned	Bad		Total Rej'd
217	1846	39	2	78	75	75					3		3
"	"	40	2	80	74	74					6		6
"	"	40	2	80	76	80		4					4
"	"	36	1	36	35	36	1						1
"	"	39	2	78	73	78				5			5
"	"	28	1	28	26	28			2				2
			10	380	359	371	1	4	2	5	9		21

Report must be finished as early as possible on morning following day on which cores were made and approved not later than 9:00 a.m.

Date 2/20/17 Signed JOHN SMITH, *Foreman.*

FIG. 5. DAILY CORE REPORT

wires, cores, etc. Some of these articles were employed as benches for holding finished cores while the remainder rendered no service except to detract from the appearance of the department.

While the general arrangement does not warrant condemnation at first glance it should be remembered that there were two foremen and that there were times when serious differences of opinion arose. This together with the separation of the workmen produced a disagreeable spirit that created serious difficulties. Another objectionable feature was that no facilities were afforded for maintaining a check on either the daily output or cores in stock and any one had access to the finished product.

The arrangement shown in Fig. 4 was finally adopted and proved beneficial to both employees and management. A change of foremen placed the responsibility upon one man and tended to promote harmony among the men besides increasing the output at an appreciable reduction in cost. A partition of wire netting was built in the room and completely separated the core makers from the ovens and the finished product.

Upon completing a plate of cores the workman placed it on a shelf just inside the partition, from where it was taken by the tender and placed in the ovens. This arrangement produced a further increase in output, owing to the saving in time over the former practice of each man being his own "errand boy."

No correct record of the quantity of cores made, baked and stored was at hand, and it was apparent that little attention had been given the matter from the standpoint of economical production. Each workman was paid in accordance with the records on his job ticket, regardless of whether or not the cores were defective.

A form for a daily record of actual conditions was designed and is shown in Fig. 5. This report was in service only a few days when the management was able to ascertain where the trouble lay. For instance, it was found that a great number of cores were being broken at or in the oven, and investigation disclosed that the oven doors were out of alignment and would stick in opening and closing, resulting in the toppling over of the entire number of cores on a plate.

It may be wondered why it was necessary to introduce this form before discovering the defect in the ovens, so it may be said here that the trouble was known prior to this, but it required some concrete information to be presented to the "boss" before definite action could be taken.

Time Wasted on Defective Cores

Defective cores were baked, consuming time and space, and the core maker was paid for them. Cores had been removed before they were properly dried, with the result that they were so soft that they would not support their weight when placed in a mold. At other times they were left too long before being dried and were air hardened, a tough skin being formed which resulted in the center remaining soft after the core was dried. As the report was examined daily and any abnormal conditions investigated the situation soon began to clear up.

The workmen were paid for everything except cores having defects for which the maker was responsible. Cores were inspected before being placed in the oven and defective ones removed where possible, but with 20 to 140 on a plate it was not advisable to remove all that might be broken, as to do so would have meant spoiling perhaps many more. The oven tender was trained to inspect, and together with the foreman, covered the inspection nicely.

The clerk, who was added to take care of the clerical work of the foundries, also kept a record of the work of the core department. Before the clerk was installed the foremen were burdened with clerical work which they were not qualified to perform in connection with their other duties. More satisfactory results were noted as soon as the clerk took over this work; increased output from, and discipline in the departments were also achieved.

SCHEDULE BOARD

Part No.	Order No.	No Pc's.	Oper No.	Pcs. Req'd Daily	Oper. Waitg.	Oper. Workg.	Oper. Finished	DATE SCHEDULED AND STATUS OF JOB: START IN TIME 1	2	3	4	5	6	NO. MADE	NO. REJ'D.	BAL. DUE	START IN TIME 7	8	9	10	11	12	NO. MADE	NO. REJ'D.	BAL. DUE

FIG. 6. THE SCHEDULE BOARD

By this time sufficient progress had been made with the time studies and other development work to warrant a scheduling system based on facts, and a board, Fig. 6, large enough to embrace the records of both foundries and the core department, was made. This board was laid out on a sheet of celluloid 24 x 50 in. and about $\frac{1}{16}$ in. thick. The ruling was first made in pencil, then the lines scratched in with a scriber and

afterward gone over with ink to make a permanent record. Any lettering or figuring subject to change is put on in pencil.

The daily entries were made with pencil and erased at the end of each period, usually monthly, after they had been transferred to a permanent record sheet which was a duplicate of the board. By this means of recording the daily progress it was possible to check the cores made with the castings made and also to tell at a glance whether it would be necessary to make any alteration in the usual program in order to maintain the schedule.

Finally, to maintain future records that would be reliable, an instruction sheet to be used in conjunction with the piecework schedule sheet, which had been in operation throughout the factory, was designed. This sheet is self-explanatory and contains all the information necessary for a beginner to perform the operation of making a core, and also supplies the information necessary for planning the work. It is as follows:

Operation E1.—Bottom core for 1¼-in. angle-valve body. Material—Sand and compound of the following proportions: One-half sharp sand, one-half molding sand (new) mixed and tempered with compound made of equal parts glutrin and water. Riddle mixture thoroughly until well tempered. Operation—Make one bottom core. Part 1440. Department 1300.

Description of suboperation. Set-Up—Procure necessary tools and supplies to perform work. (Note—Keep sand well tempered and do not work too dry nor too wet.) Set-Up Time—15 min. Tools Used—Core box 1440; sand; parting; vent wire; bench brush; mallet; strike off; adjustable clamp; supply 3- and 3½-in. wire; drier plate, 7 x 12 in.

Suboperation 1.—Brush box thoroughly and see that no sand or parting remains in grooves; use vent wire when necessary to clean grooves and corners; dust parting on both halves, place together; insert loose piece and clamp. Tools Used—Brush and parting. Time Allowed—30 seconds.

Suboperation 2.—Fill box with sand, using quick, firm stroke while filling; fill from both openings; have foreman inspect first few cores made to determine if sand is properly tempered and cores tamped properly before completed. Tool Used—Wood tamping stick ¾ in. in diameter. Time Allowed—35 seconds.

Suboperation 3.—After box is filled place one 3½-in. wire in sand through top opening of box; fill box to level with sand and strike off flush; run vent wire through core within 1 in. from bottom; repeat this operation through side opening, using 3-in. wire. Tool Used—One strike-off stick. Time Allowed—35 seconds.

Suboperation 4.—Turn box over and rap lightly with mallet; release clamp and remove, placing clamp at right side for convenience; withdraw loose piece; draw both halves of box apart, taking care that box rests level on bench plate and that halves are pulled straight, otherwise core may break. Tool Used—One mallet. Time Allowed—25 seconds.

Suboperation 6.—Remove drier plate to oven when filled and bake cores until thoroughly dry; refer to time sheet and set time dial on oven to the time at which cores should be dried. Keep oven heat at not less than 500 deg. and not to exceed 650 deg. Remove when baked to cleaning bench to be cleaned and assembled with top core.

Time allowed for baking is as follows when temperature is maintained at 500 deg.: Shelf 1, 25 min.; shelf 2, 40 min.; shelf 3, 1 hour 7 min.; shelf 4, 2 hours; shelf 5, 3 hours 54 minutes.

Average time for baking one core, 3 hours 24 minutes.

Time allowed for making one core, 1 hour 25 minutes.

Total time, 4 hours 49 minutes.

Number required per hour, 48; per day, 480.

To summarize. The several forms and the schedule board made for better conditions in general, inasmuch as the records were so interdependent that it was necessary to maintain a high degree of efficiency in the various phases of manufacture and organization in order that each phase might function properly. If any one should be out of synchronism with the others it meant that all would be affected to the same extent. Under these circumstances deviations from normal conditions can be more readily noticed and measures taken to correct the trouble than if no such methods were available.

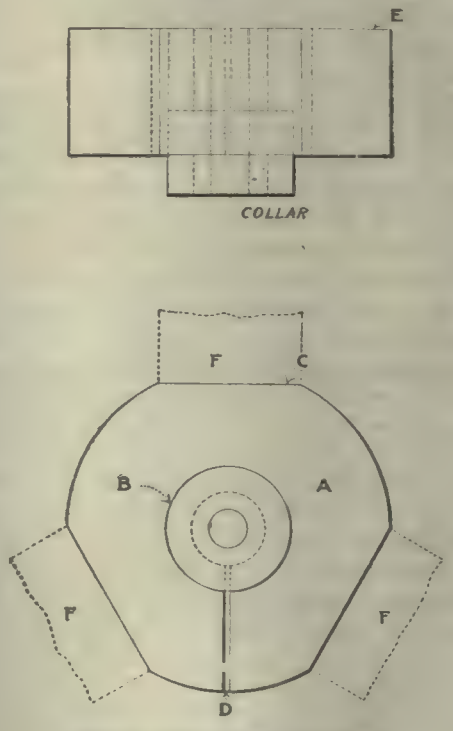
Further the cost department was enabled to obtain records for obtaining the cost of cores, and consequently the complete cost of castings, which had not been possible previously.

As the workmen became accustomed to piecework and the system, their general demeanor improved, their methods became more accurate and the work was accomplished with greater speed. The foremen evinced more interest in their work, for the reason that they had more time to give to it, and they also realized that for either department to fall down meant a loss in the one depending on them for stock. All concerned were soon interesting themselves in the development work and valuable suggestios came from some who had hitherto expressed contempt for any system whatever.

Chuck Grip for Collars, Etc.

By G. H. Roberts
Northampton, England

A simple little grip which will be found a handy addition to the vertical-boring and facing machine kit is here illustrated. It enables small articles such as collars, bolsters, etc., to be quickly and effectively set and held. It can also be applied to the lathe chuck. The grip consists of a short length of mild-steel bar *A*, of a diameter equal to that of the chuck register *E*, drilled and recessed as at *B* to give clearance to drill and provide accommodation for the work, the recess diameter being slightly greater than that of the job. Three flats *C* are then cut to form meeting faces for the dogs *F*, after which the grip is split by a saw cut *D* midway between two of the flats. The widths of a single saw blade will do.



CHUCK GRIP FOR COLLARS

In using the grip two of the dogs are screwed up to it and should be chalk-marked by the operator to indicate that they are thus permanently set for the work in hand, the remaining dog being solely utilized to hold or free the work.

To obtain an effective grip the dog opposite the slot must always be one of the first-named. Likewise a three-jawed chuck is more suitable than a four, but the grip can be applied as readily to the latter if the split is made between one of the flats and one of the dogs at right angles to this used for pressing up.

Steel-Mill Roll Shop on the Pacific Coast

By FRANK A. STANLEY

The roll-mill department of a large steel plant making mill rolls of cast iron, cast steel and chilled iron for rolling merchant bar in various sections is the topic of this article. In the description that follows data is given on the finishing of different kinds of rolls, the types of tools used and the speeds and feeds.

THE views presented in this article illustrate the equipment and methods of the roll shop at the steel plant of the Judson Manufacturing Co., Oakland, Calif. A general view in the roll shop is shown in Fig. 1, which gives a fair idea of some of the equipment for roll turning. The illustration also shows the overhead trolley and hoist system for handling rolls in and out of the lathes and for moving them from one department to another.

There are three kinds of rolls handled here, namely chilled iron, cast steel and adamite, the latter being most commonly used for making square and round merchant bar. The journals are turned before the roll is placed in the grooving lathe, where it runs on its own necks or journals while it is being turned to diameter and grooved to correspond to the other rolls in the set.

The rolls illustrated are nominally 10 in. in diameter. Actually they measure as follows: Bottom roll, 10⅛ in.; middle roll, 10¼ in.; top roll, 10⅜ in. As the rolls are geared together this difference in diameters gives the top roll a slightly faster surface speed than the middle roll; similarly the latter has a faster surface speed than the bottom roll. This is to produce a stretching effect upon the top of the bar being rolled so that it will tend to throw the bar down to the floor plate as it passes through the rolls and prevent it from curling upward with what would more than likely prove disastrous results.

This difference in roll diameters is a factor that the roll turner must bear in mind in finishing a new roll for an old set or in making a new set complete. Likewise in regrooving a roll or in making a new one he must also take into consideration the amount of wear on the others in the set, and all of his work must be done with a view to matching up his groove surfaces correctly, both as to section through the groove and as to diameters at all points. Otherwise results when the roll goes into the mill will be entirely unsatisfactory and the work will require doing over.

Fig. 2 illustrates typical forms of tools for use in the roll lathe. One square-nose tool is shown in operation on the roll, another is seen immediately in front of the tool clamp. Also a large half-round forming tool is shown in the same view, and in Fig. 3 a considerable number of tools of various shapes will be seen. These are all of course made to accurate templets.

The grooving tools are mostly about 1 in. thick, and in the majority of cases are made of Jessop's steel. As will be understood from Fig. 2 they are held down in place rigidly and they are supported by the lathe bed right up to the very point of cutting to obviate possibility of spring and chatter.

With finishing tools for half-round grooves the practice is usually to make them in the form of disks, which are ground accurately to the diameters required and at the same time relieved slightly on the face. The sharpening is a simple matter with these disk tools, as the face can be ground as required without affecting the diameter appreciably during the life of the tool.

Disk tools are generally secured by placing them on a holder where they are held by a bolt passing through a central hole in the tool.

Turning to the actual grooving of the roll, and assuming the work has reached a stage where the diameter is



FIG. 1. A GENERAL VIEW OF THE ROLL SHOP

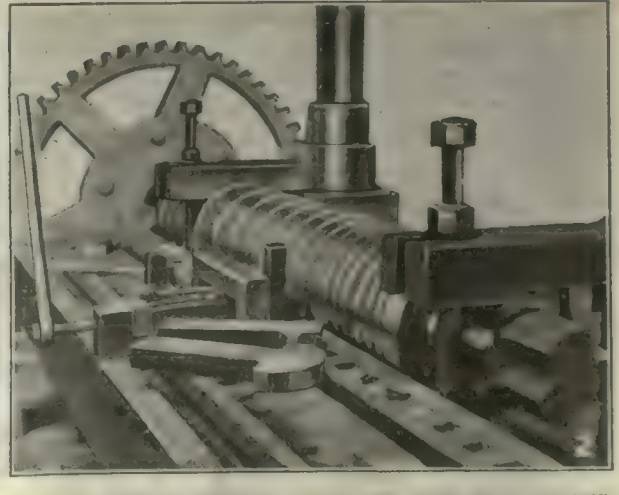


FIG. 2. ROLL IN THE LATHE AND THE TOOLS USED

correct and the grooves must be formed to match exactly with the corresponding grooves in the mating roll above it, let us refer to Fig. 4, which shows the roll to which the new one is to be made placed on the housings above the work in the lathe. The upper roll, being correct for spacing, form and depth of grooves, constitutes the master to which the other roll must be finished. It is therefore first set up on the top of the lathe housings and adjusted until it is perfectly parallel with the lower roll and it is clamped and wedged to prevent end movement as well as backward so that further gagings from its surfaces shall all be taken under uniform conditions.

Fig. 4 shows the manner in which the turner applies his calipers to determine if he has placed the grooves properly in the roll. At the same time he has to maintain constant check by calipering to see that he holds to the correct diameter for the bottoms of the roll grooves.

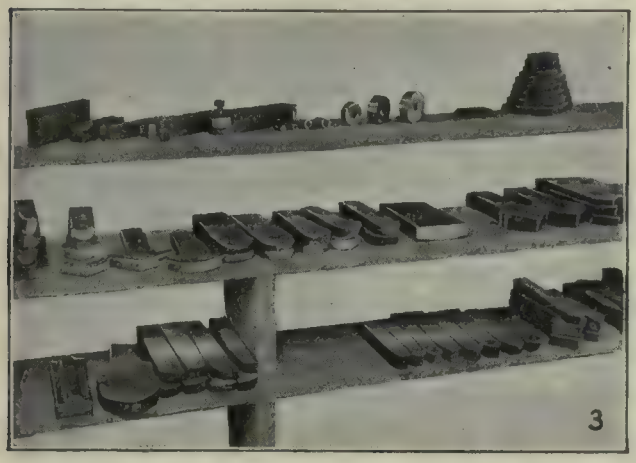


FIG. 3. VARIETY OF ROLL-TURNING TOOLS

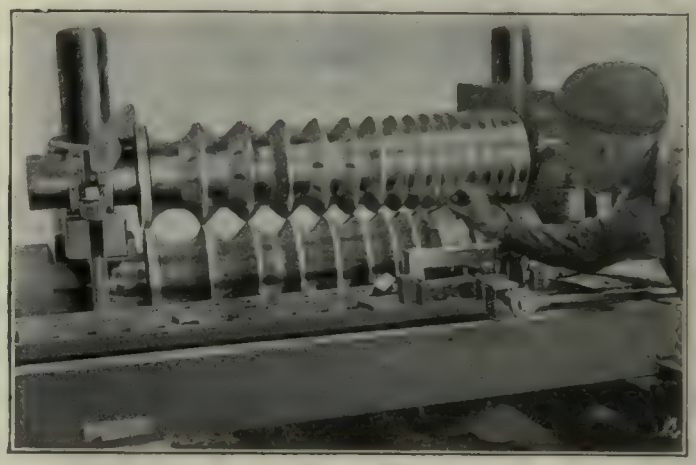


FIG. 4. CALIPERING THE GROOVES FOR ACCURACY

In the view just referred to he is checking the accuracy of the half-square groove in the lower roll by calipering diagonally across each way from the corresponding surface in the roll above.

It will be understood that in setting the upper roll the turner makes allowance for the width of gap, or space, between the rolls when in operation so that his measurements across the grooves in the pair of rolls are for the exact dimensions that will be maintained when the rolls are later placed in the mill for use.

Whether the grooves are square, round or of other form the calipers can be applied as indicated to assure the accuracy in the form of the grooves and their correct location along the roll surface, for as the form itself is always held at the same time to a templet which is placed in the groove from time to time the checking for position and relation to the grooves in the roll above means just the calipering from opposite directions obliquely, and any offset of the lower groove is revealed at once.

The foregoing operations are carried on satisfactorily only by the application of considerable judgment and experience. The average machinist has seen little of the special apparatus used in roll shops, and for a time at least he is inclined to have difficulty in understanding the necessities of the work, such as the requirements of very low turning speeds and consequent smoothness of cut, the accuracies as to diameters, forms, etc. It is a long job to complete a set of rolls and an expensive one at best, for a good many thousand dollars may be easily invested in a single set before it is finished, and if when the work is done there is unsatisfactory outcome through some fundamental error in the shop there is a still more expensive delay in getting a new set through for operation.

The slow rates of speed used in roll turning are well known to mechanics familiar with mill work, but a few words may be added here in reference to this phase of the undertaking. With the heaviest of roll lathes and the most desirable of conditions in respect to spindle drives, housing supports, proportions of roll necks and body lengths relative to diameter and so on it is conceivable that the average speeds in the roll shop might be increased somewhat; but there is apparently not the same opportunity to increase the speed to anything like the degree found possible with the general run of shop work, owing to the peculiar conditions of the job where the hardness of the material is a limiting factor beyond a certain speed. Besides the breadth the position of the cut—often a considerable distance from any point of support—bring about other limitations that necessitate holding the speed down to a low rate.

The rate of speed on cast-steel rolls will average about 9 ft. per minute during the forming of the broad grooves seen in the work. Hard cast-iron rolls are rotated at about 6 ft. per minute, while chilled rolls are run at 4 ft. per minute. With all of these rolls it is the practice to use first an old tool for scoring or getting down into the surface of the work.

In connection with chilled roll work it may be of interest to note the speed reduction between the driving belt and the roll as typical of this class of machine. The belt for example, traveling for a certain cut on a 16-in. pulley operates the driving shaft at 120 r.p.m., and through triple-gear reduction the spindle speed is cut down to $1\frac{1}{2}$ turns per minute, representing a speed reduction between the driving shaft on the machine and the roll itself of 80 to 1.

The rate of feed on such a roll will run say at 0.003 in. per turn, so that in cutting down about $\frac{1}{16}$ in. on a side some 20 turns would be required, taking about 15 to 20 min. for the depth specified.

Sales Engineering in the Export Field*

By S. T. HENRY
Vice President of the Allied Construction Machinery Corporation

This paper strongly advocates the use of trained engineers for salesmen in foreign markets. These men must not only be experts in the mechanical field but should also have a keen commercial sense in order to show prospective users how American machinery and methods can save them money.

LARGE and permanent export markets for standard American engineering machinery can be built up abroad by the introduction of American methods of using such machinery. Introducing American industrial methods abroad was a slow and tedious process until recently, though several large American manufacturers had conducted such work with success. They had sent into various countries sales engineers who were well grounded in the use of their machinery. While these engineers went as salesmen their work was to educate the engineers and the industrial men of other countries regarding American methods; they had to show these prospective customers why our way was the cheaper way; they had to prove that the use of our standard machines would produce results more quickly and economically than special machinery. These men worked under great handicaps, but they made good. They demonstrated that it was then highly practicable to sell standard American machinery instead of merely taking orders that were offered for special machines.

Change of Conditions

In the last two or three years conditions have changed completely. The world has learned more in that time about American engineering machinery and American engineering methods than could have been forced upon it in a generation of the most strenuous commercial efforts. Engineers from everywhere know the wonderful results our forces have achieved in building, equipping, and operating port works, railways, highways and machine shops in France. The world is now ready to adopt American industrial methods.

This change is demonstrated by the character of the inquiries being received by American manufacturers of engineering machinery who have made real effort to obtain export business. The bulk of engineers from overseas do not inquire now about the technical details of the machines only. They want to know how the machines are used, and whether the problems that they have to meet can be solved by American methods. The whole industrial world wants to be educated in our way of doing engineering work.

If the opportunity is handled right no limitations of trade possibilities need be considered. The thing to do is to put the work in the hands of men who are thoroughly schooled in American methods of using American machinery. These men must have commercial sense, and they must know how to deal with other business men. Above all they must have the "know how" of what they are trying to introduce. They must be able to sell ideas, not merely to take machinery orders.

A few examples may illustrate how such engineer salesmen work. Take the largest American manufacturer of mining machinery. This concern and its predecessors have consistently followed for a generation the policy of using engineer salesmen abroad. The company has branch offices or agencies in all countries of the world where mining and quarrying are done to any extent. In each of these branches or agencies is located one or more engineers who have had considerable experience in American methods of mining and quarrying.

What the Men are Selling

These men are actually selling drill holes in the rock and tons of ore in the car instead of rock drills and compressors. When a new proposition comes up they help to study the conditions to be met and advise what equipment will best suit them. In existing works they go right in and prove how American machinery and American methods will save money compared with what is being used. When up against cheap peon labor, in Mexico, for example, it is not easy to get a native mine owner to substitute an expensive mechanical plant for plentiful hand labor. He must be shown that the cost per ton of ore brought to the surface is less with such a plant.

Work of this kind is too "deep water" for a commercial salesman who can readily switch from shoes to millinery. It requires men who know from experience what the customer wants to know. Men of these qualifications become practically a part of their customers' organizations.

Here is another case. American sawmill machinery is used extensivcly in a Far Eastern country as a result of the work of a single American engineer salesman. This man knew thoroughly American methods of cutting timber, handling logs and running sawmills. When he went to this country a few years ago he was totally unfamiliar with its language. He went out and lived among the timber operators where he learned their language, their customs and their conditions. He did not meet the peculiar demands of the local lumbermen for machinery. Instead he showed them how American methods could cut more and better lumber for them at less cost. These American methods required standard American machinery.

Scarcely a logging or a sawmill job comes up in that country now without this man being consulted. His knowledge of the engineering side of the business, his keen commercial sense and his willingness to get right out on the firing line, far outweighed his previous lack of knowledge of the language and customs. No commercial salesman familiar with the language and

*Presented before the Technical Publicity Association, New York, Nov. 13, 1918.

the customs of the country, but lacking the engineering knowledge of the trade, could have hoped to make good at this work.

Numerous other examples of the success of American engineer salesmen abroad could be cited, but one more in an entirely different field should be sufficient. Hand labor is employed in excavating and loading into small cars quantities of a certain kind of commercial salt. The material lies almost at the surface in a stratum that is comparatively uniform in thickness and character over large areas of level ground. The industry is almost exclusively in the hands of English, German and native concerns. Their engineers were convinced that it was impracticable to use anything except hand labor in extracting the material from the ground and loading it into cars. At the same time climate and other conditions are such that it is very difficult to keep labor on the job.

Working under these great handicaps the industry became one of the principal lines of business of an important country. Each of the workings involves a large investment for an extensive refinery and for railways leading from the point of excavation to the refinery. The limitation on production is the amount of material that can be delivered to the plant. The cost of blasting and excavating the material also is a large part of the total cost of delivering the refined salt to the dock for shipment.

Result of One Visit

Based upon the opportunities thus presented an American concern sent an engineer salesman to study the situation, and as a result of the work he has done the indications are that the industry will be completely changed so far as field operations are concerned. The market thus presented for standard American equipment is a tremendous one.

Wherever you find an American sales engineer trained for work in foreign fields you will find him introducing American methods in the manner that these examples illustrate. At home you will find that the executives who have had experience with men of this caliber are convinced what overseas policy they must follow to get results. The ordinary commercial salesman will not do, but the engineer salesman of proper qualifications is almost assured of success in realizing on the opportunities presented in foreign markets to American engineering-machinery manufacturers.

Scarcity of the right kind of men is the one big problem in adopting a sales-engineering policy in export marketing. So many qualifications are desirable that an enumeration of them would appear to reduce the candidates to a very few. Just as in domestic work, however, it is rarely possible to find a man who matches up completely to the requirements of the job.

It is comparatively easy to find men who are thoroughly grounded in American methods of using any line of engineering machinery. When these men are sorted on the basis of ability to deal with business men the percentage of rejections is large. Those who do pass this test are nearly all eliminated when considered as to their commercial sense. This does not necessarily apply to their commercial experience, but rather to their ability to sense a commercial situation.

The few candidates left when these simple tests have been applied would nearly all be discarded because of their not knowing any foreign languages. It is frequently necessary therefore to overlook this essential qualification and send out a man who must learn the language after he has arrived, and any one who goes out thus handicapped is bound to have to work under great difficulties. The experience of numerous American engineering-machinery manufacturers has demonstrated, however, that such a handicap is far less serious than a lack of knowledge of American methods of using the machinery to be marketed.

Knowing the Buyer's Whims

This conclusion is heresy in the minds of most people experienced in regular commercial export trade, so it might be well to draw a line between marketing abroad commodities of ordinary commerce and selling engineering machinery. In the one case it is unquestionably necessary to adapt the commodity to the needs of the country. For example, it is impracticable to attempt to substitute an American hatchet for a Cuban machete. It is likewise necessary for a shoe salesman to know the whims of the average man and woman of the country in which he is trying to do business. But antiquated industrial and engineering methods are much the same the world over, and when any operation is large enough to justify the use of machinery instead of hand labor the work is nearly always in charge of men who can understand engineering arguments. These arguments are the same everywhere, but while it is a handicap not to be able to present them in the language of the men to whom an engineer salesman must talk, it is more so not to know what the arguments are.

The lack of business qualifications in most American engineers is a sad reflection on the work of our engineering schools. It is a fact that the courses in these schools tend to give young men a wrong view of the commercial side of engineering. Our technical societies also have overemphasized the ethical side to such an extent that an engineer who has anything to do with business loses more or less of his professional standing. This seems strange in the light of the fact that engineering is after all a matter of dollars and cents. This attitude of engineers toward business is probably a relic of the old days of pure-science education, but whatever the cause our engineering schools and societies will either have to get a new view of commercial affairs or fail to produce the engineer salesmen that American industry needs so greatly.

Suggestions to Technical Schools

Many suggestions have been made as to what courses our technical schools should give. One suggestion in regard to the foreign-language work required of engineer students may be stated. These courses could be given in a practical way. Young engineers should study a language as it is studied by men who must have it for commercial use abroad. Most important the student should be convinced of the value of the language to him. With some practical plan in place of the language study now given one of the chief handicaps to American engineer salesmen abroad would soon be eliminated.

Returning from these things as they might be to

things as tney are the average American manufacturer may want to know how he can use American engineer salesmen to sell his products abroad. This has been done in many ways, in each of which there have been some successes and some failures.

For the large manufacturer the problem is comparatively simple. He can afford to establish his own branch offices in the important centers of the world. He can also afford to supply his own trained men to coöperate with agencies in other centers of less importance. In the still more limited centers he can have his trained engineers on call to help local connections, scattered over a cosiderable area, to develop leads for business.

The manufacturer having a more limited output has three principal opportunities open to him under present conditions. He can turn his export sales over to one or more general export commission houses with branch offices in the countries in which he desires to operate; he can join with a group of noncompeting manufacturers in similar lines coöperating together to reach the foreign markets in which these manufacturers are interested, and he can bring together a group of his competitors under the Webb-Pomerene Bill to form an organization that will go after export business for all of them. The best plan can be determined only after careful study of what he wants to accomplish, the markets to be reached and his own limitations.

Methods of Some American Concerns

Some general export commission merchants have been quite successful in introducing and marketing American engineering machinery abroad. These concerns are of sufficient size to justify them in maintaining engineering-sales departments. These departments, to all intents and purposes, are separate machinery houses which utilize the experience and the facilities of the organizations of which they are a part.

Unfortunately the number of general export commission houses so organized is very limited. General export concerns that attempt to market engineering machinery as they do ordinary commodities make some sales, but in the nature of things they cannot build business.

Coöperative export engineering-sales organizations developed by a group of noncompeting manufacturers in allied lines is a comparatively new idea. Properly conceived, organized and financed, they apparently offer the average engineering machinery manufacturer one of his best opportunities to reach the available export market.

Such an organization insures each manufacturer of the benefit of thinking of all of the manufacturers in the group. This collective thinking eliminates many of the difficulties individual manufacturers encounter and permits the group to maintain properly trained engineer salesmen on salary in practically all of the centers of the world where there is an opportunity for the use of the particular general line of machinery involved. This means that each member of the group has good representation in many places where that member could not afford to have a salesman call even occasionally. Other advantages of the plan can be appreciated only by actual experience in its working.

Just how combinations of competitors under the Webb-Pomerene Bill will work in the engineering-machinery field remains to be seen. Thus far no such combination has been undertaken. In certain lines of commodities and of standard products there are undoubtedly advantages to be gained through operation under this bill. The difficulties apparently are such, however, that no group of competing manufacturers of engineering machinery has seen its way clear to attempt to get together in a combined effort to market its products outside of the United States.

Whatever plan is adopted by the American engineering-machinery manufacturer in his export sales work he can build a large and permanent market only by introducing American methods of using his machinery. Such introduction can be made properly only by experienced American engineer salesmen.

A "One-Way" Bow Drill

By J. A. Lucas

In a small shop, a part of the product of which is steel letters and figures, the bow drill was frequently used for routing out portions of the work, such as the centers in the figure 8 shown in the cut.

The bow drill as ordinarily made runs backward half the time, and consequently is most unsuitable as a means



MODIFICATION OF THE BOW DRILL

for driving a cutter which has sharp and properly relieved teeth. The implement shown in the cut was made to overcome this difficulty and make possible the use of efficient cutters on the work in hand.

The drawing needs no explanation as regards construction. When the cord is pulled the resistance of the rewinding spring causes the cord to wrap tightly around the spindle and revolve it. When the cord is released, there being no resistance to its return to the winding drum, it slips loosely around the spindle and the latter continues to revolve in its original direction by virtue of the momentum of the comparatively heavy wheel.

Making Shell Buckles and Brooches

By ROBERT MAWSON

In this article is shown the making of buckles and brooches from shells and ivory. The work is performed as far as possible on machines, though some of the operations from necessity are done by hand.

BY THE introduction of simple machines for making ivory or shell buckles and brooches it is possible to compete with the foreign-made articles which are largely made by hand.

Pearl buckles are made in great numbers by the Japanese. For these the workers are paid about 15c. a day for men and 10c. for women. The Providence Pearl Co., Providence, R. I., manufactures products which compete directly with these hand-made goods, and though the difference in wages here and in Japan is somewhat of an item, the increased production and superior finish of the domestic article give an advantage to the American-made goods.

In Fig. 1 are shown some of the types of buckles made. Those on each end are made with a cross-bar which is used to attach the buckle in position. The other three are made with a pin and designed as a fastening device for a belt. The various stages through which the shell passes when being made into a buckle are shown in Fig. 2. The shells employed for the work are imported from Australia. One of these as received at the factory is shown at *A*. The shell is first marked off into rectangular spaces to suit the outside contour of the buckle to be made and then cut up with a circular saw. One of these cut blanks is shown at *B*. The outer contour is then shaped by grinding on a wheel fitted with an exhaust system for removing the dust. The inside contour is then obtained by a similar method using a thin grinding wheel to suit the desired opening.



FIG. 1. A FEW SAMPLES OF BUCKLES

One of the blanks partly machined on the inside with the outside edge finished is shown at *C*. After the inside has been ground to the correct shape the buckle is polished on a buffing wheel. The buckles are next washed in muriatic acid to remove the dirt and also add luster to their appearance, afterward being washed in cold water. The final operation is drying by being placed in sawdust inside a rotating circular tank.

The average production from a shell is six buckles, which will convey an idea of the waste stock in the industry. This waste, however, is sold for fertilizing and other purposes so that it is not a total loss.

One of the grinding machines set up for cutting the inside contour of the buckle is shown in Fig. 3. The blank is held against the rotating wheel by hand and the inside contour produced. A number of the finish-ground buckles may be seen on the table and also in the box at the rear of the grinding machine.

A variety of shell ornaments used for brooches is also made at this factory. In Fig. 4 are shown the stages followed when making these ornaments. One of the shells used for the blanks is shown at *A*. This is cut into blanks in a manner similar to that followed when making buckles. One of the cut blanks is shown at *B*. The outer contour as shown at *C* is next obtained by grinding on a formed wheel. The design on the face of the ornament is obtained by cutting on small circular saws of the correct thickness, the workman holding the part in his hand.

This work depends largely on the skill of the man, who becomes so adept at it that the finished parts are practically the same as the original design of the sample.

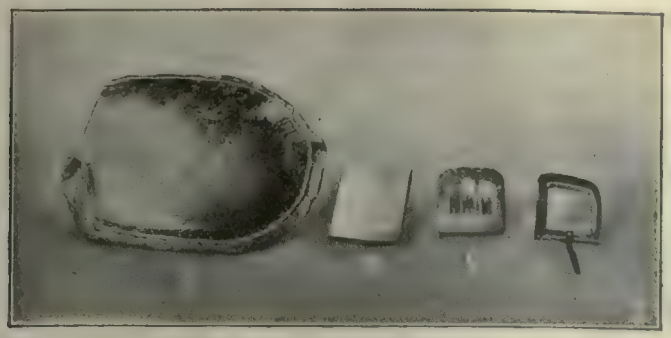
The ornaments are then washed and dried as previously noted. At *D*, *E*, and *F* are illustrated three of the finished designs of ornaments, the first two being leaves and the latter a bird. The method in which the contour is obtained by grinding is shown in Fig. 5. When grinding the first side the blank is placed in a fixture with a straight end and pushed against the revolving wheel by the operator. The grinding wheel is formed, as mentioned, to suit the shape to be produced. When grinding the second side, or the end, the blank is placed in the fixture as shown, which is made with an outline to fit into the contour that has been obtained by the first grinding. Stops are used for the fixture slide so that all the blanks are ground with equal contours and of equal size as regards width.

In Fig. 6 is shown one of the saws used to produce the design on the face of the ornaments or for cutting up shells. It runs at about 2000 r.p.m.

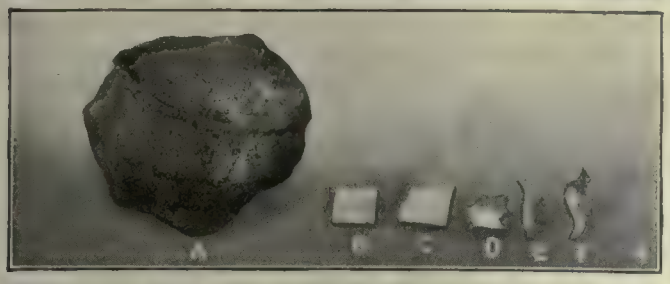
Some of the form wheels and templets used for producing ornaments are shown in Fig 7.

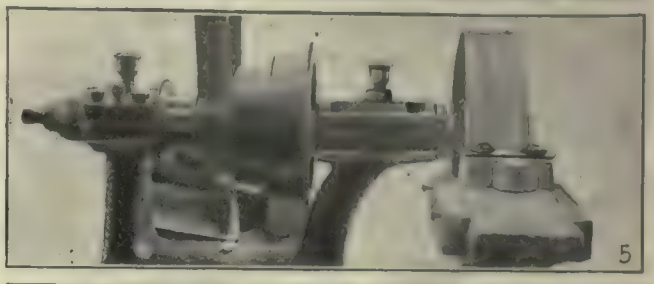
Another line of work being done in this plant is making French-ivory brooches. The steps in the making of one pattern are illustrated in Fig. 8. Blanks like *A* are received at the factory. They are then cut as shown at *B;* then the recess is made as shown at *C* and the outside form made as illustrated by the part *D*. This completes the work as done at this factory, the parts being then shipped to another concern where they are finished to the shape shown at *E*.

The machine used for cutting out the blanks is the specially built lathe shown in Fig. 9, which operates at about 2000 r.p.m. A trepanning type of milling cutter



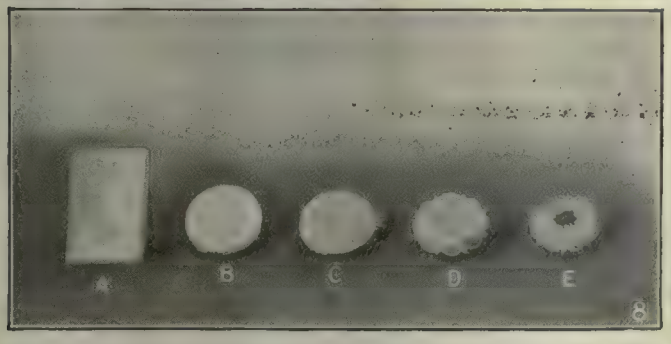


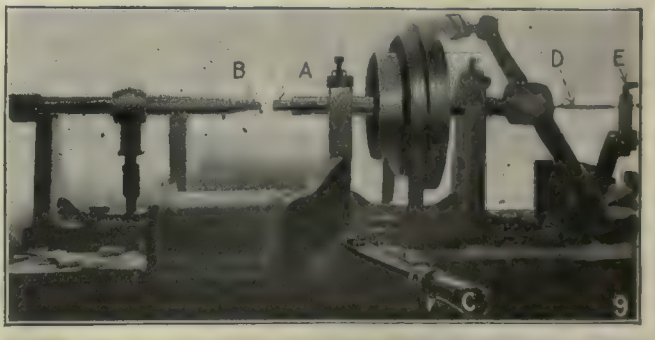




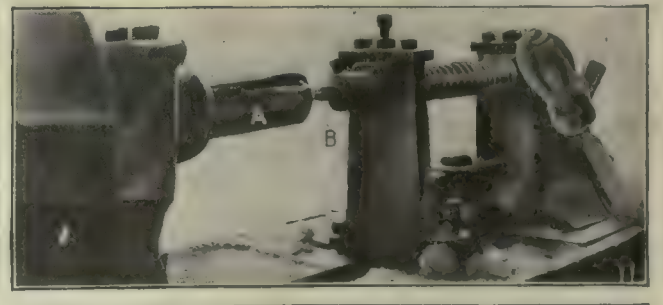


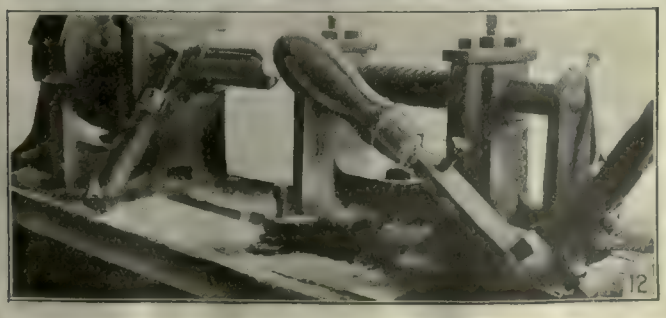


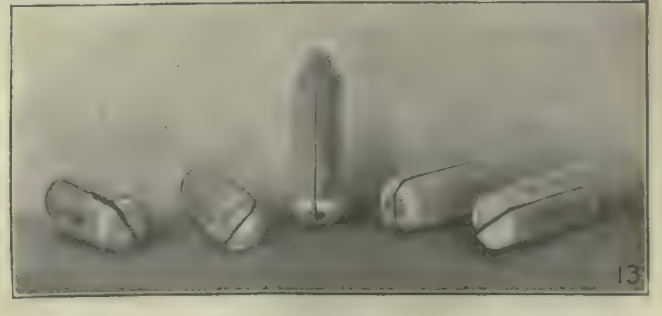












FIGS. 2 TO 13. VARIOUS PARTS AND TOOLS

A is used, in the center of which is a sliding push-out pin. The blank is placed against a circular holder at *B*, on the edge of which are saw teeth which assist in holding it. The cutter is fed in by pulling on lever *C*. After the cutter has passed through the ivory the round disk is pushed out of the cutter by means of the push-out rod *D* which passes through the center of the spindle and cutter. This rod can be set to any desired position by means of the screw *E*, so that the disk is forced out as the feed lever is thrown back.

Some of the trepanning tools are shown in Fig 10. It will be observed that a thread is machined on the shank which fits into a tapped hole in either the sliding or fixed spindle. When using a set of these tools one of the smaller ones is screwed into the work or tail spindle and is merely used to hold the blank as previously mentioned. A larger tool is screwed into the rotating spindle. An advantage of this type of tool is that each may be used for either holding or cutting the blank according to whether it is fastened in the stationary or rotating spindle. In each case, however, the cutting tool is the larger in diameter of the two. The hole through which the push-out rod operates may be observed in the center of the tools.

Recess Cutting

The machine used for the recess-cutting operation is shown in Fig. 11. The blank is held in the wooden chuck *A*. The cutting tool *B* is flat in section and held by a setscrew as shown. The operator feeds the tool against the revolving blank and the recess is formed. Another view of the machine is illustrated in Fig. 12. The tool *A* is used when placing the piece in the chuck, the hook of the tool being placed in the split joint of the chuck, forcing it open enough to allow the blank to be put into position. When the tool is removed the chuck jaws spring together, thus holding the blank securely for the machining operation.

A number of chucks used for holding different shapes of blanks are shown in Fig. 13. It will be seen that these are made with a thread on the shank which screws into the spindle of the machine.

After the recess has been machined in the blank the next operation is forming the outside contour. This work is similar to some of that previously noted for other parts and depends entirely on the operator's skill and practice to obtain the correct shape, a formed grinding wheel without any fixture being used.

More About the Modern Foreman

By James H. Follen

After reading the article by E. Andrews page 661, Vol. 49, of the *American Machinist*, on "The Modern Foreman—What Is His Present Job?" and noting the list of requirements necessary it was refreshing to read the criticism by Harry Senior on page 1008 of the same journal.

One reads a lot of bunk about "born disciplinarians" and men who rule with an iron hand, etc., but when you really meet up with a foreman who is successful with his men you will generally find him to be what is known as a "regular fellow." To one with years of experience in handling men the fact is evident that a successful foreman's greatest qualification is adaptability.

While the superintendents or plant managers are, of course, the responsible heads of their shops, nevertheless the foremen, who are the ones that come in actual contact with the workers, are vital factors in making the shop a success or a failure. Many times a man possessing the adaptability that will enable him to best coöperate with his men, each of whom presents a different problem, will prove more successful than a man without this adaptability but who actually knows far more about the work to be done.

This calls to mind a story I once heard of a machine builder who, having grown old in the game, retired from active business and left the direction of the plant to his two sons. In the course of time the boys found it necessary to appoint a superintendent and, desiring to reward faithful service, concluded that it would be good policy to promote one of their foremen, but they could not agree on which one.

Appointing the Superintendent

One of the boys was in favor of giving the new job to the foreman of the lathe department, who was the finest lathe hand and best producer they had ever had. The other partner was partial to the foreman of the erecting department, averring that the knowledge of detail possessed by him would be of greater advantage to a superintendent than that of a machine hand.

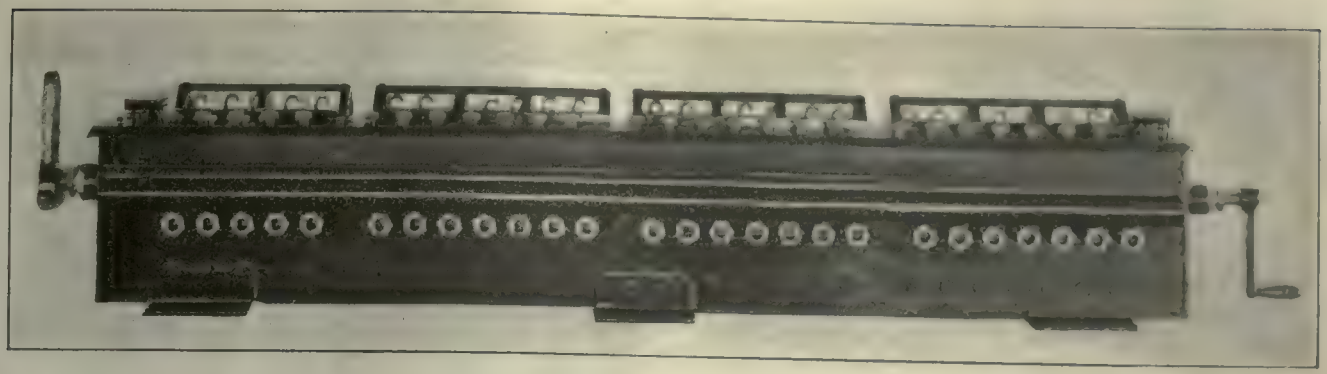
As they could not reach an agreement they took the matter to the "old man" for advice. Each of the boys expatiated upon the superior qualifications of his particular candidate, and in their zeal to back up their own judgment made an exceptionally good case for the two foremen. The old man listened attentively to the summing up and rendered his decision as follows: "Boys, you are both wrong. Better keep Bill in the lathe department, as he seems to have found his element there; also since Joe can work such wonders on the erecting floor, that is the place for him. Any damn fool will do for a superintendent."

Requirements for a Foreman's Job

While the foreman's job does not require quite all of the virtues noted in Mr. Andrews' article, if a man *could* be found carrying around that awful bundle he no doubt would be a "crackerjack," but it would be pretty hard to keep him a foreman; he would doubtless buy out the plant in a few years and hire the former boss to run it for him.

However, there is no danger. The only sure thing in the world besides death and taxes is the fact that sooner or later we all find our level, which is determined by our possession or lack of possession of the qualities that make for success. No one man has them all; if he did he'd be simply unbearable.

The whole article makes me think of the man who wrote to the editor of a paper asking him to find him a wife, saying she must be about 28 or 30, good looking, have a good figure, a kind and loving disposition, be a good cook and housekeeper and have none of the new-fangled ideas about woman's rights; also, while it was not exactly necessary, it would add to her attractiveness if she had a little money of her own. The editor (who happened to be a bachelor) replied saying he would try and find such a woman, but if he was successful in his search he would marry her himself.



Manufacturing a Mechanical Lubricator—II

By M. E. HOAG

In the making of mechanical lubricators it is necessary to join many parts permanently, and for this work the electric-welding process has superseded riveting, bolting and brazing for the reason that it will not only produce a more satisfactory and permanent joint than will even the most expensive of the discarded methods, but in point of cost is far below the cheapest of them.

IN ORDER to weld metal parts successfully it is often necessary to change their forms slightly to secure ample contact at the point of welding, and neglect to do this is frequently the cause of failure that is too often blamed upon the welder. An example of this is shown in Fig. 8, which shows the eccentric ring, or strap, used in the Kipp lubricator. The ring *A* is first drilled, reamed and cut off from 1½-in. screw stock in the automatic; then the trunnions, which are also screw-machine products, are welded on. It will be noticed that quite a heavy shoulder is left on these at *B* in order to bring the contact down near the point of welding, as otherwise the entire piece would be heated and when pressure was applied the ring would be distorted.

No jigs are used for this work, but the ring is slipped over the lower copper contact, which is round and about the same diameter as the inside of the ring. The workman then sets a trunnion on top of the ring, gaging its location by his eye, and brings down the upper contact, which is hollow, contact being made on the heavy flange *B* and the weld made. The piece is then turned over and the operation repeated. Under ordinary conditions a workman will turn out 2200 of these, or 4400 welds a day. All of the welding in the Madison-Kipp shops is done on Toledo and Thompson welders.

After welding, the trunnions are straddle-milled to remove the overhang of the shoulders, and they are then brought to size by hollow-milling on the special machine shown in Fig. 9, which leaves them as shown at *C*, Fig. 8.

The machine, shown in Fig. 9, carries two hollow mills *A*, which are driven by belts as shown. The handle *B* of the upright *C* raises up and allows the ring to be slipped over it and down onto the base *D*. A split washer is then slipped on, engaging a shoulder on the piece *C* which screws into the base *D*. A slight turn of the handle clamps the ring in place. The trunnions are located by the gage *E*, which carries two

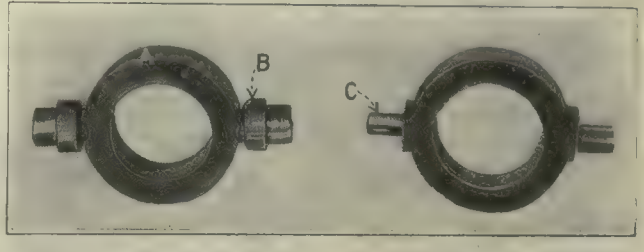


FIG. 8. ECCENTRIC RINGS WITH WELDED TRUNNIONS

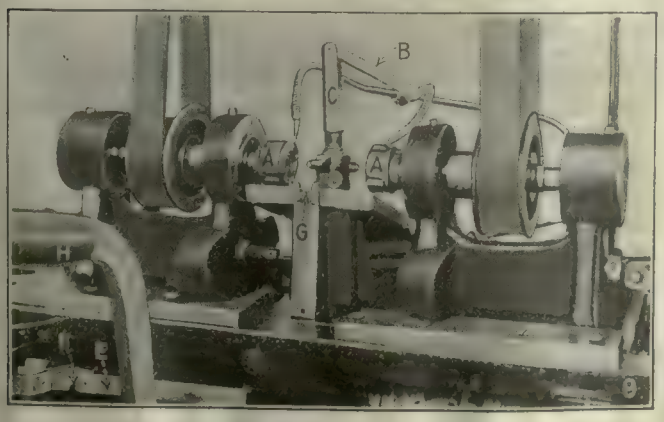


FIG. 9. HOLLOW-MILLING TRUNNIONS

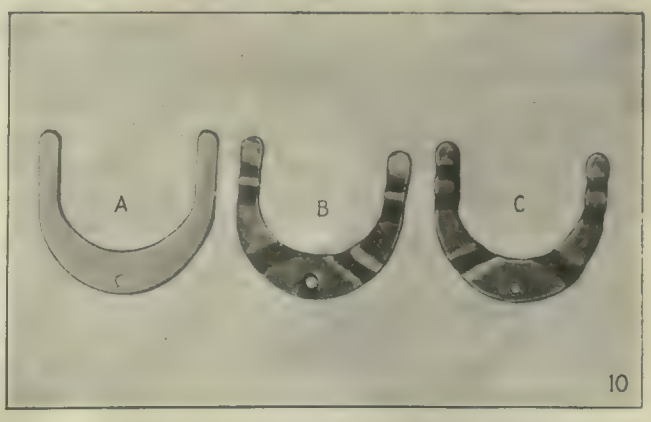


FIG. 10. THE ECCENTRIC-YOKE PARTS

notched forks at one end to engage the trunnions. A third notch at *F* fits over a corresponding projection in the upright piece at *G* and locates it, where it is held until the ring is clamped firmly in position. Movement of the lever *H* forces the mills together until they come against stops which determine the length of the milled portion of the trunnions.

The yoke is made of two punchings as shown in Fig. 10. The pieces are first blanked out as seen at *A*, and a small hole is pierced. The pieces then pass to the second stage of the tool, where a drawing punch enters the pierced hole and draws it up into a hollow cup to form a bearing as seen in the two pieces *B* and *C*. The two parts of the yoke are connected together by a small steel piece which has an opening at its center for the purpose of attaching it to the end of the pressure plunger. The steel bushings shown at *A*, Fig. 11, are placed on the trunnions of the eccentric ring; the steel piece above referred to is entered in the openings in the yoke, the two halves of which are then closed down and spot-welded at the points *B* and *C* on each side, thus binding all the parts firmly together.

The Case, or Tank

The tank is made from sheet steel 0.065 in. in thickness. The steel is first sheared to size and then passed through a series of rollers which turn down a flange at right angles to the sides as shown in Fig. 12. A set of punching dies blank out the openings *A* and *B*, and another die is used to cut out triangular pieces from the flange to form the corners. A very ingenious adjustable die pierces a series of connection holes, after which the case is formed up on horning dies.

This brings the case up to the welding operations, which consist of spot-welding a reinforcement back of the seam *C*, welding in the support *A*, Fig. 13, for the gage glass, the piece *B*, two brackets *C* and the bottom *D*. In a four-feed lubricator this will require from 15 to 20 welds, and a workman will handle about 400 tanks a day.

The welders have in some instances been equipped with two sets of contacts, which enable the workman to complete the welding of a tank without having to change or readjust them.

A number of schemes have been tried to weld the seams of the case, but so far nothing has been found so satisfactory as soldering. As all parts are held firmly together by the welds there is no strain on the soldered joint, and it renders the tank absolutely oil tight.

The barrel of the sight-feed lubricator has two long openings to receive the measuring-plunger sleeve and the pressure plunger besides numerous small holes or ports, all of which must be drilled and some of them tapped, while the plunger holes must be reamed accurately to size and tapped to take closing plugs. As stated before, there are some 40 operations on this one piece, many of which require the use of cleverly designed and accurately constructed jigs and fixtures.

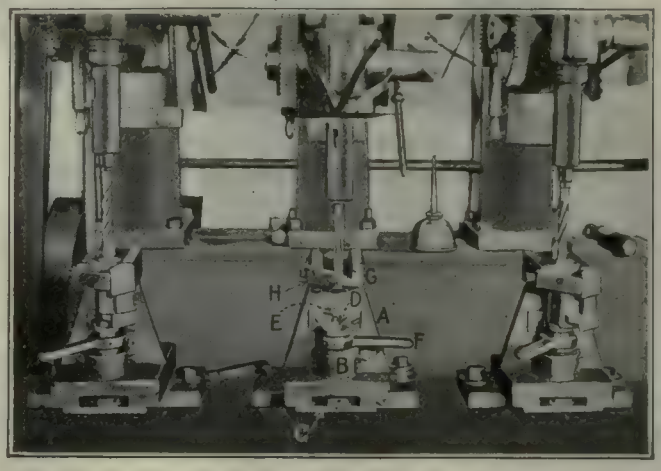
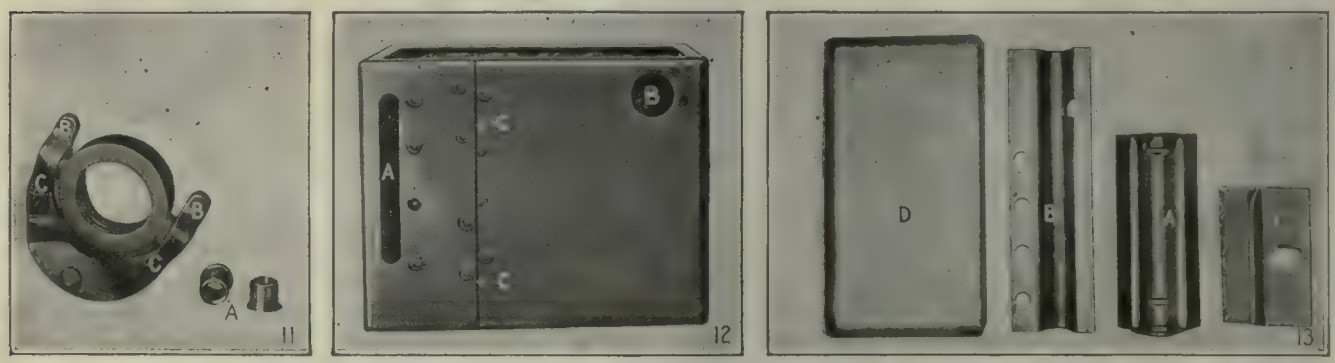


FIG. 14. DRILLING JIGS FOR THE BARREL

The first operation shown is drilling and reaming the plunger holes. For this work the jigs shown in Fig. 14 are used, and owing to the speed with which they can be loaded and unloaded one workman is able to handle several at a time. The empty jig shown at *A* gives a good idea of their construction. The body of the jig is cast iron, with a bored and tapped hole through the portion *B* to receive a threaded bushing which can be adjusted up or down by the collar *C*. Inside of this threaded bushing is a second bushing *D*, which is free to move up or down, but is prevented from turning by a key in the steel plate *E*. The lever *F* is free to turn on the top of the large bushing and has a lifting action on the bushing *D*, which is coned out at the top to receive the end of the barrel to be drilled. A second coned bushing in the support *G* receives the other end of the barrel, and as the lever *F* is swung to the left it raises the lower bushing, clamping the barrel firmly between it and the upper



FIGS. 11 TO 13. A FEW OF THE VARIOUS PARTS
Fig. 11—Eccentric ring and yoke assembled. Fig. 12—The tank after spot-welding. Fig. 13—Parts of the tank to be welded into place

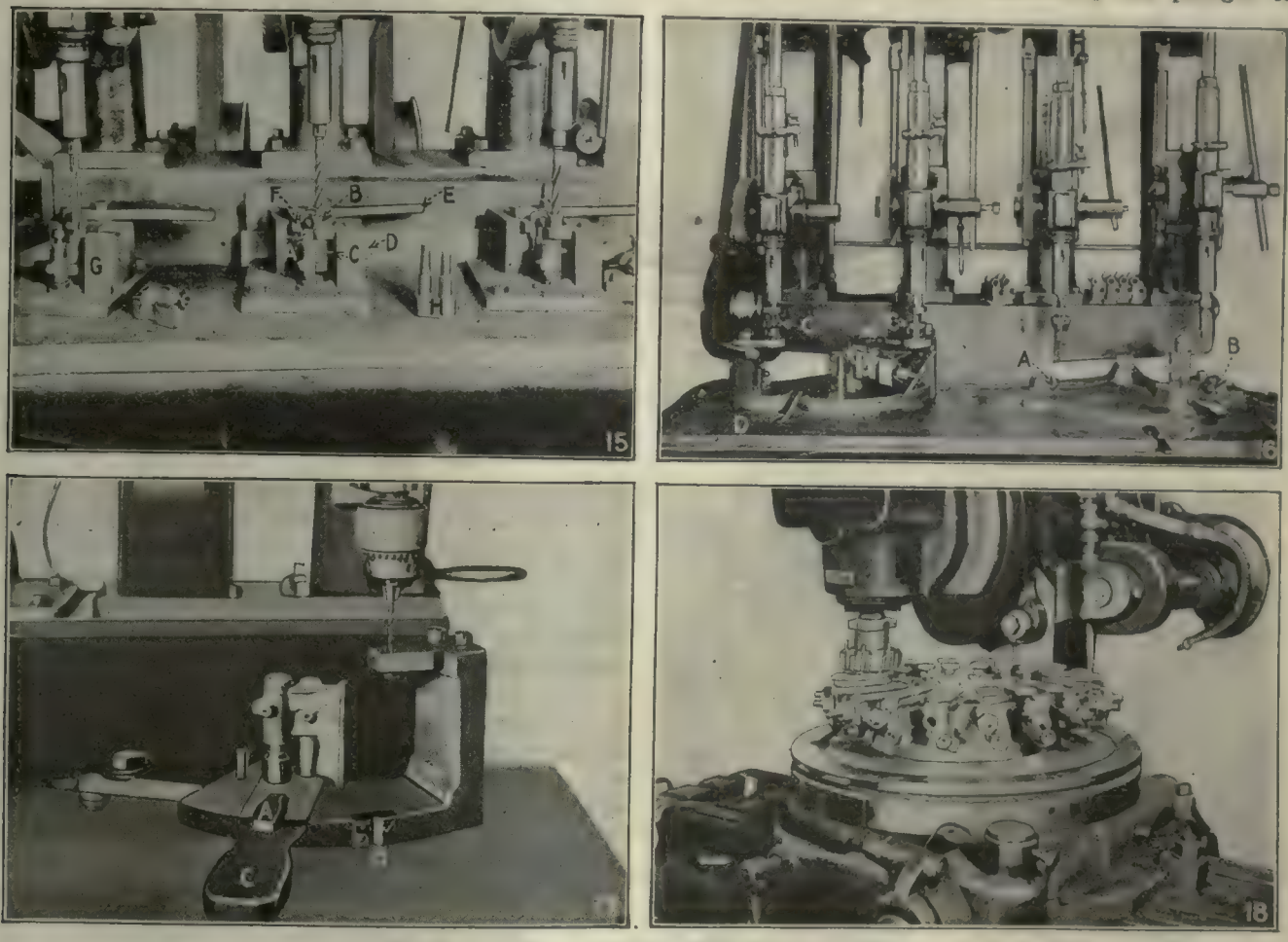
one. A block *H* engages the flat portion of the barrel and prevents it from turning during the drilling operation as may be seen from the loaded jigs. The drilling machines used on this work are equipped with power-feed and automatic knockouts which enable the workman to handle a large number of pieces a day.

Besides the machine-reaming done in these jigs the plunger holes are hand-reamed twice, which insures uniform size of holes.

The second plunger hole is drilled and reamed in the jigs shown in Fig. 15, which are somewhat different than the ones for the previous operation, but are equally simple and speedy in operation. In these jigs the location is taken from the hole already drilled and reamed, the piece being slipped onto the hardened plug *A* and then swung under the bushing *B* against the stop *C* on the end of the screw stud *D* where it is held in place by a movement of the lever *E*, which forces a hardened-steel wedge against the piece to be drilled. The reaming jig *G* is the same as the drilling jigs except that the piece is allowed to float instead of being held rigidly. As each piece is finished it is tested with the gage *H*, which carries two hardened and ground plugs properly spaced to insure correct size and proper spacing of the holes.

Both ends of the barrel are faced to length in the swinging jigs shown in Fig. 16. These jigs are simple in construction and rapid in operation and a number of them are used for various drilling and tapping operations. Swinging the jig to the right brings one hole under the facing tool and to the left brings the other hole in line, adjustable stops being provided as shown at *A* and *B*. When one end of the barrel is faced to length it is transferred to the second jig and the other end faced. The facing tools are fitted with adjustable stops *C*, and the work is held to gages which are shown at *D*.

A close-up view of one of these swinging jigs is shown in Fig. 17. This jig is used for drilling a small cross-connection hole. Proper location is secured in this case by an index plunger *A* which drops into a notch in the steel insert at *B*. The index pin is held in place by a spring which is strong enough to insure proper indexing but allows the handle *C* to be moved in and out of position without withdrawing the plunger *A*



FIGS. 15 TO 18. OPERATIONS ON THE BARREL

Fig 15—Second drilling jig for the barrel. Fig. 16—Facing the barrels to length. Fig. 17—Swinging drill jig for the barrel. Fig. 18—Circular milling fixture for the barrel

by hand, which greatly increases the speed with which the work can be handled. This operation is performed by women who operate two jigs at once, the drill spindles being equipped with a foot treadle which allows both hands to be used in loading and unloading the jigs.

Throughout the shops the speed of the work is limited only by the machining time, the jigs and fixtures being so designed that the loading and unloading time is a secondary consideration.

It has probably been noticed that in handling the barrel the sequence of operations has been reversed according to general practice, which would be to mill the

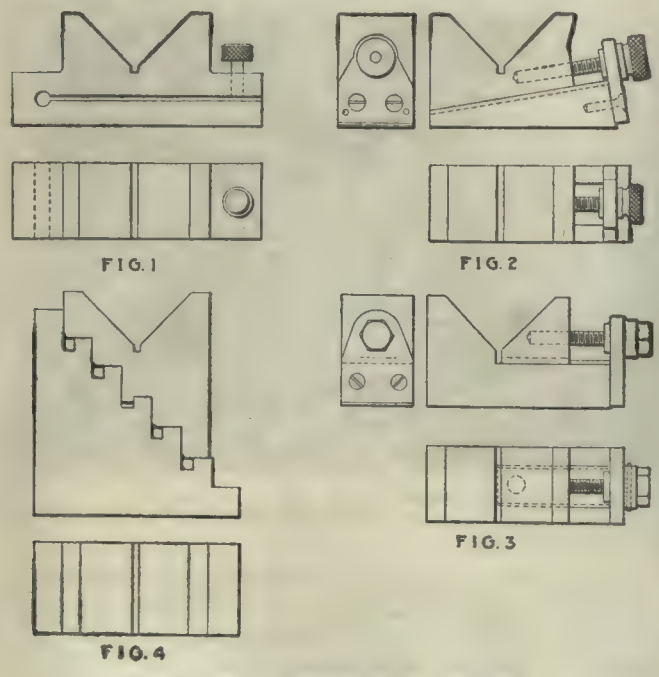
flat surface of the bracket first and then locate from this. Such a procedure would, tend, however, to produce holes eccentric with the outside of the barrels and would offer greater difficulty in locating properly. The methods here followed insure perfect alignment of the holes with the milled surface on the bracket and also insures their being concentric with the outside. In the milling operation location is taken from the drilled and reamed holes as seen in the circular milling fixture shown in Fig. 18. This fixture is very simple in construction. Two hardened studs receive the barrel and locate it, one stud being threaded and provided with a nut to bind the piece in position during the milling operation.

The next article will describe the measuring sleeve and plunger together with some very clever and unusual dies used in making them. A description will also be given of the adjustable die used in punching a series of connection holes in the tank.

Adjustable V-Blocks

By W. G. Hill
London, England

I was prompted to submit the appended details of adjustable V-blocks because of the service they are capable of rendering when used for inspection purposes or as an aid in general mechanical and toolroom work. However, they are not recommended for use in rapid-production work. I fully realize the advantages obtained by the use of permanent and absolutely fool-proof jig fixtures. This word adequately describes many of the devices now being made to facilitate production, which



FIGS. 1 to 4. ADJUSTABLE V-BLOCK
Fig. 1—V-block with slight adjustment. Fig. 2—The inclined-plane type. Fig 3—One with a sliding jaw. Fig. 4—The step-up type

cannot justly be termed jig or fixture, but can be termed jig fixtures as they perform the functions of locating the operating tools and also of securing the articles operated upon. This will be apparent if one inspects the production department milling machines of today.

The illustrations given cover many of the requirements in adjustable V-blocks. The testing of small crankshafts and camshafts, with their varying end diameters, will form examples in which adjustable Vs can be used to advantage. It is of course understood that the blocks are made in pairs to be used together. Fig. 1 illustrates a V that is made of cast iron. The

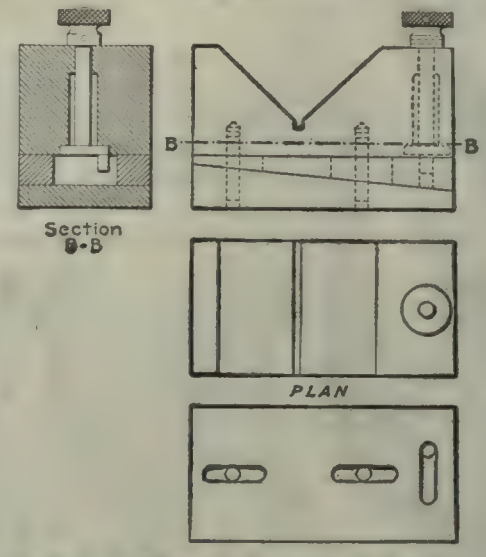


FIG. 5. A WEDGE ELEVATING TYPE

body of the block is sawed as shown and a setscrew is used to obtain a slight elevation to the V. As the rise and fall can act only with the spring of the metal it will be obvious that the lift given by a small V may not exceed 0.003 in. The rigidity of the block, however, in precision work is a point of note.

Figs. 2 and 3 are similar in design but capable of a much greater adjustment. It may be mentioned that the male V-slide on Fig. 3 is not integral with the base, but is secured in position on the base by screws and dowels, this method being adopted to obviate delicate machining operations.

The V in Fig. 4 can only be elevated in definite steps. It is used with advantage for the setting out of work on the surface plate, resting work on the lathe bed during the change of operations, or on a drilling or milling machine. The middle keeper toe on the top half of the V gives a positive lock, preventing any slipping that might be occasioned with undue vibration.

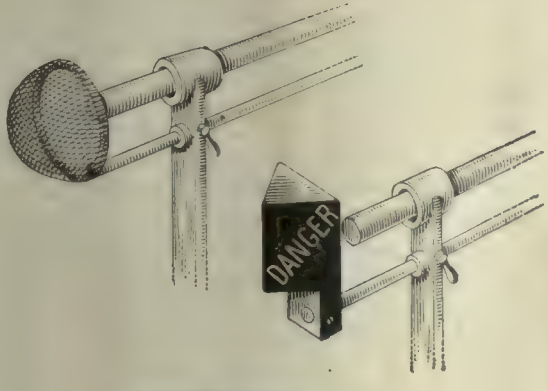
Fig. 5 shows an adjustable V elevated by a sliding wedge, which is actuated by an eccentric operated by the knurled head. The pins indicated are secured into the upper V; they pass through the moving slide and anchor the base in true relation to the upper half of the block. The bottom view which is a plan taken on the line *B* shows the slots and keeper studs which allow motion of the V-slide in a longitudinal direction only. The lateral slot in which the crankpin operates gives the necessary rise and fall, or elevation, to the V, and a light spring washer is placed under the knurled head to keep it in tension, while a small roller fitted on the crankpin serves to eliminate friction. The two last-mentioned details are not shown, as their utility will be quite clear. It will be found that these V-blocks are very handy for many jobs that would otherwise be rather troublesome if special jigs or fixtures were not at hand.

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas

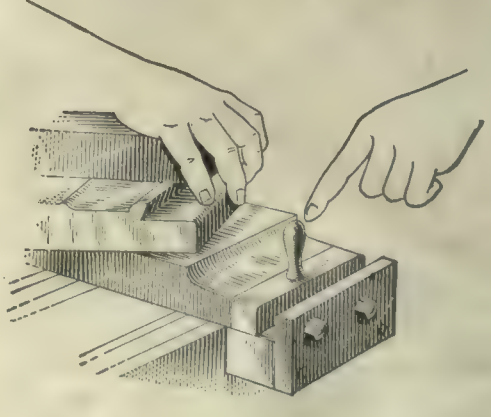












Diseases and Infections

By CHESLA C. SHERLOCK

Many occupations give rise to special diseases which are caused by conditions peculiar to the occupation and which are known as occupational diseases. Some courts hold that such diseases in themselves furnish ground upon which to base a claim for compensation, though other courts require evidence to show that incapacitation or death from such disease is aggravated or hastened by such minor injury.

WORKMEN who follow certain lines of employment often contract diseases peculiar to that employment and which are known as occupational, or industrial, diseases. It seems that the frequency of these diseases is becoming more apparent as our industrial life becomes more complex, and it is also apparent that there are few occupations in industrial life which do not have their diseases.

The first workmen's compensation acts in this country omitted the mention of these diseases. This was perhaps an oversight, but the fact was that all diseases were clearly dropped out of consideration by the limiting words of the act. Recovery of compensation was predicated upon "an injury by accident" arising out of and in the course of the workman's employment.

Since our acts were largely taken from the English act, our courts have followed the English interpretation, and we find that across the water they were of the opinion that an occupational disease was not an "accident," therefore a workman suffering from such a disorder was not entitled to compensation regardless of the merit of the case.

The fact that a workman is suffering from an occupational disease is generally evidence that he has been in the employment of his employer or others in the same work over a period of years. The ordinary occupational disease does not arise suddenly, it is the result of long association in a work which is injurious to the health.

Workmen are given compensation because there is a legal presumption that they have been contributing something to the wealth of society by their labor. When an accident arises, the law says that the workman shall be protected from total loss by the payment of compensation. But the same arguments apply to the workman who has contracted an occupational disease. The chances are that he may have contributed something more to society than the fellow who is injured by accident, yet the law throws the mantle of protection over the latter.

Why this discrimination? It is due, I think, to a technicality, and nothing else. In states where the wording of the act has been more favorable the courts have included occupational diseases in the list of compensable injuries. In Massachusetts the law allows compensation for "personal injuries," and the court has said that an occupational disease is a personal injury. Other states have by express legislation made arrangements to take care of this class of industrial losses.

The distinction is one of technicality, for the great majority of students and courts agree that there is no fundamental difference between a sufferer by accident and one by disease. If the one is protected so should the other be.

Employers often raise the objection that if legislation were enacted to take care of occupational diseases they would in time be forced to deny employment to workmen having such diseases. It has been said that employers would use a man until he commenced to show the first symptoms, then he would be turned away and would not be able to find employment again because employers would refuse to stand the loss under the statute.

This might appear to some to be a valid objection and that it would be better for the sufferers to be left in their present position where they can earn a livelihood until the disease incapacitates them than to have thousands turned out of employment, many several years before their usefulness to themselves has been lost. But the Iowa Industrial Commissioner has said in a decision that he has no such fear; that he has too much confidence in the good faith and honesty of the American employer to believe that he would stoop to such tactics. Doubtless the majority of employers would not resort to such tactics, but it remains to be seen. It might be pointed out that it is not an easy matter to escape liability under any form of contemplated legislation. If the legislative authority observes that certain legislation is defective it has only to revise such legislation and impose a penalty upon those who seek to evade its plain intent.

If employers did establish medical examinations for their workmen and discharged all who showed symptoms of occupational disease it would only be a short step for the legislative authority to amend the law and fix a penalty for all who turned away such workmen when they showed symptoms of becoming a liability to the employer. So much for the objections to occupational-disease legislation. In the meantime it is possible only to apply such law as we have and to hope that it will not be long before this class of sufferers will have as adequate protection at law as those injured by accident.

Purely occupational diseases are not compensable unless the statute expressly makes them so or unless recovery is not based upon an injury by "accident." The overwhelming authority is against the proposition that disease, at least occupational disease, can in any way be classed as an accident.

In Illinois there is a statute known as the Occupational Diseases Act, which specifically treats of cases falling under this heading. A case arose under that act where a workman had been employed in a forge room for four or five days prior to the injury. It was the duty of the decedent to feed a furnace. The temperature of the room was between 85 and 90 deg. at the time he was rendered unconscious. Half an hour later he died.

There was a conflict in the testimony as to what, if any, devices could have been used to reduce the tem-

perature of the workroom, but it was shown that the temperatures mentioned would affect but slightly a normal man. It was also shown that just before the death of the man there was a flow from his mouth which had the odor of whiskey and that in his pocket there was a flask containing whiskey. The verdict of the coroner's jury was that death was due to "organic heart disease combined with isolation," but the attending physician had testified that death was due to apoplexy.

Judgment had been rendered for $3000 for decedent's dependents, but the court reversed the judgment of the trial court, saying that the death was not an "accident" within the meaning of the workmen's compensation act, and that it was insufficient to show that the death resulted from any violation of the Occupational Diseases Act, the true cause having been apoplexy.

An Ohio Case

In an Ohio case decided in 1915 the claimant contracted lead poisoning while employed by a manufacturer of white lead and became incapacitated. He was denied compensation by the Ohio Industrial Commission. He then brought the matter to the attention of the courts and was rendered compensation. The Supreme Court reversed the judgment saying that occupational diseases were not within the contemplation of the statute. Said the court: "It is no difficult matter to bring within the purview of the words 'personal injuries sustained in the course of the employment' occupational diseases incurred in the course of the employment. It can further be conceded that had the legislature, in enacting either the original or the present law, desired to make plain its intention to exclude occupational diseases from participation in the fund, the exclusion could really have been made by adding to the words 'personal injuries' the qualifying phrase 'by accident.' As against all this the court feels impelled to follow both the executive and legislative construction of the word 'injury' as employed in the act, and to limit recovery of compensation to such as may have suffered injury otherwise than through disease, thereby giving the legislative and executive construction the added force of judicial construction."

Later, in the same opinion, the court recognized the fact that there is really no reason why occupational diseases should not receive the same attention that injuries by accident had received. Said the court: "The victims of modern industrialism springing from disease incident thereto are only less numerous than those arising from pure accident, and no sound policy can be suggested that should protect the one class and ignore the other, especially when the compensation system becomes firmly established. Until this is done the court will continue to construe the law as it was obviously intended by the legislature that it should be construed."

In a Massachusetts case a printer contracted lead poisoning. Said the court: "There is nothing in the evidence or elsewhere in the record to show what was the composition of the type upon which he worked. Nor is there anything to show that lead fumes or lead dust or any dangerous compound of lead is given off in a printing office or in such handling of type as that engaged in by the employee to such an extent and in such form as to be likely to be taken into the human system and to cause plumbism. While it is quite possible that such may be the fact we do not know it, and in our opinion it cannot be regarded as a matter of common knowledge."

In another Massachusetts case it was shown that a lead grinder 73 years old, who had followed the same occupation for more than twenty years was suffering from plumbism. The court was of the opinion that this was a "personal injury" within the act and allowed him to recover compensation.

In a California case the plaintiff was employed in a mill, sacking grain. He became afflicted with an infection of the nose and mouth known as actinomycosis, which partially disabled him. The court said: "The evidence taken upon this issue was that of expert witnesses as to the nature and causes of actinomycosis and whether it was or could be conveyed by grain to the human organism. Upon this subject the testimony of physicians was in conflict, as were also the medical treatises upon which they respectively relied for their opinions. The commission resolved the doubt and conflict in opinion and authority in favor of the applicant for compensation by its finding that 'the applicant's employment in and about the handling of grain caused him to contract the disease known as actinomycosis.' The evidence in support of this finding consists not only in the opinion evidence of the physicians who treated the applicant and diagnosed his case, but also the testimony of the applicant himself that he had not heretofore suffered from any such disorder, but that it had become actually developed while he was engaged in the work of sacking and handling pulverized grain for his employer. We think this evidence was sufficient to warrant the commission in arriving at its aforesaid conclusion, and this being so we have no power to interfere with its discretion in making said award." This case was decided in 1917.

Actinomycosis is not peculiar to any particular employment, but may arise anywhere the air is filled with dust particles.

A Case of Anthrax

In New York the plaintiff contracted anthrax while handling diseased hides. He was awarded compensation by the Industrial Commission and the matter was appealed to the courts. The New York statute allows recovery for: "Only accidental injuries arising out of and in the course of employment and such disease or infection as may naturally and unavoidably result therefrom." The court affirmed the award of compensation, saying: "There is a broad distinction between the present case and the case of an occupational disease. The latter is incidental to the occupation or is a natural outcome thereof. . . . This disease incurred by the claimant was unexpected, unusual and extraordinary, as much so as if a serpent concealed in the hides had attacked him. There is no difference in principle because the attack, instead of being made unexpectedly by a concealed serpent, was made unexpectedly by a concealed disease germ. There seems to be no question in the case but that the claimant contracted the disease in the manner and under the conditions above indicated. We think the circumstances constitute an accidental injury within the meaning of the statute. However, there is another theory upon which this award may be upheld. The claimant in the course of his employment and as a result thereof had received an abrasion on his hand or a

fissure therein. This may properly be deemed an accidental injury arising out of and in the course of his employment, and the disease or infection caused by the anthrax germ may be deemed 'such disease or infection as may naturally and unavoidably result' from such injury within the meaning of the statute." This case was also decided in 1917.

Excluded Diseases

All diseases and infections are not excluded from participation in the workmen's compensation acts. If a disease or infection is clearly of the class known as occupational diseases, then no recovery can be had unless express provision is made for it in the statute or unless the particular state court construes the statute to include it. But certain diseases are treated as compensable injuries under the most stringent compensation acts, and we daily find the courts awarding decisions to workmen who become incapacitated by disease. There is a test announced by the courts which may generally be applied correctly. It is this: Did the disease or infection result from an accident or was it in the nature of an accidental injury? We saw the New York court apply this test in the anthrax case aforementioned and we found that the workman recovered compensation. It is a common occurrence for men handling hides and pelts to suffer from anthrax and in some quarters it is even considered an occupational disease. Yet the manner in which it arises may change it from the noncompensable to the compensable class.

It is generally decided in this country that if a disease results from an injury, even though it be an occupational disease, that it is compensable. This is because the injury and not the disease was the proximate cause of the incapacity. In like fashion if a workman is suffering from an occupational disease, but sustains an injury by accident which aggravates the disease so that he is incapacitated he is entitled to compensation.

Again, a disease may take on the nature of an accident. We frequently find the courts awarding compensation where the workmen contracted pneumonia while at work. This is not a far stretch of the imagination. If a disease can under extraordinary circumstances take on the nature of an accident there is no valid reason why compensation should not be paid. It must be recognized, however, that this will be true only under unusual conditions.

We have now considered the more important phases of the workmen's compensation acts and special legislation on the subject. Let us consider briefly the common law on the subject as it stood prior to the compensation acts and as is stands today in states that have no compensation legislation.

A Missouri case, which was decided in 1916 under the common law, showed that a minor was employed as a day laborer to carry away boards that were taken from the floor of a box car that had been used in carrying cement and which were covered with cement dust. The dust was blown in the plaintiff's eye, and the caustic poison that the dust contained formed an ulcer which destroyed the sight of the eye. The plaintiff asked damages, alleging negligence on the part of his employers for failure to provide him with a safe place in which to work and in failing to warn him, being young and inexperienced, of the special danger to his eyes from the dust, of which danger the employers were charged with being or ought to have been aware. The employers claimed that the eye might have been affected by germs, independent of cement dust, and argued that the cause of injury was so problematical that the jury could not rightfully say that it was due exclusively to the dust. Said the court: "Lime and cement which contain a poison of particular malignance to the tissue and structure of the eye are commonly carried by railroads so frequently and in such quantities that their injurious properties must have been known to the defendants. It is the duty of mastership to exercise reasonable care to provide the plaintiff a reasonably safe place in which to work, and the jury were entitled to infer that the defendants should have known that the boards were covered with the poisonous dust, and that to set an inexperienced laborer to work where the dust would be blown into his eyes added a very serious danger to the hazards of his service. Not to warn him of such danger was an act of negligence for the consequences of which the master should be held responsible."

In an Illinois case the court said: "It is a matter of common knowledge that cement is now one of the most generally used materials in certain trades and industries; that it is packed in bags or barrels from which the cement is usually taken just as it is needed for use; also that it is a light, powdery substance which easily floats through the air; that there is nothing in its composition or ingredients which causes the use of it to be accompanied with such special danger that would require it to be handled different from other building materials of like character for the protection of persons engaged in the work." And the Illinois court held that the injury was due to an accident and not to the negligence of the employer in the manner of handling or failing to warn, thereby taking the opposite view of the Missouri court.

Showing Negligence

Under the common law in order for a workman to recover from his employer for a disease or infection he must show that it is the result of the negligence of the employer in (1) failing to provide him with a safe place in which to work; (2) with reasonably safe tools and appliances, and (3) failure to properly warn him of the danger of his employment if he is inexperienced or has no means of ascertaining the danger for himself. In order for the plaintiff to recover he must show above all else that the employer knew the dangers of the work or must have known them from his experience in the business. It is good law to say, under the common law at least, that an employer cannot be charged with knowledge of something that he does not know and of which he does not have the means of knowing. And unless the workman can show that the employer knew or must have known his claim will fail.

Diseases and infections are playing a more important part in our industrial affairs. It is not making too extravagant a claim to say that they will demand more attention in the next few years than they have had before and that they deserve more attention.

This is a class of industrial loss which will have to be given serious consideration by our courts and legislatures in the near future if substantial justice is to be done to the laboring classes. If the principles of our compensation system are to survive we must provide for the sufferer of occupational diseases.

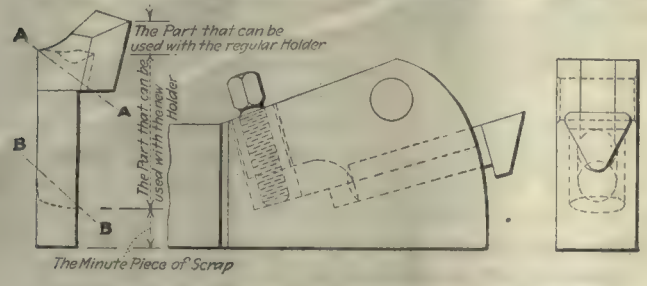


A Tool Holder for Using Up Worn-Out O.K. Tool Bits

By E. H. Kreider

Having accumulated a stock of worn-out high-speed-steel tool bits of the well-known O.K. type as a matter of economy I made a toolholder that will use them up to the limit. While the design is only in part original with me I find some very convenient points about it that I have not seen in other holders.

In the diamond-point tool here illustrated will be seen



HOLDER FOR USING UP WORN-OUT TOOL BITS

the part that can be used with the regular holder, after which it is ground off at *A* and inserted into the new holder as shown, where it can be used until only a minute piece of scrap remains as at *B*.

The cylindrical shank by which the tool is held can be left free and can be turned in the holder, thereby throwing the rake and clearance from side to side, making right and left tools out of the same bit without grinding the metal away.

Device for Gaging Cutters While Grinding

By John Miles

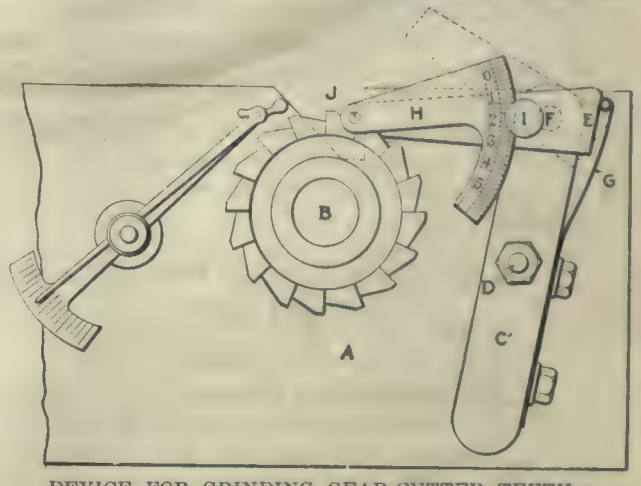
The sketch shows a device to be attached to a cutter-grinding machine for the purpose of grinding gear-tooth cutters correctly and for gaging and correcting such teeth as may be in error.

The plate *A* supports the cutter to be ground, which fits over stud *B*. This plate or the table to which it is fastened must have a movement to and from the center of the wheel, and the center of the stud *B* must be brought into alignment with the face of the grinding wheel and secured against movement in a direction parallel to the wheel spindle.

A piece of ¾-in.-square cold-rolled steel is attached to the plate *A* by the stud and nut *D* in such manner that while it may swing around *D* it may be held firmly in whatever position desired by tightening the nut.

A plate *E* about ¼ in. thick is pivoted upon *C* at *F* and tends to remain in one or other of two positions (as shown in dotted lines) by reason of the pressure of spring *G*, which is attached to the side of *C* by two screws.

A graduated sector *H* that can be fastened in any po-



DEVICE FOR GRINDING GEAR-CUTTER TEETH

sition within the length of its graduated surface by the knurled screw *I* is pivoted to the swing plate *E* by the stud *J*, which is riveted firmly to sector *H* and the lower end of which, projecting through *E*, is cam shaped, having a rise of about 0.06 within the limit of movement of the sector.

The indicator shown at the left is affixed to the table in such manner that its measuring point may be swung into the path of the cutter teeth and fastened while testing the tooth height.

With a cutter in place upon the boss *B*, the center of which has been accurately aligned with the cutting face of the grinding wheel, the cam-shaped lower end of the pin *J* projecting ¾ in. below the under surface of plate *E* rests in the tooth space back of the tooth to be ground.

The machine carriage is then moved forward until the wheel enters the tooth space of the cutter and the tooth face brought into contact with the wheel by moving the outer end of lever *C*. It will be seen that whatever this movement of the cutter may be, the tooth face will remain radial as the cutter revolves about the center of *B*, which is stationary in relation to the cutting face of the wheel.

When the first tooth has been ground sufficiently the nut *D* is tightened and the cutter is indexed around by

swinging plate *E* about its center stud *F* enough to allow the cam-shaped pin *J* to clear the teeth. This pin tends to fit snugly at the bottom of the tooth space by reason of the pressure of the spring *G*. If further grinding of all of the teeth is necessary the work is advanced by further movement of lever *C*.

The plate *E* is now swung outward to the position shown in dotted lines (where it will be held by the spring) and the indicator is brought forward to test the length of each tooth.

When a long tooth is found it is marked and moved to the grinding position. The sector *H*, which has thus far remained at zero, is released by turning back the binding screw *I* and the sector turned past two, three or more divisions as judgment may dictate, and again tightened. After grinding, the tooth is again tested with the indicator and the process repeated if necessary.

After one has used the instrument a short time a definite relation will be established in the operator's mind between the graduations on *H* and the corresponding reduction of the length of the tooth; the latter may then be made just right at the first trial. This relation would be very difficult to calculate, however, as it depends upon the amount of relief, which may vary with different cutters.

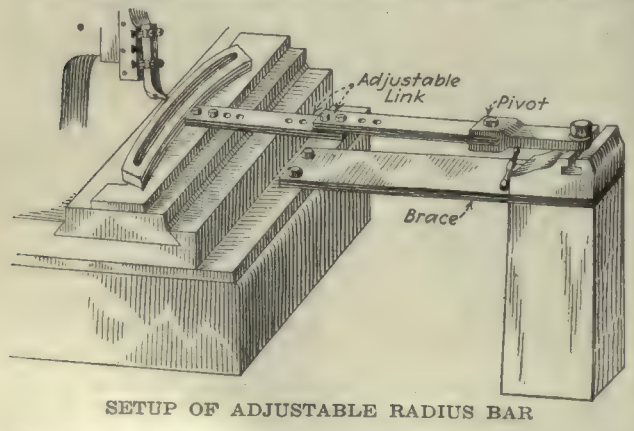
I have found that cutters may be ground to perfect concentricity by using this device much quicker than by the usual method of testing each tooth with a micrometer.

Adjustable Radius Bar for Planing Links

By Joseph Varhola

The sketch shows a slight modification of a well-known scheme for machining the reversing links of a marine engine when it is necessary to do this work in a small jobbing shop that is without special machinery for this purpose.

The slotting machine is used to do the work and the



SETUP OF ADJUSTABLE RADIUS BAR

feature to which I desire to call attention is the adjustability of the radius bar and the means provided for changing the center when adjusting for various radii.

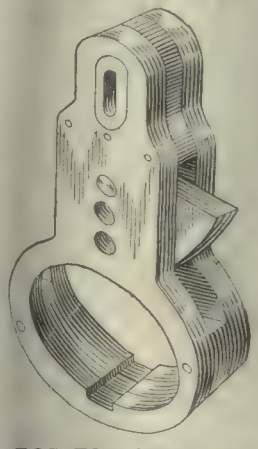
The circular and cross feed screws are removed from the slotting machine. A short piece of heavy timber is fastened to the floor at a suitable distance from the machine and on it is mounted the cross-slide of an old lathe that was out of service. A fork was made to go in the toolpost and a pin through this fork and one end of the radius bar was the center of the radius to be machined.

The radius bar was in two parts that were clamped together by bolts passing through slots near the middle of the bar. By loosening these bolts and turning the screw of the slide rest a very close adjustment could be made for any desired radius.

A Quick-Change Dog

By Leo Cohen

The device shown in the cut is intended for use on a grinding machine when there are large numbers of small pieces to be ground. It can be very quickly transferred from one piece to the next without the necessity for picking up a wrench or of transferring the loose piece of brass ordinarily used under a dog screw to prevent the latter from marring the work. It is made of two pieces of cold-rolled steel $\frac{1}{4}$ in. thick to form the sides, with fillers $\frac{3}{8}$ in. thick at each end, leaving a slot of this width through the middle. A casehardened cam piece moves in this slot, being swung from a pin which passes through the side pieces. Three or more holes are provided for this pin to adapt the tool to different diameters.



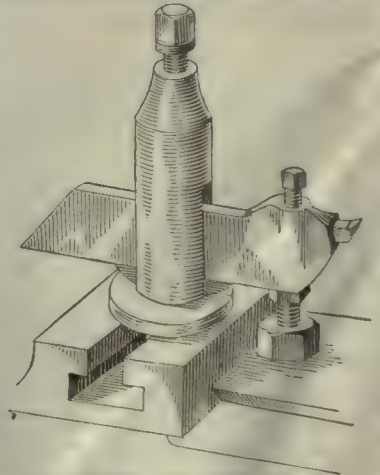
DOG FOR GRINDING MACHINE

An oblong hole is milled through the small end into which the driving pin enters to drive the work. The manner in which the dog drives the work is obvious.

A Scheme for Stiffening Cutting-Off and Threading Tools

By J. H. Spoor

Cutting-off and threading operations in the lathe are at best rather uncertain, especially if the material to be worked is machine steel. Both operations require a tool that is set almost exactly on center, and both operations are improved the more rigidly the bearings and slides are maintained. In either operation the tool is very liable to pick up a cut when it is not supposed to, and go to it with a vengeance that stops little short of a broken tool or spoiled work. When this work is to be done in a lathe with a compound rest, the little jack placed under the tool as shown in the cut will give it additional stiffness and aid the cutting action materially.



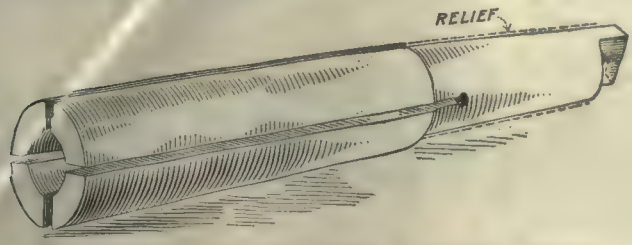
JACKING UP THE TOOL-HOLDER

Split Sleeve for Woodruff Cutters

By Oscar Craft

I have had some trouble in holding Woodruff cutters and have devised a scheme which I find to be much better than the drill chuck commonly used. This is a split sleeve made as follows:

Fit a taper sleeve to the collet that it is desired



SPLIT SLEEVE FOR HOLDING PARALLEL SHANK CUTTERS

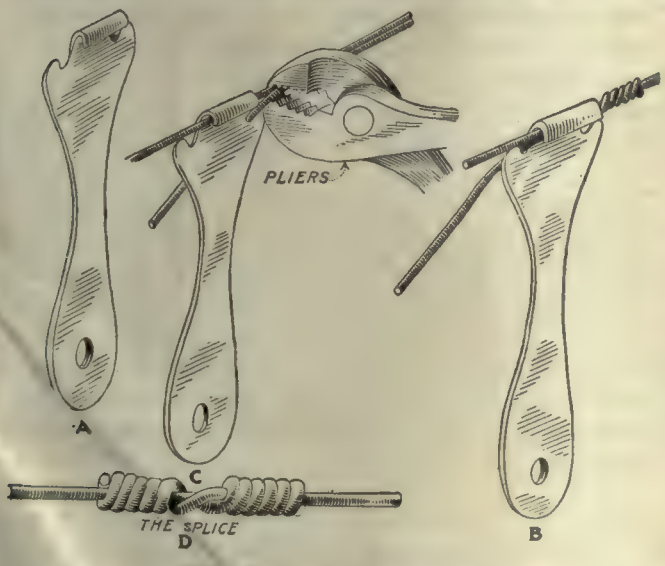
to use, and with it in place in the spindle in the milling machine carefully bore it to fit the shank of the cutter. Then with a slotting cutter make four cuts down the sleeve, as shown in the cut. The sleeve should then be relieved a trifle by slightly reducing its diameter between the bottom of the slots and the tang.

When the sleeve with a cutter in place is driven into the collet it will be held very firmly indeed. If desired a hole may be tapped in the small end, a hole drilled through the receiving collet and a draw bolt fitted, making it in effect a draw in chuck.

A Handy Wire-Splicing Tool

By Charles H. Willey

It is often necessary in the shop to splice the ends of two pieces of wire together, and when the wire is too stiff to be handled with a pair of pliers and the fingers such a tool as shown at *A* in the sketch will



TOOL FOR SPLICING WIRE

be found very efficient and handy. It is made of a piece of flat steel of $\frac{1}{8}$-in. thickness.

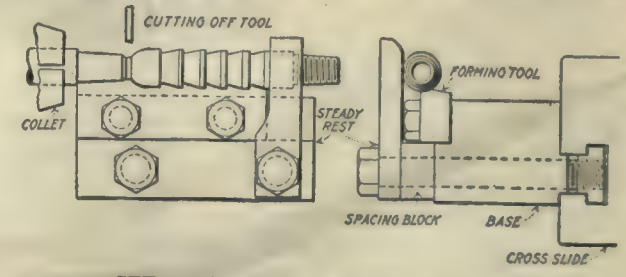
The two wires to be joined have their ends gripped parallel in a pair of pliers, and the tool used as shown at *B* to make the first seizing or winding. The splice is finished with the tool, as shown at *C*. The completed splice is shown at *D*.

A Steadyrest for a Screw Machine

By H. J. Gustave Kopsch

The cut shows a steadyrest which I designed for long, slender work in automatics and hand screw machines, and has given excellent service for months. It eliminates chattering, insures more uniform diameters on slender work, and does not interfere with tools in the turret or with operations such as drilling or tapping, which in some cases may be done at the same time as the forming operation.

The base may be used for many different shapes of forming tools if the two screw holes are properly located to have the forming tool rest against the shoulder. The steadyrest itself is hardened and polished on the bear-



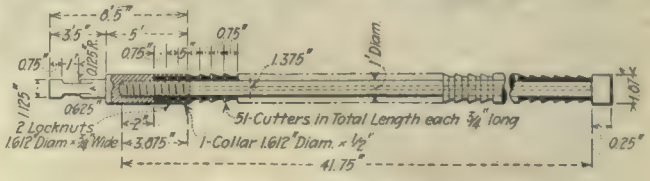
STEADYREST FOR SCREW MACHINE

ing surface. The main cause of dulling of the forming tool is the chattering of the work, and this is entirely eliminated. I have finished thousands of pieces at a much higher feed than before without regrinding the tool, and the security against the work riding up on the tool and the resultant breakage of drills, etc., is alone worth the slight expense of making it.

Any change in the diameter of the work is taken care of by simply using a thicker or thinner spacing block, as the case may be. This tool was first used on a Cleveland automatic, but it is useful on almost any hand screw machine. I believe it is a novel scheme, at least I thought of it only after having had much trouble with work of this kind, and I thought the idea might be of value to some of our readers who may have experienced the same trouble.

Long Built-Up Broach

Built-up broaches of the general design shown in the illustration are made in the shop of Armstrong, Whitworth & Co., Manchester, England. Any number of sections can be built up according to the work to be done. The cutting disks are of high-speed steel, each being $\frac{3}{4}$ in. thick. These are assembled on a crucible-



LONG BUILT-UP BROACH

steel arbor, being positioned by a key and secured by a plain collar and two locknuts, the pulling end of the broach being also made of crucible steel and screwing on to the threaded end of the arbor as shown. The broach illustrated has been tested at cutting speeds ranging from 19½ in. to more than 50 in. per minute; sixteen blanks, for instance, were broached at a speed of 50 in. per minute without effect on the broach sections.



"WE'RE AGIN

SOME months ago in New York City, and during the crowded hour on the elevated railroad, I saw two men form themselves into a human battering ram and thus gain toe room on the platform of the Ninth Avenue express. In so doing, they stepped all over each other, collided, impinged, bumped and otherwise impacted as is the necessity and custom.

Thus far the procedure was entirely regular. But what followed was not.

For the shorter and elder of the two, whose name was presumably Pat, took offense at the larger and younger individual, who was quite possibly called Mike, and thereupon burst into song.

I will omit the words of Pat's able effort and also the music, merely stating that it characterized Mike as "no gintleman, a wooden man," and one who ought to "fly for the Kaiser."

Mike, who had the appearance of a West End truck driver, evidently lacked in repartee, for he pondered this statement long and carefully. And then all unconsciously and unintentionally he gave birth to a psychological masterpiece of conciliation. "Fly for the Kaiser, is it? *Why, we're agin that gink!*"

Mike produced a common enemy and peace reigned once more on the platform. At the next station each of the former belligerents waited politely for the other to get off first.

* * *

There are plenty of common enemies on whom machine shops and machine-shop people of all ranks can unite without needing to resurrect the Kaiser. He's a dead one.

"We're agin the gink," for instance, who is a one-idea management fiend. The fellow who wants everybody else to do things the way he would do them if he ever did them.

These one-idea men started out to show Uncle Sam how to win the war—their way.

Their way consisted in following a certain ritual and constructing certain charts.

One of the brilliant contentions of these fellows was that plain figures are too old-fashioned and inadequate to show results. All manufacturers of material, therefore, were to be prohibited from reporting their weekly production in figures, and were to be compelled instead to draw a line upon a chart. Every week each manufacturer was to send his weekly chart to headquarters where it would pass through the hands of the official-chart corps for preliminary treatment.

These artists, or rather chartists, were to analyze and dissect each chart, gaze at each line upon it from various angles, and, from both near-by and from afar off, measure the spiritual essence of that line with their superior natural and cultivated chart instincts and then interpolate its hidden meaning into a superchart to go to the man higher up.

The man higher up was to permit the hidden meanings to penetrate his inner consciousness, fuse them with the fire of criticism, freeze them with his cold, analytical glance, extract from each line or cabalistic hieroglyph, its particular phase of influence on the winning of the war, and then combine these doubly hidden meanings into a master chart for the enlightenment of generallisimos and other high boys.

And after these master charts had been reverently brought into the presence of the one highest up he, being somewhat reluctant to admit himself unscientific in methods of management, and yet being in total darkness as to what it was all about, would have his secretary write upon these charts tiny, lead-pencil, old-fashioned figures showing what quantities each of the hieroglyphs were supposed to represent.



THAT GINK

Alas, that this should be not only a joke, but also a fact!

Uncle Sam fell for these one-idea men and let them exploit their theories at the expense of progress until things became so beautifully balled up that it was necessary to call for a new deal with the one-idea management jokers left out of the pack.

This is not intended as a wholesale condemnation of "scientific management." The work of Frederick W. Taylor was invaluable to industry because it made men *think* about management methods—something they hadn't been doing before.

And thinking about these things led to the improvement of management methods in general.

Taylor, being an instigator of thinking, was a common benefactor, whereas the management *faddist*, being a befuddler of thought, is a common enemy.

Time studies, for example, are invaluable when made by those who know what they are doing and why.

The Prussian Guards were wonderful examples of the result of the wrong kind of time and motion study—they could goosestep to perfection, but it didn't get them into Paris.

Men who are forced to follow the meaningless forms of a one-idea man's system of management have the same degree of enthusiasm in doing so as you or I would have if forced to practice the Buddhist ritual.

A man can't laugh in his sleeve at you and roll his sleeves up for you at the same time.

This gink that we're agin is not always a professional systematizer. Too often he is a manufacturer himself, who otherwise perfectly sane is a bit nutty, so to speak, on management theories.

Many a manufacturer who would never dream of exploiting a defective machine will fool himself into maintaining and exploiting a system of management that has four missing cylinders and a slipping clutch.

Whoever he is, he is a common enemy, for he smothers profits under a blanket of unnecessary red tape and at the same time invites the ridicule of his employees who know that he is fooling himself or being fooled.

The one-idea man is a public asset—when his idea is a big one and a sane one. He is a public liability when his idea is a fad.

During the coming months you will consider how you can make your management methods keep step with the coming period of progress.

Avoid fads and fancies.

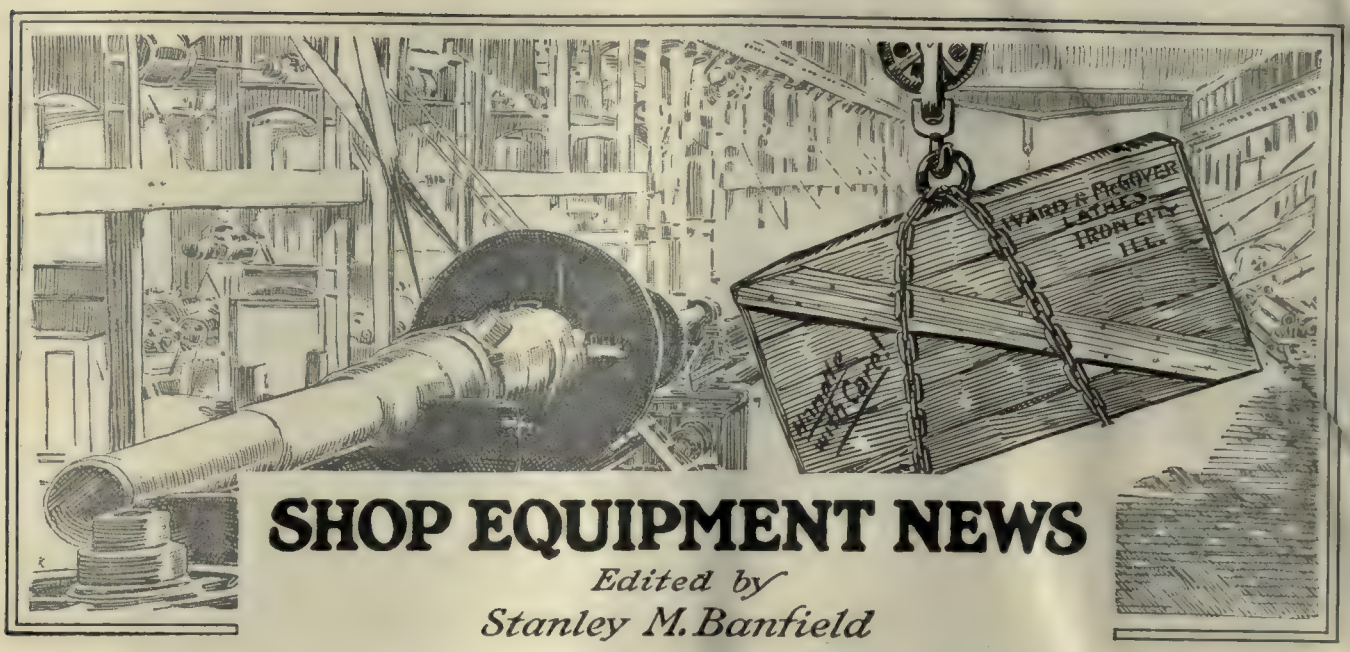
Don't stop with paying a systematizer for telling you the good points about the system he has installed in your shop. Pay the boys in the shop for telling you about its bad points.

Most of you who read this are living examples of what individualism plus American opportunity can accomplish.

Individualism is Americanism, and anything tending to destroy Individualism will destroy Americanism, whether that thing is misapplied management methods or labor communism or government paternalism.

Fads are in the discard today and facts in the ascendancy.

John H Van Deventer



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

In conformity with a Post Office ruling, descriptions of new equipment can only be used in this department which have not been previously or simultaneously advertised in this or any other periodical.

Ready Welded Tools

The Ready Tool Co., Bridgeport, Conn., is now welding high-speed steel to low-carbon steel for the purpose of making cutting tools or for other like uses. The illustration shows a counterbore made by this method, the

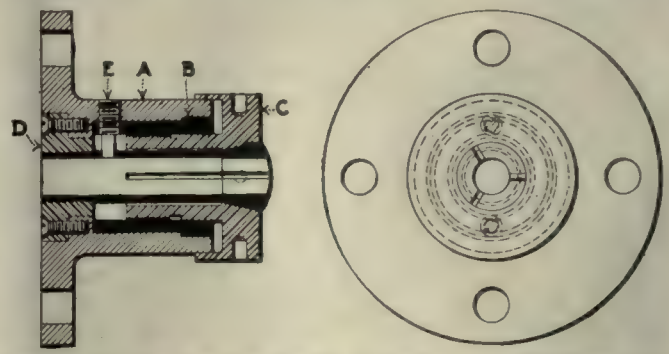


COUNTERBORE MADE BY THE READY ELECTRIC WELDING PROCESS

difference in color showing where the weld between the two materials occurs. The electric-welding process is used, and it is claimed that considerable saving is made by the use of the shank of lower-priced material and that considerable machining is saved. The company is prepared to do the welding and annealing for concerns that may desire to perform their own finishing operations.

Bemis Lathe Chuck

The collet chuck shown in the illustration is the product of the E. W. Bemis Machine Co., Worcester, Mass., and while primarily intended for a lathe chuck it is useful on other types of metal-turning machinery. A distinctive feature of the chuck is the method employed for operating the collet jaws, which have no longitudinal movement. They are held securely in the chuck body but do not ride upon it. The closing member rides upon the taper of the jaws in opening or closing them, and it is claimed that this construction makes for uniformity in the length of the work, which is of course a great advantage in cutting off stock. The chuck consists of a body *A* reinforced by the sleeve *B* which is threaded to receive the chuck-closing member *C*. This member is knurled for operation by hand, and is also provided with holes for a spanner wrench. The collet jaws, which are interchangeable for varying sizes of work, screw into the steel nut *D* and are held firmly in place by the headless setscrew *E*. In the illustration the chuck shown

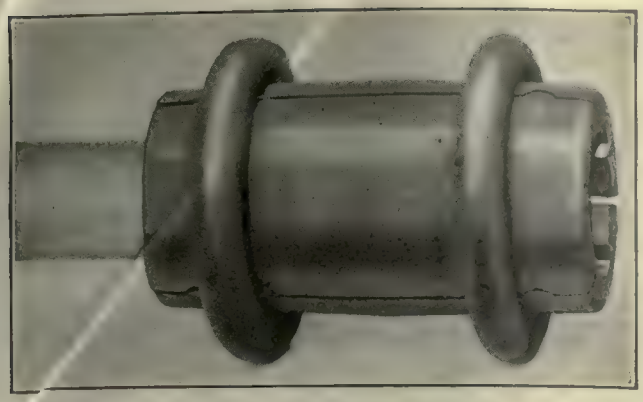


BEMIS COLLET CHUCK WITH FLANGE FOR BOLTING TO FACEPLATE

is flanged for bolting to a faceplate, but it is also made in a style suitable for screwing onto the nose of the spindle. It is furnished in two sizes, the smaller taking collets from $\frac{1}{32}$ to $\frac{1}{2}$ in. and the larger taking collets from $\frac{1}{16}$ to 1 inch.

Clark Compression Coupling

The illustration shows a new form of compression coupling that has recently been placed on the market by C. H. Clark, 60 Grand St., New York City. The entire device consists of three pieces, which are laid against the shaft, and two rings. The outside of the three pieces forming the main body of the coupling are slightly tapered and the two rings are driven on from either end, and compression is thus secured that is sufficient to hold the shafts firmly together. In installing these couplings sufficient space is left between the ends of the two shafts to allow the rings to be slipped be-



CLARK COMPRESSION COUPLING

tween and over them. It is also claimed that this coupling will line up the shafts. Additional compression rings can be used if desired.

Blomquist-Eck Horizontal Boring Mill

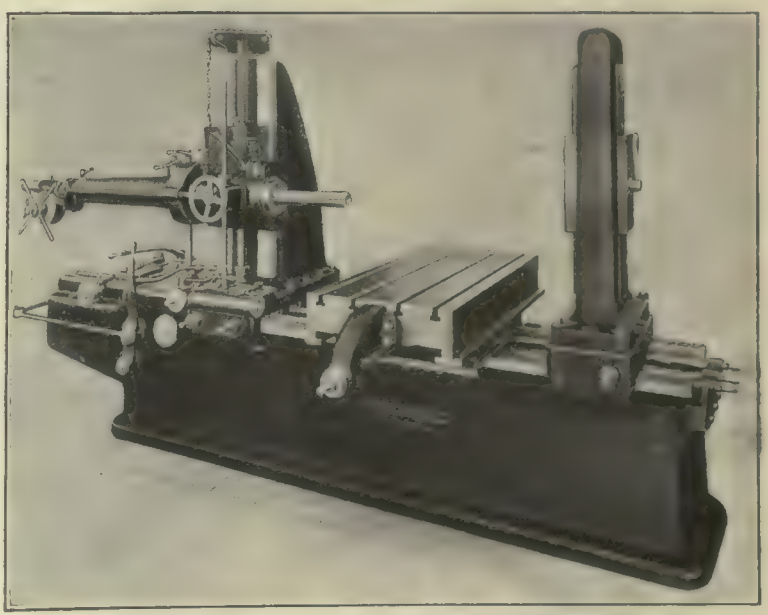
The Blomquist-Eck Machine Co., 1146 East 152d St., Cleveland, Ohio, has recently placed on the market the horizontal boring mill shown in the illustration. The new machine has been designed with a deep bed, or base, of box pattern, which it is claimed eliminates an inherent fault of most machines in that it provides an ample amount of metal directly under the column where the greatest stresses occur. It is also claimed that the speeds and feeds are such as to allow the most advantageous speeds and feeds to be used for any class of work that is likely to be handled. In building the machine a complete system of jigs, fixtures and gages is used, thus insuring interchangeability of parts. The various groups of mechanism form complete individual units, and any unit can be inspected, removed or replaced without disturbing the adjoining unit.

The bed, or base, is of box section cast entirely in one piece, the outer walls directly under the column being left intact without cored openings, a feature of construction that is said to add greatly in resisting the lines of stress. Chip chutes are provided, and these are so arranged that their walls give additional strength. The bed is reinforced directly underneath the column by sections tied together and cast integral with the base, the bed being further reinforced by heavy ribs running lengthwise and at right angles. The column is also of box section and is braced internally by ribs placed in both horizontal and vertical positions. The sides are tapered and flare out at the bottom, giving a large bearing on the bed.

The spindle saddle is designed with a long, narrow guiding edge with a single-screw, adjustable, taper gib for adjustments on one side and a square lock form with gib on the other side. The center of the spindle is placed close to the column face in order to avoid overhang, and the elevating screw is placed between the column faces and the spindle. The units comprising the spindle and saddle are counterbalanced by a weight within the column. High-carbon heat-treated steel is used for the spindle, which is ground its entire length and bored for a Morse taper. End thrust in both directions is carried on ball bearings. The spindle sleeve consists of a hammered, high-carbon steel forging ground inside and outside and provided with tapered adjustable bearings made of Government bronze. Either bearing can be adjusted to compensate for wear, and sight-feed oil cups are provided.

A shaft and a set of planed-steel bevel gears are used to raise the boring-bar support and spindle saddle in unison. The bar support, or bearing proper, may be securely clamped by a lever binding bolt in any position desired. The close-coupled drive-gear shafts are mounted on S.K.F. double-row self-aligning ball bearings. All shafts are made of high-carbon steel, and gears are of hardened steel-ring type, heat treated and shrunk on cast-iron hubs. The smaller spur gears of the drive are made of solid steel heat treated, while all bevel gears are planed from hammered-steel forgings. The speed changes are made by two levers at the front of the machine operating selective sliding gears. The entire driving mechanism is located in the base, and each individual shaft and bearing can be removed and replaced without disturbing any adjoining unit, access to the entire unit being had through the oil-tight top plate cover. All gears run in a bath of oil, and in addition a positive cascade oiling system is provided for both gears and bearings.

Feed to the spindle in either direction, to the spindle saddle in raising or lowering upon the column, to the table saddle parallel to the bed or to the table longitudinally upon its saddle, is introduced through direct positive gears in a manner similar to that used for the speeds. The shafts are of high-carbon steel mounted on



BLOMQUIST-ECK NO. 1 HORIZONTAL BORING MILL

Diameter of spindle, 3½ in.; travel of spindle, 30 in.; taper in spindle, Morse No. 5; number of speed changes, twelve, 16 to 196 r.p.m.; number of feed changes for spindle or table, 9; number of feed changes for spindle or table with back gears, 18; feeds, 0.003 to 0.518 in. per spindle revolution; working surface of table, 24 x 54 in.; automatic longitudinal feed of table, 36 in.; automatic traverse feed or parallel movement of table with bed, 37 in.; maximum distance from spindle nose to outboard bearing, 5 ft. 5 in.; maximum distance from top of plain working table to center of spindle, 27 in.; maximum distance from top of bed to top of table, 10 in.; diameter of constant-speed friction drive pulley, 14 in.; width of driving belt, 4 in.; speed of friction driving pulley, 350 r.p.m.; weight, crated, 11,600 lb.; horsepower recommended, 5; motor recommended, constant speed, 900 to 1200 r.p.m.

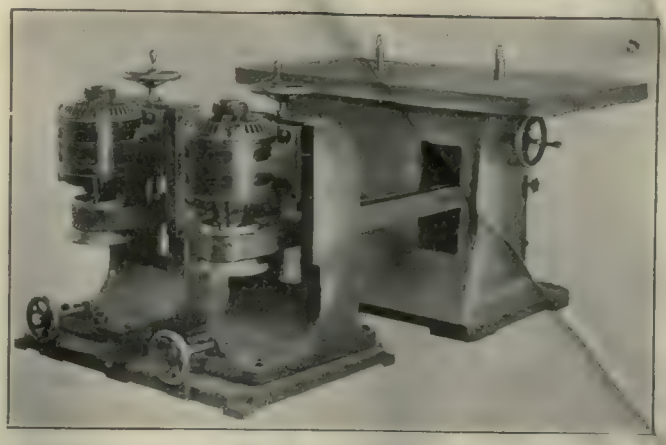
S.K.F. ball bearings. The gears are of steel, heat treated. The entire feed mechanism is located in the base, and any unit may be removed and replaced without disturbing any adjoining unit. All gears run in a bath of oil, and in addition a cascade oiling system is provided for bearings and shafts. The feed changes are made by means of two levers placed directly in front and at the top of the gear box, there being three selective interlocking levers provided in addition, which engage either the spindle, vertical or table feeds. No two conflicting feeds can be engaged at the same time, and for operating star-feed facing heads or work of similar nature all feed levers can be positively locked in a neutral position. Convenience and safety for the operator are provided by placing all controlling levers at the front and high enough so that there is no occasion to stoop or reach beyond the normal working position.

The bed surfaces have been so designed and proportioned that the use of a long, deep saddle to compensate for any overhang of the table at the extreme front and rear positions has been made possible. When in either of the extreme positions the table is supported in the saddle for practically three-quarters of its entire length, the saddle being gibbed to the bed by the square-lock method having a long, narrow guiding edge with a taper gib for adjustment. The table is reinforced by ribs, is provided with T-slots and is gibbed to the saddle by the square-lock method. A friction-type power rapid traverse is provided for all members operated by the feed, and this operates at one rate of speed in either direction. It is instantly engaged or disengaged without disturbing the original feed setting, and the clutch control is so sensitive that it is said that practically any amount of travel can be had. An adjustable safety friction leather washer in the clutch mechanism prevents damaging any portion of the mechanism engaged. Hand feeds are provided for the spindle travel or movement, table saddle and table in addition to the automatic feeds, all screws being fitted with graduated dials.

A single friction clutch pulley drive operating at constant speed is furnished as regular equipment, but constant or adjustable-speed motor drive can be furnished if desired, as can also any type of electrical control, such as manual, automatic or push button. Attachments such as circular swiveling table, auxiliary table and star feed are furnished as extras if desired.

Oliver Motor Drive for Double-Spindle Wood Shaper

The Oliver Machinery Co., Grand Rapids, Mich., has placed on the market a new compact motor drive for double-spindle wood shapers, the new drive making use of standard vertical motors. As shown by the illustration a separate motor is used for each spindle, each motor being mounted on vertically gibbed ways, adjustable by means of a handwheel and screw so that the motor can be located at the correct height, as shown by the scale and as called for by the height of the spindle to suit the work. Each motor stand is independently adjustable to and from the shaper to adjust the tension of the belt. Another advantage is that either shaper spindle can be run independently. It is said that the new arrangement takes up less room on the floor because the distance required between centers is only 5 ft., making the actual floor space about 7 x 5 ft. The arrangement makes use of standard vertical motors, doing away with the need of specialized built-in motors, and can be adapted for new shapers and also for those already in use. The motor-starting unit may be of such a type as is desired.



OLIVER MOTOR DRIVE FOR DOUBLE-SPINDLE WOOD SHAPER

Lindblad "Adlight"

The jointed electric-light fixture shown in the illustration is one of the recent products of K. F. M. Lindblad, 65 Sudbury St., Boston, Mass. It is particularly designed for work in the shop or for other places where it is desirable to move the light around considerably in order to locate it at the most convenient point. The device is made of ⅜-in. square steel tubing, the links swinging alternately sidewise and up and down and the cord being run on the inside. The device is 42 in. long, but can be readily extended if necessary by the use of a piece of ordinary ½-in. iron pipe. It will be noticed that there are no slide points, wire loops or thumbscrews, it simply being necessary to take hold of the light and push it to the position desired.



LINDBLAD "ADLIGHT"

Carnegie Electric Tool Steels

The Carnegie Steel Co., Carnegie Building, Pittsburgh, Penn., has recently placed on the market a new line of electric carbon tool steels, these being made in five grades ranging from 70- to 130-point carbon content. These steels are made up in a considerable variety of sizes and shapes as are generally required for machine-shop tool work.

RECONSTRUCTION NEWS

TIMELY INFORMATION for LIVE MACHINE SHOPS



DURING the 19 months, April, 1917, to November, 1918, the United States was a belligerent in the world war, says the chairman of the Federal Trade Commission. American industry and finance passed through an ordeal that brought both strength and weakness into sharp relief. Before this nation could strike its full stride things were reduced to rather elementary and primitive terms. Much of mystery and of pretense was swept away. Out of it all must come to those in varied pursuits and walks of like a charity and understanding, one with the other, based on fuller knowledge.

During these 19 months the Federal Trade Commission had a peculiar opportunity to sense what was going on, especially in the industrial world. It has been the cost-finding agency of the Government; the expert accountant to the War Industries Board and its price-fixing committee; to the Army, the Navy, the Food Administration, the Fuel Administration, the Railroad Administration, the Shipping Board, the Post Office and other agencies.

Lessons of War Cost Finding

It is to be remembered that cost finding and price fixing were two entirely different functions. One was a striving for exact fact through painstaking study and labor; the other, building on this fact foundation, was a matter of discretion, of judgment, of accommodation to seen and unseen forces and an effort to distribute equitably the hardships inevitably resulting from the dislocations of war.

In its cost-finding work the Federal Trade Commission of necessity had to search into the very vitals of industry. Some took this as a matter of course, appreciating at once the end in view. For some other industries, however, such intrusion into the privacy of business was met at first with reluctance and misgivings. For the latter this attitude quickly changed, however, and these industries also welcomed and aided the commission in its work. At the end it can be said that there remains no suspicion that a single business secret has been betrayed. Costs were obtained from whole industries, sometimes involving in a single inquiry the examination of the books of thousands of companies. These results were brought together and presented without disclosing the identity of individual figures except to the responsible officers of the Government and after opportunity for scrutiny by each concern of the processes and results as to its own case.

Thus came confidence and understanding where impersonal discharge of duty was met with candor. The vast majority of patriotic and enlightened men of affairs welcomed every effort to steady and stabilize industry as it gathered its vast powers to ride the red seas of war and to deliver the tremendous blow against the enemy.

Before this country entered the war, and therefore before war powers could be exercised in control, a huge and false price structure was built up, and in spite of all that could be done it became more aggravated. Cost of living and wages went upward as prices rocketed. That price structure and its attendant inflations to-day are among the chief perils of the reconstruction period. That they are no greater can be attributed almost wholly to the coöperation of industry in the program of price fixing which checked, so far as possible, mounting prices and for the time negatived price based solely on supply and demand.

One great handicap lay in the fact that basic natural resources had been appreciated in value before the price-fixing function came into operation. European belligerents had for three years been bidding frantically for the treasures that nature had placed under our stewardship, and as a result our raw materials had been hugely written up before the United States entered the war. So when price fixing was undertaken it started from inflated value for undug ores and coal; untouched petroleum and uncut forests. Despite this false start and the difficulties that flowed therefrom, cumulating in all subsequent industrial operations, price fixing did stabilize industry and insured it against ruinous collapse at the end of the war.

Costs for 10,000 Industries

It is estimated that in its work for various Government agencies the Federal Trade Commission obtained cost and production figures of upward of 10,000 companies in scores of important industries and many minor ones which had an approximate aggregate investment of $20,000,000,000 and the commodities directly affected by such cost findings represented annual sale values of at least $30,000,000,000, not far from twice the amount of the First Second and Fourth Liberty loans taken together.

These cost studies by the commission demonstrated frequent and great deficiencies in the accounting methods employed by mining and manufacturing concerns, especially in cost-accounting methods. In some

of the oldest and greatest industries there was not even an attempt at that determination of unit costs and profits by products which is essential generally to the safe conduct of industry.

It is evident that where such cost accounting is not established it should be introduced and where it is defective it should be reformed. Inventories should be carefully kept; labor and material used should be accounted for as used; indirect and overhead charges should be fairly allocated and proper allowance made for depletion and depreciation of resources and plants. On the other hand capital charges for construction should not be mingled with operating or production expense nor should there be introduced items of actual or imputed outgo, such as income and profit taxes, depletion of appreciation of plant investments or interest on capital owned.

Business World Wants Correct Costs

However where complete records are kept it is relatively easy to correct bad principles, reject improper items or introduce omitted ones. Inventories and records of expense and sales by products are necessary to compute profit and loss by products.

The business world, well aware of the extent to which defective cost-accounting methods prevail, is alert to promote reforms. A few years ago the Federal Trade Commission initiated an effort to be helpful in this direction and applied to the Congress for funds to carry it on. As these were not given the movement lagged, but as a result of the commission's enforced studies and as a byproduct of its war work that effort may well be profitably and economically resumed. If the earlier effort of the commission could have gone forward before the war the Government would have been repaid many times over during the war through making it possible to ascertain costs much more expeditiously and cheaply.

In the immediate future the question of costs will be especially critical for the nation's business in arriving safely at post-war readjustments. The matter is important to the individual producer, to his banker and to the industry and the public at large.

The cost and profit findings of the commission developed many facts of interest, but was done under such pressure that there has been little time as yet to analyze or interpret the results. Two facts, however, which are generally known, may be mentioned. First, the average cost during the war period was much higher than before the war; such increases were frequently as much as 100 per cent. Second, the variation in costs between different companies, often considerable in normal time, was enormously exaggerated under war conditions.

The great increase in average cost was due in part to increase in cost of the instruments of production and material and supplies; to increased cost of labor partly through increase in wages, but more through violent and frequent shifting of labor and a consequent loss of the efficiency that springs from organization, habit of work and special skill; to wastes caused by effort for increased production and, of course, to the general depreciation of money in terms of goods or services. The cost of living continued to mount rapidly, and with it wages and labor cost.

Fundamental to the cost increases, however, was the writing up of values of natural resources. This tended to bring about the production of raw materials from relatively barren or inaccessible sources with a consequent diversion of labor, capital and transportation to uneconomic operations. It is doubtful whether high prices did really stimulate production to the degree that has generally been believed.

Where there were successive stages of production in an industry (sometimes integrated and sometimes independently operated) the costs were increased by the taking of high profits between the successive stages of production. High costs or high profits, or both, in one stage had a cumulative effect on costs in all succeeding stages—a sort of pyramiding of cost. Price fixing arriving too late to get at the source of the trouble in the short space of the war, was useful in checking its unlimited extension.

The abnormal variation in costs came largely from the bringing in of uneconomic supplies of raw materials and the writing up in value of advantages by integrated concerns and those controlling natural resources. Congested transportation and dislocations of labor with the consequent irregularity of industrial operations also made for wide cost variations.

In considering such variations, however, it should be borne in mind that the lower-cost company may not be more profitable than the higher-cost producer even when both sell at the same price. Often the lower cost is the result not of greater economies or natural advantages but of investment in more stages of production or in more extensive mechanical equipment, and the larger unit profit resulting from the lower cost is absorbed in providing the proper return on the greater unit investment.

Discussing Actual Costs

Not the least benefit of cost finding incident to price fixing was the bringing together, with Government officers, of the representatives of the industries for full and frank discussion of costs, methods and products. This, with the assembling of such a body of current data as was never before had in this country, demonstrated the value of such meetings and of the preparation and exchange of such proper and useful information.

It would seem that the commission might well continue, at least as to certain industries, this assembling and distribution currently of basic and reliable information, and that, well within the law, industry, meeting with Government officers, might continue to exchange helpful experiences and information without the danger of being suspected of price fixing or other restraints of trade.

If certain laws enacted to deal severely with admitted abuses are fully observed in their spirit in this manner it would seem that the public interest would be fully served. In such case a peace-time adaptation of the war-time meetings between individuals and Government for frank discussion, would be as helpful as it would be innocent of wrong intent or harmful effect. Such open conferences might be expected to serve all the good and necessary ends which are among those sometimes sought by clandestine meetings. Pursued in the generous American business spirit of fair play such confer-

ences might be extremely useful by ascertaining the facts and clearing away doubts and suspicions.

From the experience of cost finding we believe we may argue for: (1) Standardized accounting systems suited to the various industries; (2) cost and profit accounting for individual products; (3) reasonable standardization of products and elimination of excessive costs due to unnecessary multiplication of styles and types; (4) compilation and issue of current basic trade information; (5) conferences between industries and Government for the exchange of proper and useful views and information.

As for the outlook there need be foresight but no fear. A period of readjustment must be met with the new and broader view. The same coöperation of industry, of labor, of capital and of Government that armed the nation for war will make it still greater in peace.

Readjustment Period

As a nation we organized lines of supply and communication from Chile and Australia and Alaska and from every state and every farm and factory, and through these lines across oceans and continents to the battle front of France. As a nation we arrived at a power to dispatch a ship loaded with men and food and supplies on the average of every 10 minutes night and day, Sundays and holidays. As a nation we launched ships at the rate of 490,000 gross tons a month, or about 700 tons every hour, on the average. As a nation we armed and sent across the sea our young men, true crusaders of democracy, at the rate of 10,000 a day. As a nation we threw upon liberty's altar billions and billions of dollars in loans—about $500 at every tick of the clock, day and night, Sundays and holidays.

Such a nation, as a nation, may turn with confidence to the solution of whatever problems of industry or finance which the future may hold in store.

Locomotive Repair Work

One of the bright spots in the railroad administration is the Mechanical Department Circular No. 6. This has a direct bearing on the repair of locomotives which gets it directly back to the machine shop and the machine tool. We shall never know how many hundreds of thousands of dollars it has cost us to save a few thousand dollars' worth of oil on our locomotives during the past 20 years when the oil-saving craze has been upon us.

This points out that:

> Investigation has developed that in many instances locomotives are not properly lubricated, which in addition to increasing coal consumption also causes excessive wear on cylinders, cylinder packing, valves and valve chambers as well as on piston-rod and valve-stem packing.
>
> It has been found that this is due on some roads to the practice of draining lubricators of all oil upon their arrival at the terminal and putting in the exact amount allowed for the trip before leaving. If excessive switching is necessary during the trip, or if any other unusual delays occur, or if the oil feed is not so regulated that it will last during the trip the locomotive is often operated to the terminal with cylinders not lubricated. Cases are also found where on account of this practice yard engines are worked for hours without cylinder oil. This practice is extremely expensive.
>
> Lubricators should be filled before locomotive leaves terminal and sufficient oil should be carried on the locomotive to provide against any necessity for damaging cylinders, valves, packing or other parts of the machinery during the trip. Piston-rod and valve-stem packing should be properly lubricated and a suitable swab provided to retain the oil. Enginemen will be held responsible for the proper use of all lubricating oils furnished them.

It appears to be the consensus of opinion that one outlet for the surplus capacity of the United States is in the direction of foreign trade, and with that in mind T. C. Powell, special representative of the United States Railroad Administration with the War Industries Board, is addressing a large number of the firms which in the course of the past year have had relations with the War Industries Board, to establish a point of contact between the United States Railroad Administration and the exporters and importers of the country, to ascertain whether the administration can be of any substantial assistance.

The Port and Harbor Facilities Commission created by resolution of the United States Shipping Board in May, 1918, has been for months collecting all the information available with regard to facilities at the ports, and is coöperating with the Railroad Administration in preparing other data for consideration.

Any information regarding the foreign trade of the machine industry will be of service in this connection. Coöperation is necessary for success in this work.

Hobbing Wormwheels Without Gashing the Blanks

By Oscar Craft

I recently had occasion to set up the milling machine to hob a number of wormwheels without gashing the blanks in the usual manner.

The hob is placed on the arbor as near to the column of the machine as could be done without making the work interfere, and farther out on the arbor is mounted one of the regular change gears of the milling machine. This meshes through a suitable intermediate train with a gear upon the wormshaft of the dividing head.

The number of gears (odd or even) in the intermediate train depends upon whether the wormwheel to be cut is right or left hand, while the ratio of the driving to the driven gear is a result of the circular pitch of the wormwheel and the reduction gearing in the dividing head. This latter is usually 40 to 1, and as the wheels under discussion had 48 teeth, the gears I used were 40 to 48.

The intermediate gears must be mounted on a swinging link to compensate for the slight up-and-down movement of the knee when setting the hob into the work, and this can easily be done by fitting a piece of 1 in. x ½-in. cold-rolled steel to turn freely upon the outer end of the dividing-head shaft, drilling the bar at the proper places for studs on which the intermediate gears are mounted, and connecting the outer end of this bar to the milling-machine arbor by a link of suitable length which has a hole in one end to fit a collar on the arbor while the other end swings about a pin in the end of the bar.

Theoretically of course there is a slight relative rotation of the work, which is mounted upon a mandrel between the centers, when the knee is raised to the cut, but this movement is so slight that it may be disregarded.

Announcing a New Member of the McGraw-Hill Family

On March 1 of this year a new member of the McGraw-Hill family of engineering publications will make its initial appearance. It will be a monthly technical magazine issued in Spanish under the name *La Ingenieria Internacional*, and will serve the particular engineering requirements of Latin America and Spain.

This new periodical is the outcome of a natural evolution and has been under consideration for some years. Its purpose is to afford a medium for the presentation of those developments in American engineering which will be of value to Spanish-speaking enginers, contractors and manufacturers whose occupations call for a more diversified application of engineering than can be covered in a technical journal having a strictly specialized industrial field. At the same time the best engineering practice in Latin America, Spain and other Spanish-speaking countries will be reflected in the columns of *La Ingenieria Internacional*, so that, as the name implies, the reader of this magazine will have at hand a symposium of engineering methods representing the latest and best of all countries.

This new engineering journal will be an important medium in the development of international good-will and at the same time a medium by which American manufacturers engaging in export trades can carry their message to prospective buyers in foreign lands, reaching a class of people that has not been reached even by the extensive foreign circulation of the existing McGraw-Hill papers, which are confined to the English language.

La Ingenieria Internacional will be more than a general engineering publication. It will be a highly specialized journal of general engineering, particularly designed to serve those portions of the world which are newly developing and where the engineer, the contractor and the manufacturer must turn his hand to many lines. The field of this paper is entirely distinct from that of the *American Machinist* or any of the McGraw-Hill journals, which will continue to be the leading exponents in the English language of the latest and best in American engineering practice.

Draftsman or Engineer?

By E. A. Dixie

I thoroughly indorse M. E. Duggan's sentiments expressed on page 1088, Vol. 49. I have not done much designing during the past 15 years or so, but recently I had occasion to design a small machine. The first thing I did was to get the mechanism down on paper. This done I took my drawings to a patternmaker only to find that he was working on Government work and could not handle the job. The rest of the patternmakers in town were just as busy, so I decided to make the patterns myself.

Up to this time I had merely satisfied myself that the machine would function properly. For the time being I was merely a draftsman—the parts would work properly and would not interfere. But as soon as I assumed the rôle of patternmaker I saw that slight changes in the drawing would greatly reduce the cost of the patterns and expedite their completion. By the time I was partly finished with the alterations to the drawings it suddenly struck me thuswise: "Making patterns that can be molded is not the patternmaker's job. The efficient patternmaker should make the patterns so that they will not only mold but mold easily."

There is a core at that part of the pattern. The core is there because there is an undercut that will not draw. Can the undercut be dispensed with without impairing the functioning of the machine? If it can be dispensed with we can also eliminate core prints and core boxes, the casting can be made in green sand and no cores will be necessary. When I got thus far it struck me again: "There's a whole lot to this designing job," so before going further with the work I made my patterns in my mind, molded them in my mind and in my mind carried them to a mental machine shop so that I could mentally discover what troubles I would run into when I had all the castings made.

I found in this case that they would be easier to machine than they would have been if made as originally intended. This is usually the case, and should be so; the job that has enough clearance to pull out of a mold should be easier to machine.

Very few of us are clever enough to be experts at more than one branch of the machine business, but before a man is entitled to dub himself a designer he should have a good working knowledge of patternmaking, molding and machine work, so that he can determine the least expensive way, and whether simplicity of pattern or foundry work will compensate for complexity of machine work or vice versa.

Help in Solving Industrial Problems

That the pressing problems of industrial management have shifted from methods to men is seen on every hand. This has developed a new angle to management, and realizing the need for experienced council in this line the Industrial Relations Service, Ltd., has been formed with offices at 50 East 42nd St., New York, to act as adviser in all kinds of industrial differences or, better yet, to advise before the differences arise at all.

The organization is comprised of a group of men who have had diversified experience in this field, and include George E. Holmes as president, Joseph A. Holland vice president, William J. McDermott and Charles R. Chase. Of these perhaps Mr. Holland is best known to the machine industry, having been connected with the National Metal Trades Association, the General Electric Co., the Remington Arms Co. and the American Sugar Refining Co. in charge of employment in its various branches.

Such an organization can be of great value in preventing labor turnover and discontent by pointing out to managers who have not studied the human element or the changing conditions of employment.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



At present there are 350 concerns, employing about 200,000 men and women, engaged in supplying accessories for aircraft in the United States.

The minimum number of acres on which two, three or four plow tractor outfits may be expected to prove profitable, according to tractor owners, is 130, 170 and 210.

There are in the United States about 130 manufacturers making about 200 varieties of tractors. The engines used in these tractors vary from one and two cylinders, with bores of about 10 in., up to eight cylinders of 3½-in. bore by 5-in. stroke.

Australian commercial and financial interests are formulating plans to connect Australia with London and other sections of the British Empire by commercial airplanes. A company has been formed to finance the survey of an aerial route to London by way of Sydney and Port Said.

The tendency among German airplane designers to return to the monoplane for certain uses is apparent. As near as can be ascertained there are two types of monoplanes in existence in Germany, namely, the Junker, having a stationary engine, and the Fokker, with a rotary engine. Monoplane-seaplanes, the fuselage of which is above the wings, have been used by the German navy. These seaplanes attain a speed of 100 knots.

Military planes flying above an altitude of 10,000 ft. are equipped with an apparatus for supplying oxygen to the flyers. It was proved by the English air casualties that 90 per cent. of the accidents was due to the flyers suffering from lack of oxygen. The device was designed by Lieutenant Colonel Dryer of the British R. A. M. C., and works under variable tank pressure from 100 to 2250 lb. per square inch with a temperature range of from 70 deg. to 80 deg. F. to 20 deg. or 50 deg. below zero. The first of these devices was made by De Lestany, Paris, and an original model was brought to this country to start quantity production. Under the direction of Brig.-Gen. T. C. Lystor of the Medical Research Board and the Bureau of Aircraft Production over 5000 have been manufactured and accepted by the Government up to date, and over 3600 have been shipped overseas.

Comparison by the United States Aircraft Board between the manufacturing prices of the Liberty motor and some of the best European motors demonstrated that the European engines would approximate $10,000 an engine, while the Liberty engine of greater horsepower, which was produced originally for $6000, is now $5000.

Appropriations for keeping the roads clear of snow in New Jersey will be made by the various boards of freeholders. Motor trucks with snow plows attached will be used. In rural communities a 3-in. layer of snow will be allowed to remain to facilitate the running of sleighs; in thickly-settled communities the roads will be cleaned entirely.

The United States Navy Department purposes a system of aerial defense of the American coast line by erecting 90 hydroplane stations between the Atlantic and Pacific coasts and will include Panama, Hawaii, Guam, Alaska and the Philippines. Hydroplanes with a speed of 160 miles an hour and dirigibles of the Zeppelin type will be used for patrolling. The cost is estimated at $85,769,300 for the next fiscal year.

The latest Benz airplane motor has aluminum pistons and an adjustment on the carburetor for flying at high altitudes. The motor has an offset crankshaft that has for a long time been common in German and Belgian construction. Offsetting the crank has the effect of decreasing the guide pressure of the piston and cylinder and lengthening the stroke of the piston, as the offset is increased with any given crankpin circle.

To illustrate that highway transportation is vital to the nation's business S. W. Feim of the Automobile Chamber of Commerce gave some interesting examples before the Society of Automobile Engineers. In Iowa the International Harvester Co. laid out several motor-truck routes around Mason City, ranging from 90 to 150 miles in length, to demonstrate that a rural motor express is a paying proposition. Afterward a company was organized with a capital of $50,000 by leading business men of Mason City and the lines taken over. Between Indianola, Iowa, and Des Moines freight is being carried by motor truck for $17.35. The same load by railroad costs $23.41. The load was handled five times by railroad and only twice by truck.

The Pierce-Arrow Motor Car Co. is making a six-cylinder 24-valve engine, using it on the new passenger cars known as the Series 5. The advantages put forward are greater volumetric efficiency, smaller valves for the same area, increased time of maximum opening, cleaner scavenging due to the elimination of pockets and reduction of carbon deposit. Each cylinder has two exhaust and two intake valves 1¾ in. in diameter placed in the throat, having a ⅜-in. lift and giving the same areas as a 3-in. diameter valve with the same lift. With this arrangement of the valves on a T-head cylinder it was necessary to adopt detachable heads. This is believed to indicate the tendency in motor design for the immediate future.

The British De Haviland single-seater scout is a biplane with a single pair of struts. Both planes have a span of 25 ft. 8½ in. and a chord of 54 in. A dihedral angle of 172 deg. is formed by the wings, which have no sweep back. The lower planes have a uniform angle of incidence of 2½ deg., while the upper plane has 2 deg. near the center section and 2½ deg. at the tips. The machine is driven by a 110-hp. La Rhone rotary motor manufactured by the Darracq Motor Co., London. Its performance, according to the British official rating, is as follows: Endurance at 10,000 ft., including climb, 3 hours; ceiling, 16,000 ft.; speed at ground level, 109 miles an hour, and at 10,000 ft., 102 miles an hour; climb to 10,000 ft., 12 min. 4 seconds.

At the present stage of peace conditions airplane manufacturers are divided into two sets—those who are turning at once from war work to peace work with the immediate prospect of expanding their business, and those who will not put their peace-time projects into immediate effect because they expect, for a few months at least, business will be slow on account of the termination of Government contracts, the high rate and uncertainty of wages and the high prices of material. With the cancelling of Government contracts, especially in those plants that in normal times were not interested in airplane building, a large amount of capital became tied up in raw material unsuited for the general market. Many of these concerns expect that the financial adjustment with the Government will be long delayed, in the meantime tying up their capital so that they cannot resume manufacturing operations to any extent.

SPARKS FROM THE WOR

E. C. PORTER,

The Utilization of Surplus Army Supplies

Division of Military Aeronautics Does Valuable Work in Reclaiming Duplicate Material

The Division of Military Aeronautics has turned up since Aug. 6 surplus supplies worth $10,000,000, and its examiners have not yet finished their task. The supplies listed include typewriters, motor cars, motor trucks, oil, lumber, wood, iron and steel working machines, motorcycles, building material, airplanes and about everything in the accessory line from screw-eyes to stove bolts.

The official name of the body engaged in this pursuit is the Surplus Inactive Supplies Service, Purchase and Storage Branch, Purchase, Storage and Traffic Division of the General Staff, and it has branches in nearly all bureaus of the War Department. Its object is to utilize duplicate supplies purchased through the unavoidable lack of organization in the emergency at the beginning of the war. These surplus supplies are listed, and through a system of trade, transfer and sale they are either used in the department or sold.

Since Aug. 15, the Division of Military Aeronautics has sent out lists of 1200 different surplus items, including more than 50,000 separate units valued at over $3,000,000. Each of the 75 branches in the division was asked what articles it wanted, and so far 532 orders for over 30,000 separate units, at a value of $750,000, have been received. The work of transferring this material to the various subdivisions is now under way, and will continue until the supply of all branches is reduced sufficient for three months in advance.

Already the division has turned over to the Surplus Inactive Supplies Service of the General Staff property amounting to $2,087,341 which none of its own branches could use. Some of the larger items on this list were 150,000 gal. of oil, worth $75,000; 417 typewriters, valued at $25,000, and 200 tons of hay, valued at $3000.

Another class of surplus supplies now being inventoried includes parts for 3500 French Gnome airplane motors listed at the time they were ordered in this country by the French High Commission at $10,500,000 but which now must be sold as junk for from $25 to $120,000 a ton. There are 2000 tons of these motor parts. This motor was at one time one of the most popular in France, but owing to the advance in design it has become obsolete. Very few of these motor parts are finished. Some are yet in steel billets; some are finished as high as 90 per cent. and some as low as 5 per cent.; some have been boxed and sent across seas. All will now have to be scrapped. Eventually they will be paid for by the French government, the money being advanced by the United States.

With these Gnome motors will go 300 Penguin training planes, now obsolete, worth $750,000, and 128 L. W. F. airplanes worth $1,427,000. In this collection will also be 1500 J. N. 1 airplanes valued at $9,000,000, also now obsolete, and 500 additional motors valued at $750,000.

Other material found and immediately put to use was 4,500,000 ft. of ⅝-in. rope. The present demand for this article is very large, and specifications were changed in order to take advantage of this "find." This ⅝-in. rope was substituted for ½-in. rope and the 4,500,000 ft. put into equipment for squadrons overseas, effecting a saving of $75,000.

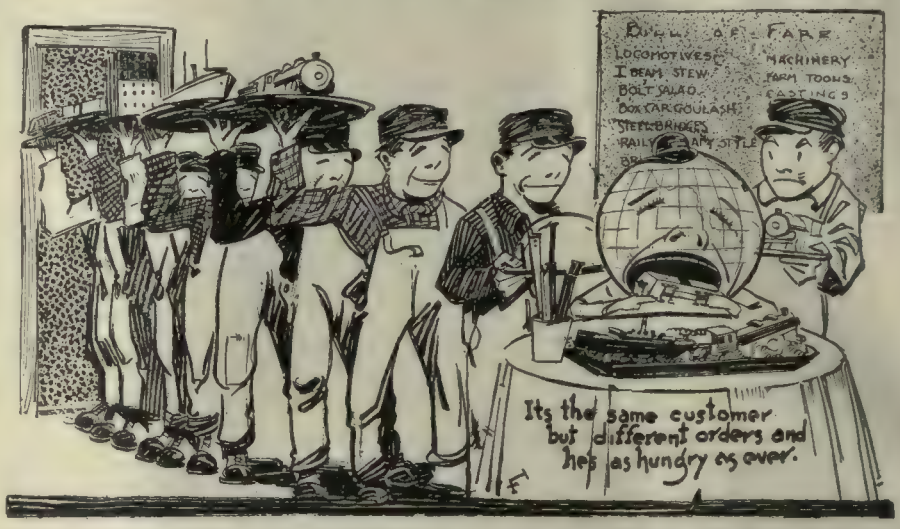
Another consignment of goods put to use consisted of 500 pairs of field glasses, worth $37,500, found in a supply depot at Omaha. Other supplies amounting to $75,000 were discovered and shipped overseas.

At the Middletown, Penn., depot 9000 gal. of "dope," a preparation for airplane-wing fabric and worth $47,500, was located and used.

Seven carloads of iron, steel and woodworking machinery were found in a supply depot at Hampton, Va. In one of these cars was a wire-testing machine badly wanted in France. Five thousand steel drums wanted for oil containers were discovered in private storage, and while they were not the property of the Government nevertheless they were put into immediate use and the owner was afterward paid.

War Machinery Diverted into Peace Industry

The Waterloo Gasoline Engine Co., Waterloo, Iowa, had just completed the installation of $150,000 worth of special machinery for war work when its contract with the Government terminated. J. E. Johnson, the general manager, says that notwithstanding the setback the plant will be operating at its full capacity by Jan. 1 on gasoline engines and tractors. The company employs more than 1200 workmen.



* * *

Work for Handicapped Men

A recent canvass made of the Ford Motor Co. plant at Detroit gives the following information as to the work that handicapped men can do:

Jobs that could be filled by legless men, 670; by one-legged men, 2637; by one-armed men, 715; by totally blind men, 10. The time required for cripples to become expert at these jobs is estimated for 1743, one day or less; for 1461, one day to one week; for 251, one to two weeks; for 534, one month to one year; for 43, one to six years.

About 18 per cent. of all the employees at the Ford plant are said to be cripples or physically substandard. Eighty-five per cent. of them, however, are classed as fully efficient workers.

* * *

Cost of the World's War

Figures of the war's cost to the world compiled by the Federal Reserve Board show that the approximate public debt per capita had increased from $60 before the war to almost $400 at the end of July. To this is to be added the cost since July.

LD'S INDUSTRIAL FORGE
NEWS EDITOR

Crowell to Direct the Distribution of Surplus Army Property

Benedict Crowell, Assistant Secretary of War and Director of Munitions, has been requested by the President to assume responsibility for the proper disposition of all property acquired by the War Department since Apr. 6, 1917. Mr. Crowell has appointed C. W. Hare, Assistant Director of Munitions, to have general supervision of this work, and Brig.-Gen. C. C. Jamieson has been appointed Director of Sales in direct charge of an organization to be perfected for the disposal of surplus army property.

Policy and procedure upon which sales will be made is being formulated by the Director of Munitions, the Assistant Director of Munitions and the Director of Sales. It is the intention of the Director of Munitions to so market Government property as to interfere as little as possible with business conditions, and to this end the Assistant Director of Munitions and the Director of Sales will, as occasion may require, confer with committees representing the industries affected.

Any information in connection with the various problems involved will be furnished by either the Assistant Director of Munitions or the Director of Sales at their offices in the Munitions Building, 19th and B Sts., Washington.

Personals

W. P. SPARKS is now with the Cleveland Milling Machine Co., Cleveland, Ohio, as its representative at Indianapolis, Ind., with office at 316 Terminal Building.

SAMUEL MOORE, who was formerly general manager of the Bond plant of the American Radiator Co., has recently been made general superintendent of this company.

PHILIP M. HATHAWAY is now chief engineer of the National Lead Co., Crooke Works, Brooklyn, N. Y. He was formerly with the International Register Co., Chicago, Ill.

GEORGE H. JOHN, JR., at one time planning engineer of the Stokes & Smith Co., Philadelphia, Penn., is now instructor in mechanical engineering at Columbia University, New York.

JOHN G. SHIRLEY, assistant works manager of the Gilbert & Barker Manufacturing Co., Springfield, Mass., has been appointed production manager of the S.K.F. Ball Bearing Co., Hartford, Conn.

STEPHEN H. PAINTER is now special representative of the Ingersoll-Rand Co., in Chile and Bolivia. He was formerly with the company in New York as manager of the Calyx drill department.

H. W. CLARKE, recently connected with the McGraw-Hill Co. at Chicago, has been made advertising manager for the Chicago Pneumatic Tool Co., Chicago, Ill. Prior to his connection with the McGraw-Hill Co. he spent eight years with the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

H. C. WHITE has been appointed factory manager of the Harris Manufacturing Co., Stockton, Calif., manufacturer of gasoline, combined grain, rice and bean harvesters. He will enter on his new duties on Jan. 1. During the last three years Mr. White has been engaged in reorganizing the plants of the Holt Manufacturing Co. at Stockton, Calif., and at Peoria, Ill.

Will You Provide the Job?

¶ "Have you a job for a man who is trained for it?" is the question the Federal Board for Vocational Education is now asking the employers of the United States. "The Government will do the training. Will you provide the job?"

¶ It is the intention of the Government to assist in placing each disabled soldier and sailor, regardless of his handicap, in suitable civil employment. The men are not to be dealt with from the viewpoint of giving them special "soft jobs." On the contrary, the employers of America are requested to consider their employment as a business proposition. An effort will be made to place each man in the occupation in which he is most interested, provided it is neither waning nor overcrowded.

¶ How this is to be accomplished is discussed in a monograph, "What the Employers of America Can Do for the Disabled Soldier and Sailor," copies of which may be obtained from the Federal Bureau for Vocational Education, Washington.

Business Items

The Peninsular Machinery Co., Detroit, Mich., formerly located in the Kerr Building, has moved to larger quarters at 279-281 East Jefferson Street.

The Trueson Steel Co., Youngstown, Ohio, has expanded its field of activity and is going into the manufacture of all kinds of pressed-steel parts and equipment. It is in a position to give valuable suggestions for work of this kind and will welcome an opportunity to investigate a possibility for all such equipment and parts.

American Machine Tools in the Export Field

Our Goods Are Now Favorably Known Abroad, and for Years to Come Foreign Demand Will Be Immense

"It has been conclusively demonstrated that machine tools form a considerable portion of the backbone of war," say A. R. McEwan, manager of the machinery department of Gaston, Williams & Wigmore, Inc. "American machine tools have proved their unquestionable superiority, and American manufacturers were early called on to supply the sudden and increasing demand caused by the war.

"Already taxed to the utmost new and enlarged demands were made upon them when this country became a participant in the war. The governmental requirements had to be satisfied first. This naturally brought about curtailment of foreign shipment through licensing exports.

"What should be of the most vital interest to our machine-tool manufacturers right now is the future of American export trade. Our excellent sales and distributing efforts since the war began and the advantages thus gained should be safeguarded by continued aggressive and intelligent tactics.

"The end of the war will leave vast stretches of Europe broken and devastated. Present indications are that France will regain Alsace and Lorraine. After peace is concluded she will then be the richest country in iron in all of Europe. Her great coal fields are not far distant from her iron deposits either. Rehabilitation will be undertaken at once beyond doubt. Belgium also will have to be rebuilt and reëquipped. This will mean great demands for our machine tools. Other territories will also require our products in similar increased volume.

"What condition will the American machine manufacturers face when this era of reconstruction and rehabilitation has begun? This is the period that should be anticipated by America and a keen survey made of the foundations for future trade that were laid in that period of our war-time prosperity. It has required scant salesmanship to market machinery and machine tools during this time. They have been eagerly sought by the foreign buyer at a time when merit of workmanship and design were of least importance and when most anything was apparently good enough to send abroad if prompt delivery could be made. This was fortunately the viewpoint of only a limited number of manufacturers.

"Numerous American machines have

been sold that in other times could never have found a foreign buyer. This is one unfortunate circumstance that may prove a boomerang to some lines of American-made machines and machine tools. True this is an unpleasant feature, but facts might as well be faced courageously if errors are to be righted and permanent progress made.

"There are many other lines of machines that have not suffered through the questionable practices of short-sighted manufacturers, and these lines will certainly reap a golden harvest through preference when normal conditions prevail again. Through all the stress of rush production it has been they who have maintained that high quality for which American machinery has been famous for many years.

"There are many lines of American machine tools that have met with world-wide success because of their greater range of usefulness and adaptability than those of European design. Interchangeability of parts has also been a decided factor in our success. This feature has been met abroad, so is no longer our exclusive advantage. In future we will have to depend on our equipment for quantity production, our wealth of material and our positive quality to overcome the competition whose natural keenness has been made sharper by war-time stress.

"Many of our manufacturers have added vastly to their production equipment in order to meet war demands. What is to happen to this when the war absorption ceases? Are our American manufacturers going to reduce their output and allow capital invested in costly plants to remain unproductive? If so it will only add heavily to the cost of the diminished product, and this would eventually prove industrial suicide.

"The evidence at hand points to the belief that they will seek to maintain the maximum output through extending their marketing facilities. This will reduce unit-production cost and enable them to enter the foreign markets better equipped to meet and defeat competition.

"There are other handicaps to our foreign trade. We have to consider the cost of ocean freights. These will diminish with resumption of unhampered sea traffic, but it will require a long time to resume prewar conditions. Distance from some of our markets and added cost of delivery and delay will also prove burdens to us.

"Briefly the whole American machinery and machine-tool situation can be summed up as follows: Our goods on the whole are now favorably known abroad. For years to come the foreign demand is going to be immense. We can hold the trade won during the war and win more in constantly increasing volume if we do those things which are so plain any and everyone should see. Whether or not this is done depends absolutely upon the foresight, courage and ambition of the majority of American manufacturers."

Obituary

A. R. GORSLINE, for the last 12 years president of the Cochrane-Bly Co., Rochester, N. Y., died at his home Nov. 25, 1918, after a brief illness.

Mr. Gorsline was born at Parma, N. Y., Jan. 27, 1858, and went to Rochester with his parents when he was 13 years old. After completing his education in the public school and high school of that city he went to Auburn State Prison to look after a contract his father had with the state.



A. R. GORSLINE

He remained there about three years and then spent two years in New York in the stationery business, afterward returning to Rochester to enter the Bank of Monroe, where he remained until this institution was merged into the Commercial Bank. About that time his father was owner of a flour mill in Rochester, and due to failing health Mr. Gorsline took over the management of the mill, which he ran successfully for a number of years. On the death of his father Mr. Gorsline disposed of the mill and entered the Cochrane-Bly Co.

When the European War broke out Mr. Gorsline saw the situation in its true light and expressed the opinion more than once that it was the duty of American manufacturers to furnish England and France with the material they so urgently needed, and on the entrance of the United States into the war his attitude was that we were civilian soldiers and that we should coöperate with the Government to the best of our ability. His own extreme efforts during the past four years undoubtedly hastened his death.

Mr. Gorsline had many friends in Rochester among the machine-tool builders and allied trades, and was actively connected with the Rochester machine industries.

Trade Catalogs

Grover File Handles. The Grover File Co., Nashua, N. H. Booklet. Pp. 8; 6¼ x 3½ in. This booklet gives a number of illustrations of file handles of various sizes and includes a description and price list of same.

Tilting Reverberatory Melting Furnaces for Non-Ferrous Metals. W. S. Rockwell Co., 50 Church St., New York. Bulletin No. 36. Pp. 8; 8½ x 11 in. Illustrates and describes furnaces ranging from 500 to 2000 lb. in capacity. A table of standard sizes of hand-operated types, and a table of specifications are given.

Bright Annealing Furnaces. W. S. Rockwell Co., 50 Church St., New York. Bulletin No. 37. Pp. 4; 8½ x 11 in. This bulletin illustrates the type of furnace used for annealing copper wire and similar products without oxidation. It contains a number of halftone illustrations showing the various uses of these furnaces.

Vul-Cot Fiber. American Vulcanized Fibre Co., Equitable Bldg., Wilmington, Del. Catalog. Pp. 16; 6 x 9 in. A number of illustrations of the manufacture of Vul-Cot fiber, which is used for machine parts and many articles of commerce, are shown.

Stock List of Cutters. The Cleveland Milling Machine Co., Cleveland, Ohio. Booklet. Pp. 48; 3¾ x 6 in. Illustrating the plain-milling cutter, side-milling cutter and spiral-shell end mill; angular cutters; spiral-cut, straight-shank and slotting end mills; metal saws, gear cutters, etc. A table shows the kind of steel, diameter, width of face and various other information.

New Publications

The Style Book of the Detroit "News."—Pocket edition; 92 pages. The Evening News Association, Detroit, Mich. Edition limited to 1000 copies.

This book presents its subject in a concise, clear and forceful manner; in fact it has gone its name one better, and is really a guide book. It gives the aim of the *News* in the first chapter, and under various heads, choosing them at random, may be found instructions to reporters and copy readers; on diction and grammar, and a short dissertation on the law of libel. There are also blank pages for notes. The style recommended by the work is about as consistent as it is possible to make any style, considering the number of authorities that the English language is blessed or cursed with, as one likes. If those that aspire to write will "read, mark, learn and inwardly digest" the advice given in this little work they will avoid many of the outlandish expressions so commonly used and that mean nothing. A. L. Weeds is the editor of the book, though he acknowledges the help he has received from various sources in its compilation.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary. 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Burring, Countersinking and Chamfering Fixture
Skelton Sales Co., Syracuse, N. Y.
"American Machinist," December 19, 1918



An automatic fixture for burring, countersinking or chamfering light work after it leaves the automatic screw machine and intended to be attached to any small drilling machine. The tool-carrying fork and the cam for closing the jaws on the work are integral, the amount of tension on the work being governed by the spring operating on the fork. The machine is at present made in two sizes, No. 1 having a jaw capacity for parts up to ⅜ in. in diameter, the length of the pieces handled being from ⅛ to 1½ in., and No. 2 a jaw capacity up to 2 in. in diameter, taking pieces from ⅛ to 2 in. long.

Welding Compound for Stellite, "Tip-it"
Haines Stellite Co., Kokomo, Ind.

"American Machinist," December 19, 1918

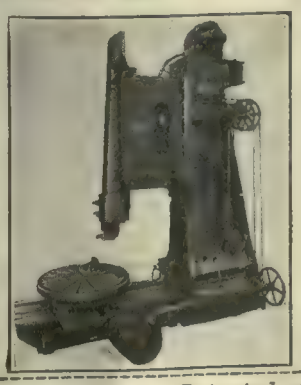
Welds can be made with the ordinary forge, coke, gas or oil furnace so long as it is possible to obtain a heat of 2000 deg. F. The compound is adapted for welding Stellite to steel, and in this work the shank is recessed to fit the Stellite bit, and the two are placed in the fire and brought to a temperature of about 1600 deg. F., at which time they are removed, the scale scraped from the shank and a thin layer of compound spread along the recess for the bit. The bit is then put in place and the heat is brought up to about 1800 to 1850 deg. F., when the compound will begin working in the joint. When a heat of 1900 to 1950 deg. F. is reached a fine bluish flame will appear from between the Stellite and the steel. When this condition is reached the tool is removed from the fire and a pressure brought to bear along the length of the bit, this pressure being of about 50 lb. per square inch. After this pressure is applied the weld is complete.

Countershaft, Portable with Motor Drive
Presto Machine Works, 124 Pearl St., Brooklyn, N. Y.
"American Machinist," December 26, 1918



The base is a heavy iron casting provided with a bracket to carry a ¼- or ⅓-hp. motor. This is plugged directly into the lighting circuit, the switch being conveniently located high up on the column, which is of heavy iron pipe, and at the top is a bracket with idlers and driving pulley as shown. The outfit complete weighs approximately 75 lb., and can readily be moved from machine to machine where required. It is sufficiently heavy to stand where put without lag-screwing to the floor.

Planing Machine, Upright Generating
Newton Machine Tool Works, Inc., 23d and Vine Sts., Philadelphia, Penn.
"American Machinist," **Dec. 26, 1918**



These machines are built in sizes of 36- to 72-in. stroke. The rams are counterweighted and have square bearings in guides provided with taper adjusting shoes. The vertical clamping surfaces are solid and steel faced and are equipped with suitable toolholding clamps. Beneath the rams are mounted the steel swiveling relief toolbox aprons, which can operate in any position in a complete circle. Motion is transmitted from the driving motors to broad-faced steel racks on the back of the cutter bars through all-steel spur reduction gears. A sensitive stroke-control disk has been incorporated, the trips on which can be operated by hand while the machine is in motion.

Shaping Machine, Crank, 16-Inch
Sellew Machine Tool Co., Pawtucket, R. I.
"American Machinist," December 19, 1918



Length of stroke, 16 in.; automatic cross-traverse, 21 in.; vertical adjustment of table, 12 in.; top of table, 13¾ in. long 12¾ in. wide; side of table, 13¾ in. long, 12¾ in. wide; vertical or angular movement of tool slide, 3¼ in.; greatest distance from bottom of ram slide to top of table, 15 in.; capacity of swivel vise, 8 in.; vise jaws, 10 x 1¾ in.; width of belt, 3 in.; weight with countershaft, 2300 lb.

Graduating Machine, Automatic
Noble & Westbrook Manufacturing Co., Hartford, Conn.
"American Machinist," December 26, 1918



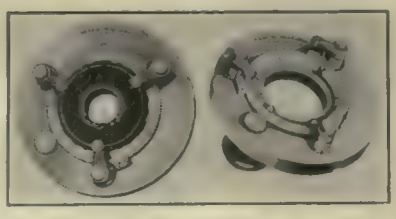
Intended for graduating work where speed and accuracy are required. The machine is power driven and automatic, the handling of pieces to and from the machine being the only labor required. The work is held in proper relation to the die with accurately cut gears, and the depth of the impression is controlled by a foot lever, a cam and a weight. An adjustable stop is provided for regulating the depth of graduation. The machine is made with steel spindles and adjustable bearings and is controlled by a clutch on the spindle of the driving die.

Tool-Marking Outfit
J. M. Waterston, 77 Woodward Ave., Detroit, Mich.

"American Machinist," December 19, 1918

This manufacturer has recently placed on the market a convenient tool-marking outfit consisting of a steel scriber, a bottle of varnish, a bottle of etching fluid, a bottle of cleaning fluid, a brush and full directions for etching names or other desired marking on steel tools.

Chuck, "O. G." Bevel Gear
Garrison Machine Works, Dayton, Ohio
"American Machinist," December 26, 1918



For the rapid chucking of bevel gears true with the pitch diameter and for the grinding or remachining of holes or other integral parts. No measuring, truing up, indicating or experience is required, the gear simply being placed in the chuck and the knob at the back turned, this clamping the gear automatically in position. This knob turns all the clamps simultaneously into radial position over the gear and then clamps them. Unequal pressure on the clamps is avoided, as they are brought down on the gear with a light coil spring, which is located inside of the hollow stud on which the clamp is mounted. The device can be furnished for spur, helical or skew bevel gears and pinions.

Patented, Aug. 20, 1918

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.27	$4.245	$4.20	$4.17	$4–4.04	$4.27	$4.20
Soft steel bars	4.17	4.145	4.10	4.17	4–4.04	4.17	4.10
Soft steel bar shapes	4.17	4.145	4.10	4.17	4.14	4.17	4.10
Soft steel bands	4.77	4.995	...	...	...	...	...
Plites, ¼ to 1 in. thick	4.52	4.495	4.45	4.42	4.39	4.25	4.45

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.67	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.52	6.495	6.445	6.00	6.45	6.52	6.445
*No. 26 black	4.60	6.42	6.395	6.405	5.90	6.35	6.42	6.405
*Nos. 22 and 24 black	4.55	6.37	6.345	6.295	5.85	6.30	6.37	6.295
Nos. 18 and 20 black	4.50	6.32	6.295	6.245	5.80	6.25	6.32	6.245
No. 16 blue annealed	4.10	5.72	5.695	5.645	5.20	5.65	5.72	5.645
No. 14 blue annealed	4.00	5.62	5.595	5.545	5.12	5.55	5.62	5.545
No. 10 blue annealed	3.90	5.52	5.495	5.445	5.05	5.45	5.52	5.445
*No. 28 galvanized	6.05	7.77	7.745	7.695	7.25	7.70	7.77	7.695
*No. 26 galvanized	5.75	7.47	7.445	7.395	6.95	7.40	7.32	7.395
No. 24 galvanized	5.60	7.32	7.295	7.245	6.80	7.25	7.47	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 13%	List plus 25%
Cleveland	List plus 11%	List
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.30	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
⅛, 5/32, 3/16, ¼, 5/16, ⅜ No. 8, 7/16 and No. 10	25.50 to 33.00	1/16 by 12 in. long	14.00
½		1/16 by 19 in. long	12.00
No. 12		⅛ by 19 in. long	10.00
5/16, No. 14 and 7/16		¼ by 21 in. long	10.00
No. 18		* Special Welding Wire	
No. 20		⅛	33.00
		3/16	30.00
		¼	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼, and ⅜	47%	20½%	¼ to 1½	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	¼ to 1½	36%	21%
½	48%	35½%			
¾ to 1½	52%	39½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	40%	28%	41%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	36%	25%	37%	23%	37.1%	23.1%

Malleable fittings. Class B and C, from New York stock sell at list +15%. Cast iron, standard sizes, 5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.00*	26.00	23.50
Tin in 5-ton lots	72.00	83.00	86.00
Lead	6.50	8.55	6.50
Spelter	8.40	9.50	7.75
ST. LOUIS			
Lead	6.15	8.25	6.38
Spelter	8.05	9.25	7.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	38.00	38.00	35.00	38.00	35.00	36.00	35.00
Copper wire (carload lots)	35.00	35.00	36.00	35.00	31.00	33.00	33.50
Brass sheets	39.75	39.75	35.75	40.50	34.00	33.50	35.00
Brass pipe	46.00	46.00	38.50	42.50	46.50	44.00	41.00
Solder (half and half) (case lots)	55.00	58.00	40.50	47.00	43.25	56.00	41.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

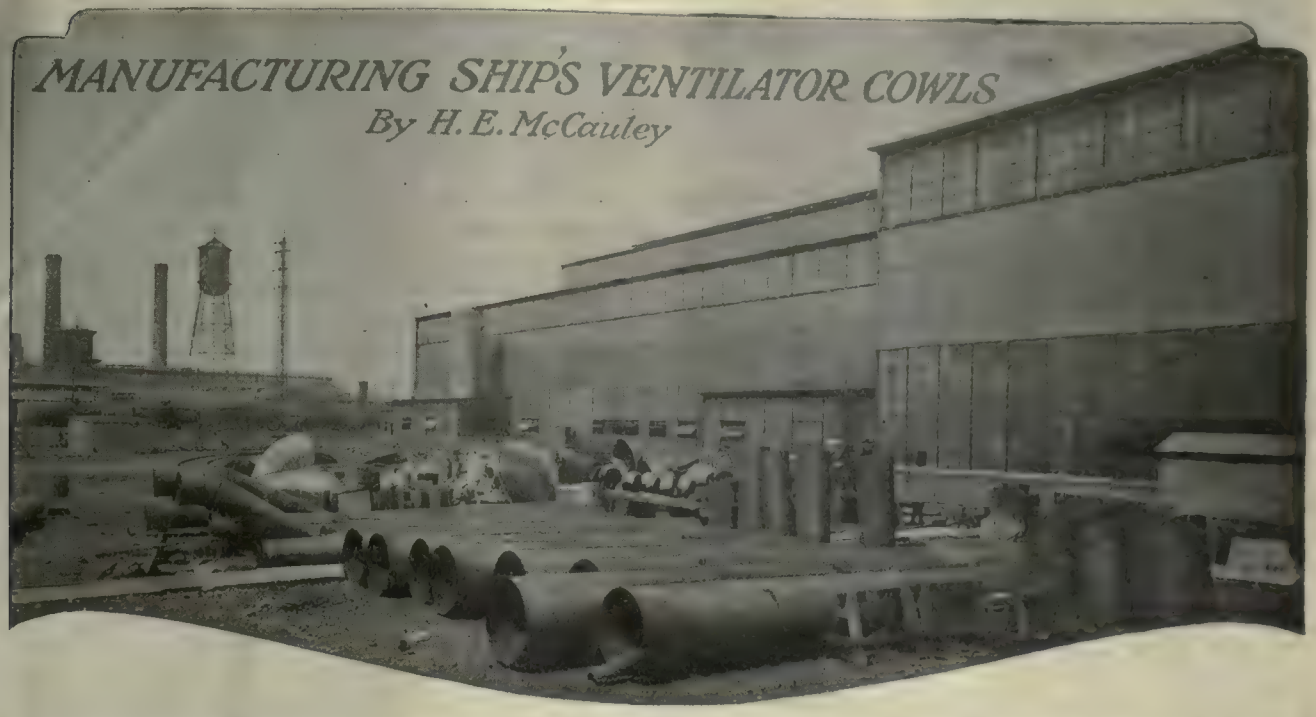
BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$36.00	$29.00
New York	38–40	30.00
Cleveland	38.50	34.00
Chicago	29.50	37.00

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MANUFACTURING SHIP'S VENTILATOR COWLS

By H. E. McCauley



Sheet-metal work is an important item in the construction and equipment of the modern steamship. Parts shaped by hammering are perhaps the most difficult to produce. This article covers in a general way the sheet-metal shop of the Sun Shipbuilding Co., Chester, Penn., and specifically the manufacture of American-type ventilator cowls. The following matter was especially prepared by the foreman of the sheet-metal department for the American Machinist.

ONE of the editors of the *American Machinist* recently told me that the Sun Shipbuilding Co. made the "cleanest, neatest, slickest" ventilator cowls he had ever seen and asked me to tell how it is done. So here goes:

Very few outsiders have any idea of the enormous amount of sheet-metal work entering into the construction and equipment of the average ship. The articles made of sheet metal for use on shipboard are many and various. Some of the parts of this material, such as liners for bearings, are simple flat pieces of sheet metal or brass and require very little skill to produce. Others are more complicated and require considerable skill not only in their making but in laying out the patterns or templets that are used to expedite their production in quantities.

In the headpiece, Fig. 1, is shown a view of the exterior of the sheet-metal shop and storage space for some of the finished work for which at that time there was no room under cover. Unfortunately the illustration does not convey the storage space as it appeared to me at the time the photograph was taken. The air ducts in the foreground are up to 3 ft. in diameter and the two large ventilator cowls at the back of them stand 8 ft. above the ground. The wide variety of work is also not conveyed by the illustration. There are ventilators by the dozens, with mouths from 12 to 84 in. diameter, oil tanks, waste cans,

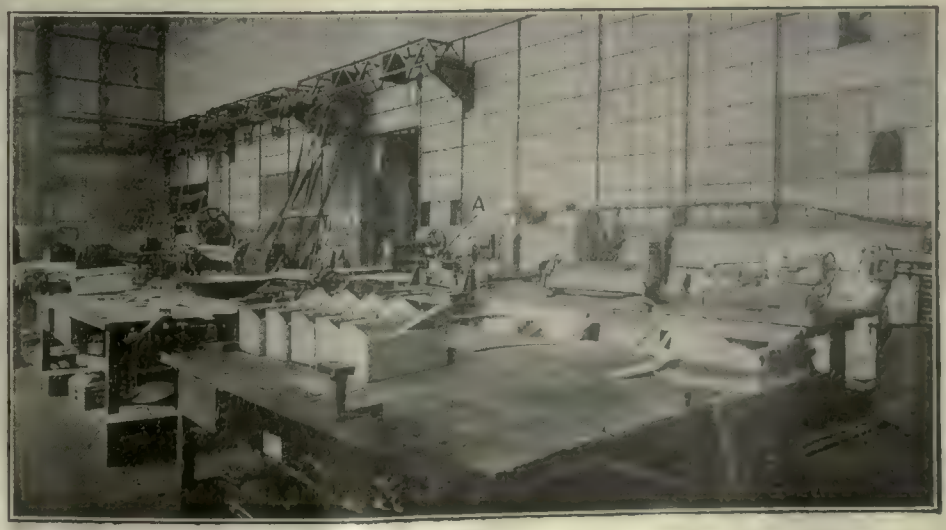


FIG. 2. PART OF THE SHEET-METAL DEPARTMENT

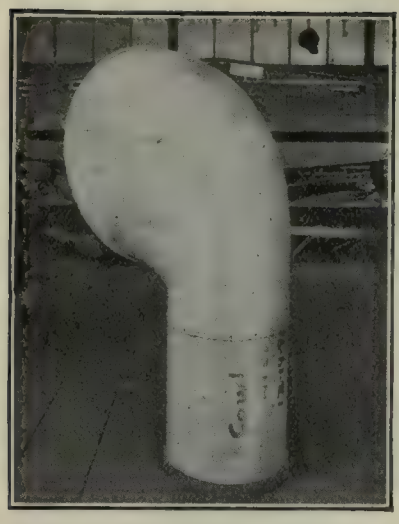
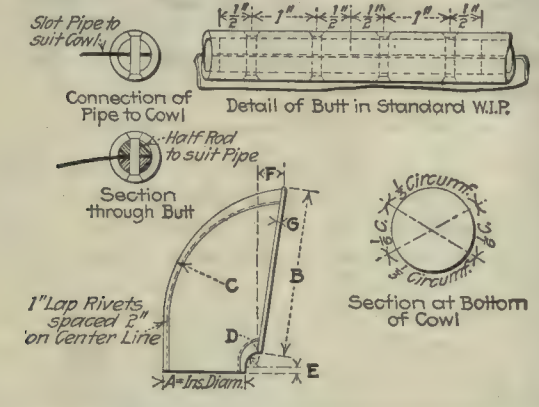


FIG. 3. AMERICAN-TYPE VENTILATOR

bilge strainers and scores of other articles made by the sheet-metal worker. Some of the work, such as ventilators, is standard, for a ventilator of a suitable size for a certain location on one ship will suit the same location on another ship of the same size. Other items are special, being made to suit particular conditions on the ship for which it is ordered or the whim of one of the officers. Where single special pieces are ordered the work is usually laid out directly on the stock used in its construction, but where quantities of the same piece are to be made templets or patterns are made, usually of sheet metal but in some cases of heavy paper or pasteboard.

In Fig. 2 is shown a small part of the interior of the sheet-metal department, a number of the machines and some of the benches with work in progress. An item of considerable importance, as it cut down machine



SCHEDULE OF SIZES

A	B	C	D	E	F	G	GAGE	RIVETS	REMARKS
6"	12"	9½"	1½"	1"	1¾"	½" STD. W.I. PIPE	#22 U.S.S.G.	4 #	
9"	18"	14½"	2"	1½"	2¾"	" " " "	#20 " "	4 #	
12"	24"	19"	2"	1½"	3¾"	" " " "	" " "	4 #	
15"	30"	24"	2½"	1½"	4¾"	" " " "	" " "	4 #	
18"	36"	29"	3"	2"	5½"	¾" " " "	" " "	4 #	
21"	42"	33"	3½"	2"	6½"	" " " "	#16 " "	5 #	
24"	48"	38"	4"	2½"	7¼"	" " " "	" " "	5 #	
27"	54"	43"	4½"	2½"	8"	1" " " "	" " "	5 #	
30"	60"	48"	5"	2½"	9"	" " " "	" " "	5 #	
36"	72"	57"	6"	2½"	11"	" " " "	#14 " "	6 #	
42"	84"	72"	6"	2½"	11½"	1¼" " " "	" " "	6 #	

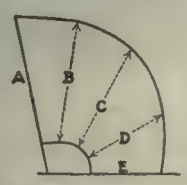
FIG. 4. STANDARD VENTILATOR COWLS, SUN SHIPBUILDING CO.

breakage to a great extent, does not show clearly in the illustration; that is, the marking on each machine its capacity in thickness of sheet steel that it will cut or bend or whatever it may be the duty of the machine to do. One of these labels is shown at *A*, in Fig. 2. It is made of sheet metal painted white and on it in clear large black letters is marked the capacity of the machine as: "Limit No. 10 iron."

As the tools used in the sheet-metal shop are familiar to all who will read this no description of them is necessary, and we can pass directly to the subject of manufacturing ventilator cowls, of which 40 or more go to the outfitting of a single ship.

There are two types of ventilators in common use on shipboard. The type shown in Fig. 3 has the joints crosswise of the length of the cowl (although they cannot be seen either in the illustration or in the work itself), between the sections that go to its make-up. This is usually called the American type of ventilator cowl. In high-grade work all the members except the bottom, or "stem," are shaped by hammering or as it is termed in the sheet-metal shop "bumped out," so that the cowl has a smooth surface which is a continuous curve just as shown in Fig. 3.

In cheap work the members that go to make the cowl are a series of sections of cones, the smaller end of the largest being secured to the larger end of the next smaller, and so on till the smaller end of the smallest is secured to the stem, or bottom, section that enters the cylindrical duct or leader that conducts the air to the various parts of the ship. The outline of a cowl made in



Size of Cowl	A	B	C	D	E
6"×12"	12"	10⅜"×10¼"	8¼"×7½"	THIS SIZE ONLY	6
9"×18"	18"	16⅝"×15⅝"	13¾"×12¼"	11×9⅜"	9
12"×24"	24"	20½"×21¾"	16"×18½"	12⅜"×14½"	12
15"×30"	30"	25½"×27⅛"	20"×23"	15⅜"×18¼"	15
18"×36"	36"	32½"×30½"	27½"×24¼"	21⅛"×18⅜"	18

FIG. 6. CROSS-SECTIONAL DIMENSIONS OF AMERICAN-TYPE COWLS

this way is a series of obtuse angles and is not pleasing to the eye, the completed job having the appearance, as a foreman I once knew put it, "as if someone had made it himself." The only excuse for making a cowl this way is either cheapness or that skilled sheet-metal workers are not available.

The other type of cowl is termed the European. When properly made it also has a smooth exterior and pleasing appearance, but the seams run lengthwise. This type is generally used for the larger sizes of cowls with mouths from 36 in. up to 84 in. in diameter or larger. The method of laying out the templets for this type of cowl will be taken up later.

In Fig. 4 is shown the drawing and detailed dimensions of the cowl standard of the Sun Shipbuilding Co. It will be noticed that the drawing shows the European type of cowl, but in this shop cowls up to 18 in. stem by 36 in. mouth are made after the American type. The column of dimensions under *E* is subject to slight change when the cowls are made according to the American type, as it is more advantageous to make the stem a little longer than called for in this column. For instance, I make the stem of the 36 in. cowl 1½ or even 2 in. deep and other sizes below this in column *E* can be increased from ½ to 1 in. The dimensions in column *D* can also be increased slightly.

The diagram, Fig. 5, is first laid out from the sizes given in the table in Fig. 4. For demonstration I have chosen the 18 x 36-in. size. It will be noticed where I have noted the sizes that they differ slightly from those given in the table; this is in accordance with the suggestion given in a previous paragraph.

Lay off the right angle *BAC*, Fig. 5, with the compasses set to 3¾ in.; in the throat radius scribe the quadrant *ADE* from the center *A*. From the point *E* drop a perpendicular *EF* the same length as the figures given in column *E*, Fig. 4, plus the allowance referred to. In this size I add ½ in., making it 2½ in. from *E* to *F*. From the point *F* draw the line *FG* parallel to *EB* and equal in length to the size given in column *A*, Fig. 4. It will be noticed that this size is given as 18⅜ in the layout; the extra amount is due to the thickness of the stock and clearance where it fits the duct.

From the center *D* with the compasses set to 36 in., taken from column *B*, Fig. 4, scribe the arc *HI*, Fig. 5. From the center *I* on the line *AC* lay off the point *J* on the arc *HI*, getting the distance from column *F*, Fig. 4. Connect *J* and *D*, Fig. 5. From the point *G* erect a perpendicular *GK*. With the compasses set to 29 in., taken from column *C*, Fig. 4, draw the arc *JLK*, Fig. 5. Step off the line *JLKG* into four equal parts at *MNK*. Then step off the throat-circle line *DEF* into the same number of parts at *OPE*. The points *OM*, *PN* and *EK* are then connected. The lines *JD*, *OM*, *PN*, *EK*, and *FG* are bisected at *QRSTU*, and these are joined by lines as shown. The projection to the left is then made as shown and we are ready to lay out the templets.

In some shops the mouth of the hood is made elliptical, but we make both mouth and stem round. Some shops make their hoods a very pronounced ellipse. This is of course a matter of individual taste, but I prefer ellipses with less difference between the major and minor axes.

In Fig 6 are given the major and minor axes of the elliptical sections we use.

The templet for the stem section marked *I*, Fig. 5, is the simplest to lay out as it is similar to a stove-pipe elbow.

The templets for the other sections marked 2, 3 and 4 are laid out in a different manner from No. 1, but the method employed in laying out any one of the sections 2, 3 or 4 is applicable to other sections.



FIG. 8. FINISH-WELDED COWL AND TEMPLETS

The layout for Section 1, Fig. 5, is shown in Fig. 7. The layer-out first draws the horizontal line *AB*, Fig. 7. Near one end of *AB* from the center *C* he draws the half circle *DEF*, which is the same diameter as the stem of the hood, i.e., the distance *DF*, Fig. 7, is the same as *FG*, Fig. 5. He then erects the perpendicular *FG*, Fig. 7, equal to *FE*, Fig. 5, and *DH*, Fig. 7, equal to *GK*, Fig. 5, and connects *G* and *H*, Fig. 7. To the right of *D* on the base line *AB* he lays out a distance *IJ* equal to the whole circumference of the circle *DEF*. The half circle *DEF* is now stepped off into any number of equal parts, in this case eight, and indicated in Fig. 7. The line *IJ* is laid off to the same spacing, 16 spaces in all, as there are eight on each side of the center line. Perpendiculars are dropped from the base line *FD* to the points and other perpendiculars are erected on the line *IJ* in the same manner. The perpendiculars on the line *FD* are now projected on the other side of *FD* to points *Y* on the diagonal line *GH*. Lines are now drawn from the points *Y* parallel to the base line *AB*. The points where the horizontal lines from *Y* intersect with the vertical lines are now connected; a French curve is a handy tool for this. The templet for No. 1 section now appears as in Fig. 7 and also in Fig. 8, where all the templets for the 18 x 36-in. cowl are shown. In Fig. 8 a finish-welded cowl *A* is shown on the ball stake

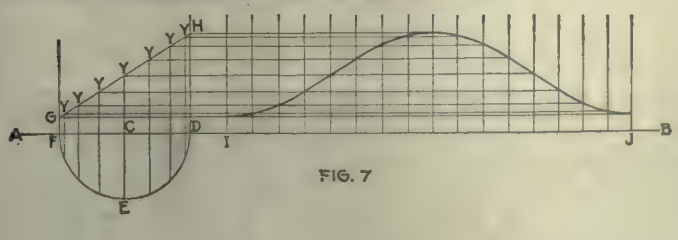


FIG. 7

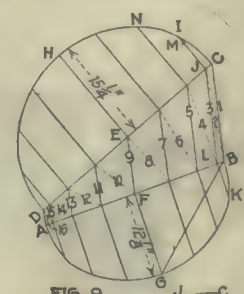


FIG. 9

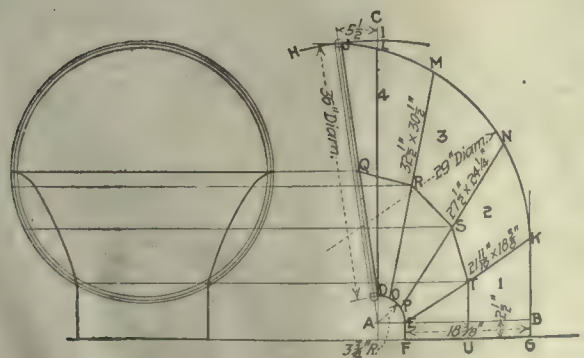


FIG. 5

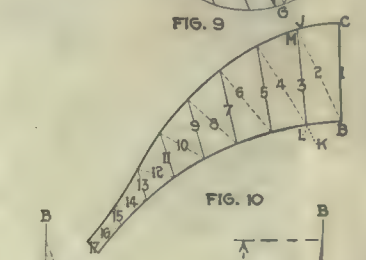


FIG. 10

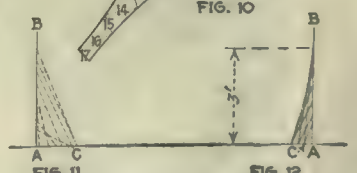


FIG. 11 FIG. 12

FIGS. 5, 7, 9, 10, 11 AND 12. DIAGRAMS AND LAYOUTS FOR AMERICAN COWL

Fig. 5—Diagram of cowl. Fig. 7—Method of laying out templet for section 1. Fig. 9—Diagram of ellipses for section 3. Fig. 10—Half templet layout. Fig. 11—Dotted-line triangles used in layout. Fig. 12—Solid-line trangles used in layout

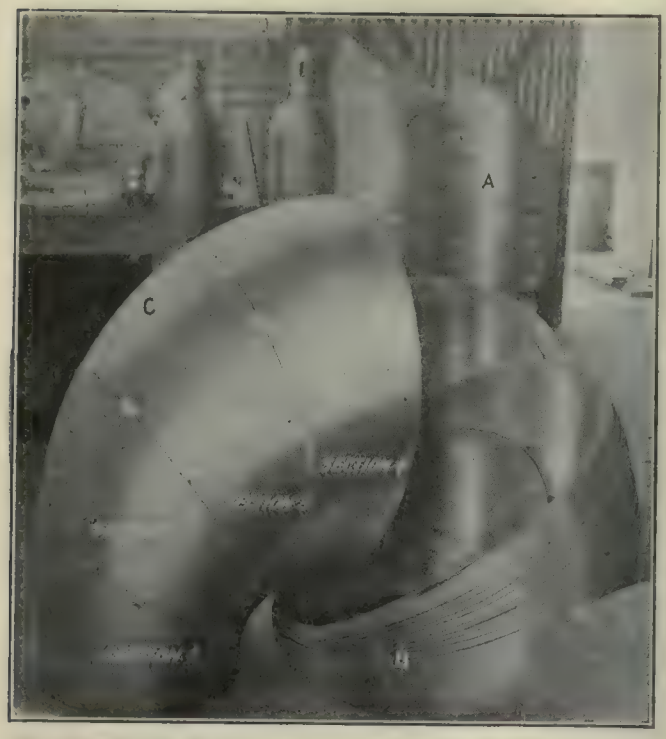


FIG. 13. COWL SECTIONS AND COWL TACKED TOGETHER

B where any dents that it has acquired during the manufacture are taken out. The method used for laying out each of the sections 2, 3 or 4 or, in the case of the 6 x 12-in. cowl which is made in three sections, for laying out the two sections above the stem follows: As an example we will take the section marked 3, Fig. 5. The line *AB*, Fig. 9, is first laid off equal in length to *PN*, Fig. 5. The compasses are then set to the distance *NM*, Fig. 5, and an arc drawn from the center *B*, Fig. 9. With the compasses reset to the distance *PM*, Fig. 5, another arc is drawn locating the point *M*, Fig. 5, on the layout Fig. 9. This point in Fig. 9 is designated *C*. In the same manner the point *D*, Fig. 9, is located, and *BC*, *CD* and *DA* connected by lines as shown.

The line *DC* is bisected at *E*, and the line *AB* at *F*. A perpendicular is erected on *DC*, at *E*, and on *AB*, at *F*. By referring to column C, Fig. 6, it will be seen that the minor axis is 24¼ in. Lay-off on the perpendicular starting at *F* a point *G* distant from *F* one-half of 24¼ in. or 12⅛ in. The same process is gone through with the perpendicular on *E*, but the point *H* is distant from *E* one-half of 30½ in. taken from the B column, Fig. 6. The layer-out then draws one-half of the 32½ x 30½ ellipse on *DC* and one-half the 27½ x 24¼-in. ellipse on the line *AB*. The perimeters of these half ellipses are then stepped off into a number of equal parts, in this case eight, although any even number of spaces may be stepped off. Perpendiculars are then erected on the lines *DC* and *AB* to pass through the points stepped off on the perimeters of the half ellipses. The points where the perpendiculars occur on the line *DC* and those where they occur on the line *AB* are joined by full and dotted lines as shown and marked 1, 2, 3, 4 and so on, in Fig. 9.

We are now ready to lay out the half pattern itself as shown in Fig. 10. We first take the full line 1, Fig. 9 (that is the distance *BC*), and lay it out on the pattern stock shown at *BC* in Fig. 10. We then take the distance *CI*, Fig. 9, and from *C*, Fig. 10, describe an arc *J*, Fig. 10.

Two groups of triangles are shown in Figs. 11 and 12. Those in Fig. 11 are made up of dotted lines while those in Fig. 12 are made up of solid lines.

The length of the dotted line No. 2, Fig. 9, is now taken and laid out perpendicularly on the dotted line *AB*, Fig. 11. We now lay out from the point *A* in Fig. 11 the distance *AC*, equal to *IJ*, Fig. 9, and connect *BC*, Fig. 11. Set the compasses to the distance *BC*, and with one leg set in the center *B*, Fig. 10, lay off *M* on the arc *J*, Fig. 10, equal to the distance *BC*, Fig. 11. Take the distance *BK*, Fig. 9, and from the point *B*, Fig. 10, lay off the arc *K*, Fig. 10.

Now take the length of the No. 3 line, Fig. 9, and lay out this distance on the solid-line triangle at *AB*, Fig. 12. Take the distance *LK*, Fig. 9, and lay it off from the center *J* on the line *JI*, Fig. 9. It will be observed that this length is slightly shorter than *JI*. Mark the point *M*. Set the dividers to the distance *IM* and lay this distance off from the point *A* and at right angles to *AB* in the solid-line triangles, Fig. 12, and mark it *C*. Connect *BC*, and with the compasses set to *BC*, Fig. 12, from the center *M* lay off on the arc *K* the point *L*, which gives the true length of the line 3, Fig. 10.

We next take the distance *IN*, Fig. 9, and repeating exactly as described we lay out the entire half pattern as shown in Fig. 10. The half pattern is then cut out and by turning it over the whole pattern can be scribed off.

The patterns are carefully cut out of sheet steel

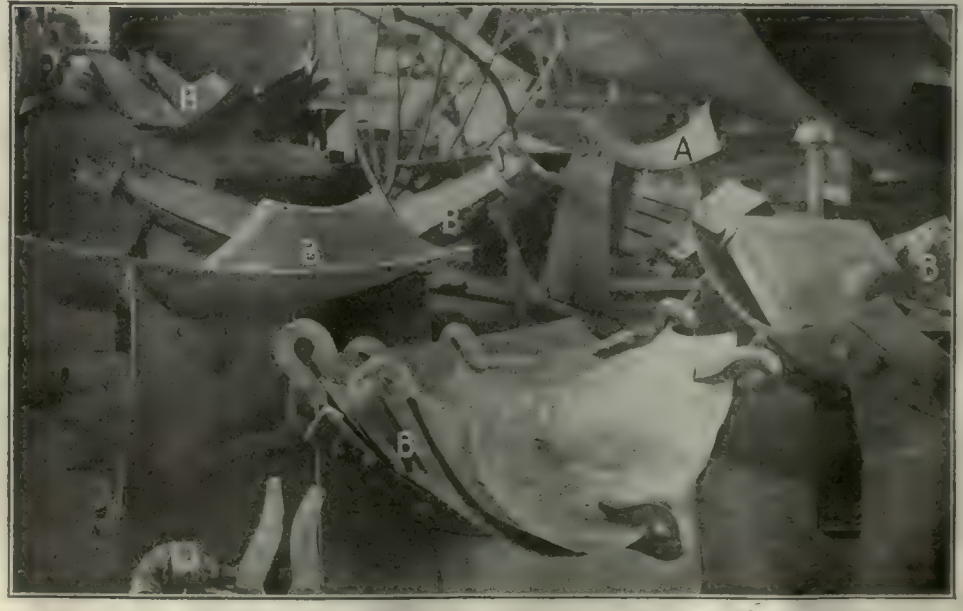


FIG. 14. FORMS IN WHICH COWL SECTIONS ARE BUMPED OUT

and we use galvanized sheet because of its nonrusting properties. The sections are then scribed from the patterns, cut out and welded to form them into rings as shown at *A* and *B*, Fig. 13.

The members shown at *A* are No. 1 sections which are left just as they are welded together, that is to say they are not bumped out. Those shown at *B* are No. 2 sections and after welding they are bumped out to shape them to the curve of the cowl.

At the time when the photographs were taken, larger cowls of the other type were being made so I cannot show the work in progress. Similar forms are used for this work, however, and the description will make the methods clear.



FIG. 15. COWL SECTIONS AND PLANISHING HAMMER

The forms used in bumping out cowl sections are usually of cast iron and made of course from properly shaped patterns. At the time we undertook the manufacture of cowls the pattern shop and foundry were too busy to bother with our cowl-form patterns and castings. We have, however, in the boiler shop, an Italian blacksmith who undertook to forge the forms from ½-in. boiler plates. A number of these forms are shown in Fig. 14. It will readily be seen how the forms shown at *A* and *B* can be used to hammer to shape a section of a size suited to it.

All hammering on the sections is done from the inside. Sometimes the section is heated and hammered while still red hot; at other times it is hammered cold, but just as with all form work in sheet metals it must, whether hot or cold, be soft enough to work, and must therefore be annealed from time to time.

Mallets made of hard wood are used to a great extent to bump out the sections.

When the sections are to shape and as smooth as they can be made with the forms and wooden mallets they are planished with a power hammer shown at *A*, Fig. 15. As previously stated the other type of cowl was being manufactured when these illustrations were made. One of the side sections of such a cowl can be seen at *B* lying on the platform on which the operator stands while at work. It will be noted that the face of the hammer and that of the anvil are well rounded.

When the various sections are shaped to the workman's satisfaction they are "tacked" together with the oxyacetylene torch. This is rather a delicate job as the metal is so thin. The welding wire used is only a trifle over $\frac{1}{16}$ in. in diameter. A cowl so tacked together is shown at *C*, Fig. 13. This method of tacking the sections together before completely welding the seams is made necessary because of the excessive and unequal expansion of the parts which would take place if the entire seam were welded at once.

The short sections of the seam between the tackings are now welded and any dents in the cowl are worked out by hammering over the ball *B*, Fig. 8. The slight ridges formed by the molten welding wire are next ground off and the cowl is either galvanized or painted when it appears like the small cowl shown in Fig. 3. The mouth of the cowl is finished off by pinning on a ring of iron pipe which has a saw slot in it to permit it to be fitted over the sheet metal at the cowl mouth. The size of pipe used for each size of cowls is given in column G, Fig. 4.

Approximating the Tap-Drill Size

BY L. S. WATSON

Referring to Mr. Cox's formula on page 900, Vol. 49, of the *American Machinist* for finding the size of tap drills permit me to draw attention to the fact that it would not work out very well in the case of a United States Standard thread.

For example, take a 1-in. 8-pitch tap: One and one-half times the pitch = $\frac{3}{16}$. 1 in. — $\frac{3}{16}$ = $\frac{13}{16}$ or 0.8125 in. The double depth of an 8-pitch thread is 0.1623 in., and 1 in. minus 0.1623 in. equals 0.8377, which is the correct size of the hole that should be drilled.

Figuring by Mr. Cox's formula it will be seen that 0.025 in. would have to be removed with the tap, which is not very good practice. On a small tap as $\frac{3}{16}$ x 32 pitch the tap would remove about 0.007, which would cause unnecessary loss of time and considerable breakage of taps.

The best method, and one that is within reach of practically all machinists, is to subtract the double depth of thread from the diameter of the tap and use the nearest standard-sized drill available. The double depths of thread can be obtained from a handbook, a chart or the standard-pitch gage that is in the kit of all machinists and tool makers, or it can be figured out as follows: Double depth of thread = $P \times 6495 \times 2$.

Making Dies for Cutting Rubber, Leather, Paper, Cloth, Etc.

By S. A. HAND
Associate Editor *American Machinist*

Dies for cutting articles from rubber, leather, paper, cloth, etc., are different from dies for blanking metal. They may be described as continuous knives formed to the shape of the piece to be cut. In fact they much resemble the cutters with which our mothers used to cut out gingercake horses for us in our childhood days.

WHEN a die for cutting rubber, leather or the like, of some particular shape, is ordered the customer furnishes the die maker with a heavy paper pattern of the size and shape to be cut, and from this the die maker makes a duplicate out of sheet tin to be used as a gage or templet in making the die.

Dies of the character described in this article are made from bars of composite steel, usually about 3 x $\frac{3}{8}$ in. One inch of the width is tool-steel tapering from $\frac{3}{8}$ to $\frac{1}{8}$ in. in thickness, and the remaining 2 in. is Norway iron to which the steel is welded as shown in Fig. 1.

Cutting dies are of two types—machine dies that

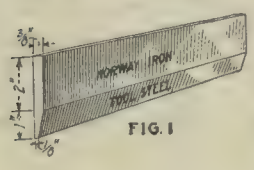
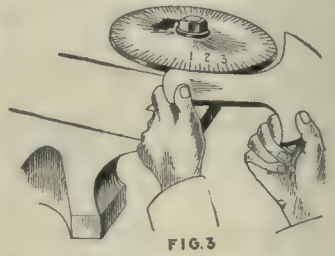


FIG. 1


FIG. 3

FIGS. 1 AND 2. THE STOCK AND THE MEASURING WHEEL

are intended for use in a press and dies that are provided with a handle by which to hold them while they are driven through the material to be cut by blows from a heavy mallet.

To find the length of steel required to make a given die the die forger measures the templet *A*, Fig. 2, around its outer edges with a wheel *B* 1 ft. in circumference and graduated in inches and eighths. This wheel is similar to the one used by wheelwrights for measuring the circumference of wagon wheels to find the length of stock for making tires, but is differently mounted. The die-forger's wheel is mounted loosely on one end of a rod or spindle about 8 in. long and provided with a shoulder near the opposite end.

In use the projecting end of the rod is placed in a hole in the anvil face in an upright position so that the wheel is free to revolve in a horizontal plane. The measurement is taken by revolving the templet while its edge is pressed against the periphery of the wheel, Fig. 3. The bar of steel is then cut off to the length so obtained plus an allowance for the weld, which is usually about $\frac{1}{8}$ in. for the average die.

For finding the bending points the bar is held in a fork on the anvil and the edge of the templet held against it near the end as shown in Fig. 4. The templet is rolled along the bar until the first bending point is reached. Its position is marked on the bar with a soapstone pencil and then scored lightly with a chisel.

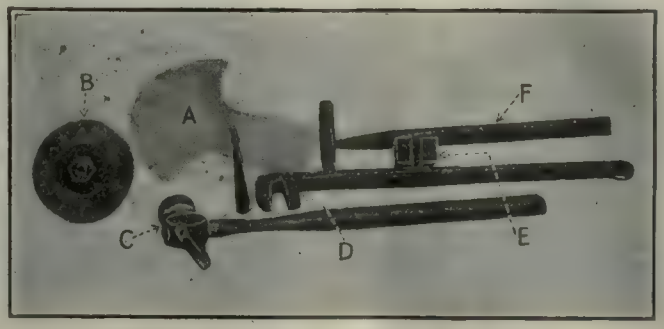
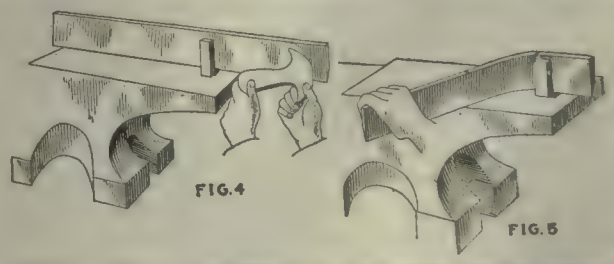


FIG. 2. SOME DIE-FORGER'S TOOLS

After heating in an open fire the bar is cooled on each side of the chisel mark by local application of water, leaving enough of the length hot to make a bend of the desired radius.

In making the bend the bar is held in a bending fork fitted in the hardy hole in the anvil and one end pushed or pulled around by hand, Fig. 5. It is surprising how near a skilled die forger will get the bend to the proper radius and angle at the first try. However, in order to get the bend to fit its corresponding part of the templet, he may have to push or pull the bar one way or the other while changing its position in the bending fork or hammer it on the horn of the anvil or on a stake, similar to the kind used by tinsmiths, of which he has many of various sizes and shapes.

The next bending point is located as before except that at the start the templet is held with its corresponding part in the bend already made before rolling it along the bar. The second bend, unless it be a very


FIG. 4 FIG. 5

FIGS. 4 AND 5. LOCATING AND MAKING FIRST BEND

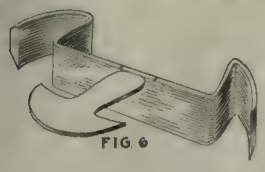
sharp one, is made in the same manner as the one just described.

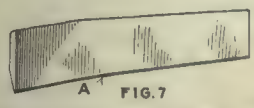
For making sharp bends a machine very much like a miniature bulldozer is used. It is fitted with a pair of V-dies, and being hand operated it can be stopped at any point of the stroke so that the angle of the bend is under perfect control. A very good bend of large radius can be made on this machine by making a series of slight bends at several points.

At some stage of the bending process, depending on

the size and shape of the die, one end is scarfed for the weld. After making all the bends on one half of the bar, except the bend necessary for bringing the ends together, the previous operations are repeated on the other half.

By fitting the templet to the bend at one end of the bar and rolling it toward the center the position





FIGS. 6 AND 7. CLOSING BENDS AND BENDING TO PREVENT BUCKLING

of the closing bend, Fig. 6, is found and marked. In making short bends which curve outward it is necessary to first heat the bar where the bend is to be made and give it a slight bend in the direction of its width as shown at *A*, Fig. 7. If this is not done the cutting face of the die would have low spots at the bends, due to unequal lines of compression on the tapered steel portion of the bar. After making the closing bend by which the two scarfed ends are brought together, they are welded. By the use of borax and a patent welding compound as a flux the weld is made at a very low heat, avoiding danger of burning the steel. It is generally the practice after welding to reheat the weld, apply the flux and hammer it again. This is done to insure a good weld in the steel part of the bar.

Upon completion of the weld it is necessary to do some refining to bring the die to the contour of the templet, leaving sufficient stock for the grinding and filing operations which follow. This is accomplished by local heating and cooling, tapping in various places and directions with a hammer, gently here and hard there, all depending on the intricacy of shape, the amount of correction necessary and the relative location of the part to be corrected. A detailed description of this procedure is impossible and the actual performance must be seen to be appreciated, as every move made is purely the result of judgment and skill, and I very much doubt if the most skillful die forger could describe the process or tell the how or why of the many things he does in refining the shape of the die.

Fig. 8 shows a die after leaving the hands of the forger. Its accuracy of size and shape is truly remarkable.

Grinding

After the forging process has been completed the top of the die is rough-leveled and the outside rough-ground on a grindstone, particular attention being paid to the condition of the weld after the scale has been removed. It is then taken to the bench, where the templet is applied and its outline scribed on the cutting face. Next it is "buzzed," or ground, Fig. 9, on the inside to remove the surplus stock. This is done by a small wide-faced abrasive wheel running at a very high speed.

From the buzzer the die goes back to the bench to be filed on the inside to the lines, after which the grindstone removes the surplus stock from the outside.

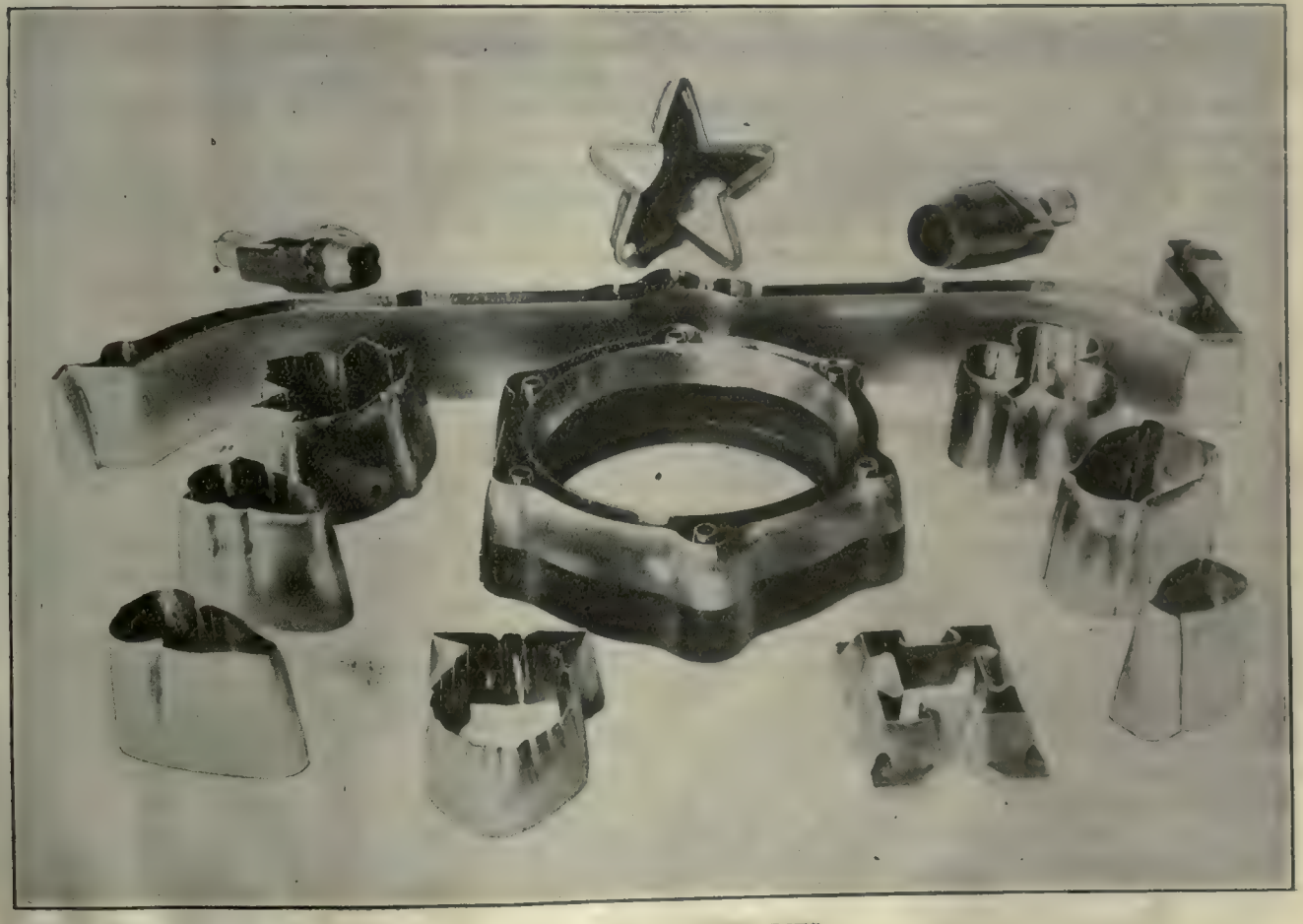


FIG. 11. SOME FINISHED DIES

The heating for both hardening and tempering is done in an open hard-coal fire and the quenching in cotton-seed oil. The temper is drawn to a light blue.

The next operation is to level the cutting face on a disk grinding machine, after which the die goes back to the bench to be filed on the inside for correction of any distortion that may have taken place in hardening; the grindstone is then used to bring it to the proper height by grinding on the back and to rough-grind the cutting edge on the outside. After this the kinks and curves on the outside, which could not be reached by the grindstone, must be filed so as to bring the cutting edge to the same thickness at all points. Then it is polished on the outside with an ordinary polishing wheel, the kinks being touched up with a very small wheel running at high speed, which is also used for polishing the inside.

The last operation is to sharpen the cutting edge with a file.

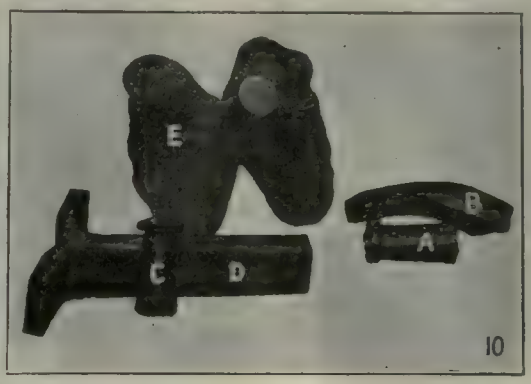
Handles *A*, Fig. 10, and the bases *B* by which they are attached to the dies are made of Norway iron and are welded together, after which the base is forged as shown at *E* to suit the die for which it is intended. The base part is attached to the die by welding just before hardening. *C* is a handle for another type of base *D*, which is shown partly finished.

Fig. 11 shows a few of the types of dies made by the Hoggson & Pettis Manufacturing Co., New Haven, Conn., where the illustrations and data for this article were obtained.

Every shape of die calls for some special treatment in the course of its making, and anyone who thinks it a simple matter to make such dies as shown in the illustrations is greatly mistaken, as the whole process from start to finish is one that requires long experience and consummate skill.







FIGS. 8 TO 10. A DIE, "BUZZING" AND SOME HANDLES
Fig. 8—A die as it leaves the forger's hands. Fig. 9—Buzzing the inside of a die. Fig. 10—Die handles

How We Saved the Truck Wheels

By J. Thomas

We received a contract to machine a large number of truck wheels for gun carriages for antiaircraft guns, and after we had finished up a number with bronze bushings it was decided to change from bronze bushings to roller bearings. The bushings being quite thin we decided we could bore them out quicker than we could force them out.

The job was let to an outside shop to remove the bushings and enlarge the hole to the proper size. Upon inspection, after the wheels had been returned, we found that they had all been reamed with a reamer that had cut over size, so that the bushing for the roller bearing would just slide through. The stock was a special alloy steel furnished by the Government and it meant a serious loss to us, besides delaying the production of the gun carriages. To get over the matter we decided to try to close the hole by shrinking, which proved successful.

We had the blacksmith heat the truck wheels to a dull red, then, placing them on a rod laid across the cooling tank, we rolled the rod back and forth on the edge of the tank, allowing the outside and flange of the wheels to come in contact with the water. This cooled the outside quickly, causing it to close on the still red-hot center. The wheels were kept moving until they had turned black and were then laid down to cool. By this method we were able to close the hole from 0.004 to 0.006 in., which was enough for a force fit for the roller-bearing shell.

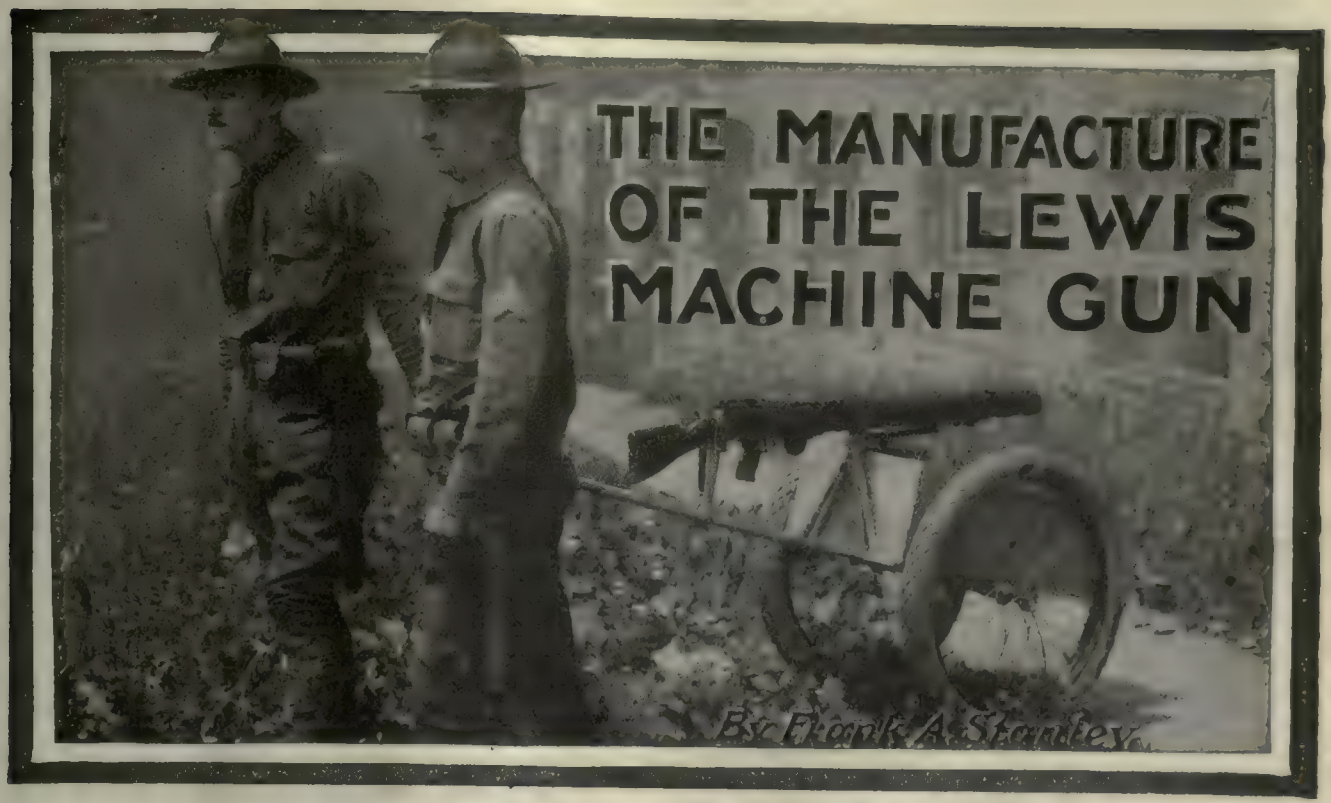
This was taken up with the Government inspector, who by the way was a practical mechanic, who was satisfied with the job.

The Small Shop Still With Us

By M. L. Lowrey

From reading the *American Machinist* and kindred publications one gets the idea that there are no more small shops, but there are—many of them—not only in the small towns, but also in the big cities.

I have observed that many of those men who hold responsible positions in big shops are men who began life in the small ones, and I have noticed too that copies of the *American Machinist*, *Power* and similar periodicals are usually to be seen lying around in the small shops and almost never in the big ones. I believe the reason for this is that the men in the big shops think they are already at the head of the procession, while those in the small country shops, realizing their isolated position, try to keep up with their trade by reading the experiences of others and applying the knowledge thus gained to the solution of their own difficulties, with the result that they are usually better all-round mechanics, more self-reliant and more successful than those who work to a set form, as is now the custom in the big shops.



XIV. The Radiator, Locking Piece and Magazine

This final article deals with reaming and gaging the radiator, the manufacture of the rear locking piece by which the radiator is secured to the gun and some operations on the magazine pan and center. The tools illustrated are jigs and gages, together with some ingenious devices for milling and profiling awkward forgings.

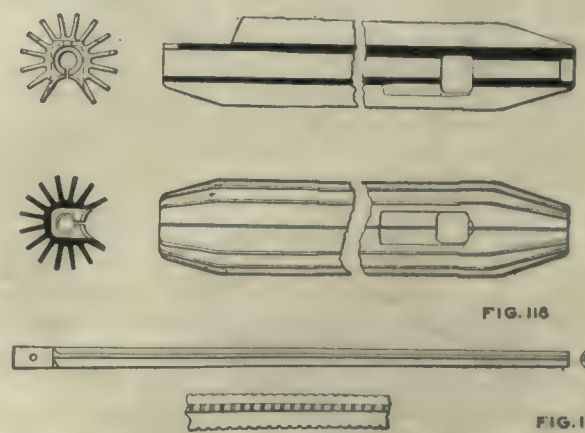
THE radiator, as pointed out in earlier installments, must be an exact fit to the taper exterior of the barrel, otherwise full and complete radiation of heat will not be secured. Consequently, great pains are taken to finish the taper bore so as to assure proper fitting to the barrel throughout the entire length.

The radiator outlines are shown in Fig. 118. The material is aluminum and the radiator is formed with a series of longitudinal vanes extending the full length. The aluminum body when finished is secured in a steel casing, and the latter is fastened to a steel member known as the radiator-casing locking piece, by means of which the radiator is secured in place on the gun.

The details of assembling and method of mounting in position will be seen by referring back to the sectional views presented in the first section of this series of articles.

It is not purposed here to show all of the operations connected with the manufacture of either the radiator or the locking piece, but enough will be described to convey an idea of the character of the work in general and to show something of the special tools found necessary for the work.

The bore of the radiator is finished to diameter and correct taper by application of roughing and finishing reamers and tested by a long plug gage representing in its dimensions and degree of taper the size and taper of the barrel. The barrel must fit snugly the full length without forcing either end of the hole in the radiator, and therefore the requirements in reaming the



FIGS. 118 AND 119. THE RADIATOR AND THE ROUGHING REAMER

Fig. 118—The radiator. Fig. 119—The roughing reamer for the radiator

bore are most exacting. The type of roughing reamer used for the first reaming operation is illustrated by Fig. 119, which shows clearly the form of notch used in serrating the cutting edges of the teeth. The reamer has a total length of $27\frac{1}{16}$ in. and has four teeth around which a left-hand helix is cut.

The taper-plug gage for testing the bore after finish-reaming is shown in Fig. 120. This gage is applied to the bore after coating the gage surface with prussian blue. With such a long taper plug it is impracticable to attempt to slip it into place as with shorter gages, owing to the likelihood of the gage contacting accidentally with some portion of the bore before being

properly entered. So the practice is to place the radiator upright and allow the gage to enter the hole until within a few inches of depth, but of course without touching any portion of the walls. Then the plug is released from the hand and allowed to drop the remainder of the distance. It falls straight to its seat along the taper bore, and when removed the character

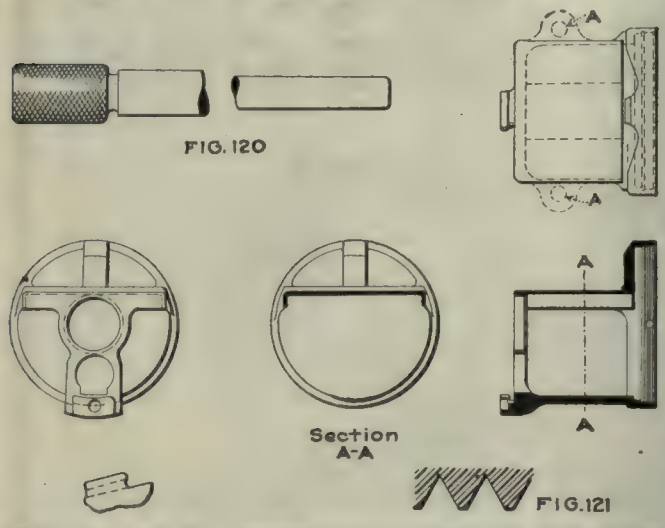


FIG. 120

FIG. 121

FIGS. 120 AND 121. TAPER PLUG GAGE AND RADIATOR LOCKING PIECE

Fig. 120—Taper plug gage for radiator. Fig. 121—Rear locking piece for radiator casing

of the contact is defined by the condition of the marking material with which it is coated.

The casing for the radiator screws into the locking piece as shown in Fig. 121. This is a high-grade steel forging machined in a number of operations, the sequence of which is covered herewith.

The casing is permanently assembled to the rear locking piece, which is machined on top to form a flat platform to serve as a guide for the magazine, while at the bottom it forms a link between the barrel and receiver groups. It is therefore bored through the rear wall to form an opening to fit over the barrel, and immediately below is another hole for the piston.

The forging is made with two lugs on the sides, as indicated by the dotted projections *A*, which are drilled and used for positioning the work in various fixtures until all machine operations have been completed up to the point where the under side of the table is to be profiled, and the lugs are then cut off, after which the profiling operation mentioned is accomplished, leaving only a few more stages through which the piece must pass to completion. These subsequent operations are mostly filing and simple counterboring cuts that do not require the locating lugs for holding the work in a given position for satisfactory accomplishment.

Only a few of the entire series of operations and the tools therefor are illustrated here. The first machine cut is the rough-milling preliminary to milling the surface on top of the table. The latter operation leaves stock for finishing later on. Then the locating holes are spotted, drilled, reamed, burred and used for positioning the forging for the operations that follow. Both front and rear ends are now milled; then the inside is profiled to shape by working from both right and left sides. The work is placed by its locating holes and milled to shape by the aid of suitable profiling fixtures. These are not shown here, for many profiling devices of more or less similar character have been fully described in previous articles in this series.

The test gage for the inspection of the work after these cuts is illustrated in Fig. 122, this drawing showing the gage for testing the profiling from the right-hand side. The tool carries four gaging members with knurled handles and with wing contact points at the inner ends of the spindles. The profiled forging is placed as indicated by the heavy dotted lines, with the table face in vertical position and the locating lugs slipped over two closely fitting plugs shown at *B*, where they are fitted into the corresponding face of the gage fixture. A thumbscrew *C* is set up lightly to press the work against four hardened stop feet and secure the work in the fixture and the four contact gages 1, 2, 3 and 4 are then slid into forward position and rotated easily by the fingers to test the accuracy of the profiling cuts. The contour surfaces with which these gages contact will be noticed in the dotted outline in the side view of the fixture. The plan view shows the different positions from the center line of the respective portions of the interior to which the gage wings are applied in the test.

One of the gage spindles is seen in Fig. 123, and it will be noticed that the contact points are made on the limit principle, one end of the wing being marked "Go," the other "Not Go."

Several hand-milling operations and a straddle-milling cut are now taken to form the shape over the locking lug and rough the locking face and mill the radiator

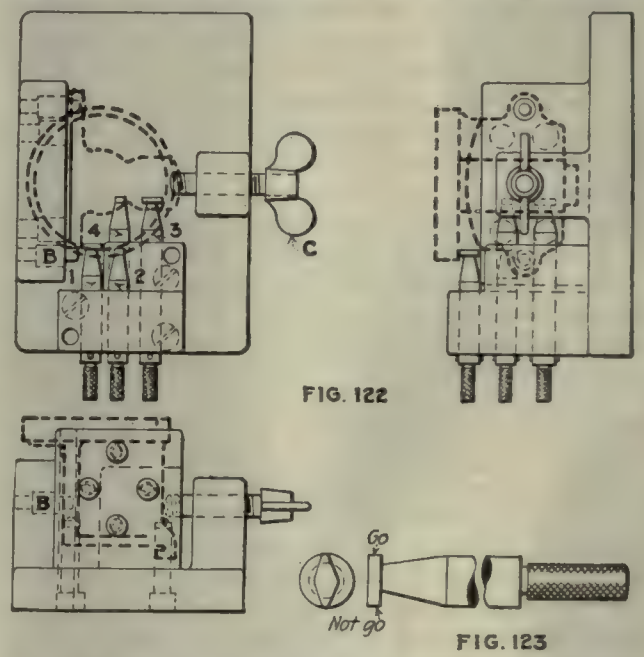


FIG. 122

FIG. 123

FIGS. 122 AND 123. A PROFILE-TESTING GAGE AND ONE OF THE SPINDLES

Fig. 122—Gage for testing profile of radiator rear locking piece. Fig. 123—One of the gage contact spindles

brace (see Operations 10 to 13), then in Operation 14 the hole for the barrel is drilled and reamed and the rear end faced. Operation 15 consists of boring the face, reaming the casing hole, turning the outside to size and tapping the radiator-clearance hole. This is a roughing operation, and Operation 15½ which follows

finishes the foregoing surfaces. Operations 14, 15 and 15½ are accomplished in a turret lathe.

The gaging fixture in Fig. 124 is used to check the accuracy of the last-named operation. The work is located here, as in previous gages, by placing it over hardened position pins *F*, which fit closely in the two locating holes, and here it rests as before upon four plugs or feet *G*, upon which it is drawn down by the straps and thumbscrews at either side. Plug *H* is then pushed into the hole bored for the barrel. The plug is therefore a close fit and will not enter the bore at all unless the hole is correct as to size and in exact position.

The facing of the rear end of the locking piece is tested by the three fixed micrometer heads *K*, the spindles of which are run in to contact with the face of the work to be inspected. The gage spindle *L* is fitted to carry the limit-gage contact piece *M* in the form of a wing. This gage tests the undercut at the point indicated in the drawing where the gage is turned with the short arm of the head in contact with the surface of the work. The position of the work in this gaging fixture is clearly shown by the outline of the forging in the various views.

The gage used in connection with Operations 15 and 15½ is represented by Fig. 125. The work is located and held in this gage in exactly the same manner as described in connection with Fig. 124. The gages *B* are of the flush-pin type with limit shoulders ground on the end.

A Drilling Jig

The jig in Fig. 126 is for drilling and reaming the piston hole and certain other holes and the work is held as shown. It is placed over position studs in the vertical jig face at *A* and clamped against the six hardened feet *B* by hook bolts *C* which are drawn back by wing nuts *D*. The knurled piece *E* is a short length of pipe screwed into the jig base for convenience in handling the work. The work is still further secured and supported by the hardened clamp *F* at the front,

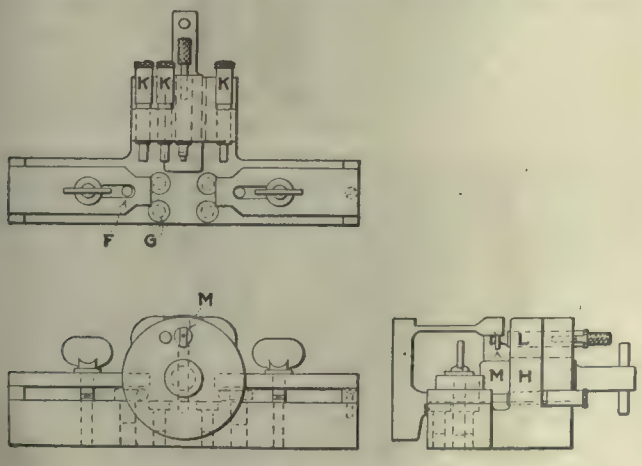


FIG. 124. A MICROMETER GAGE

which is pressed back by the thumbscrew *G*. The latter is tapped through a pivoted leaf *H* which is mounted upon a pin at one side and held closed by a button *J* which is turned to clear the slotted end of member *H* when the jig is opened to allow the work to be entered or removed. Part *H* carries two guide pins which serve to retain the clamp block *F* in proper position and so prevent it from swinging about the clamp screw *G* when the jig is opened.

Several of the tools shown are of a type used for the locking piece of both the American model and the airplane guns. The details of the parts differ somewhat in the two constructions, but the tools for

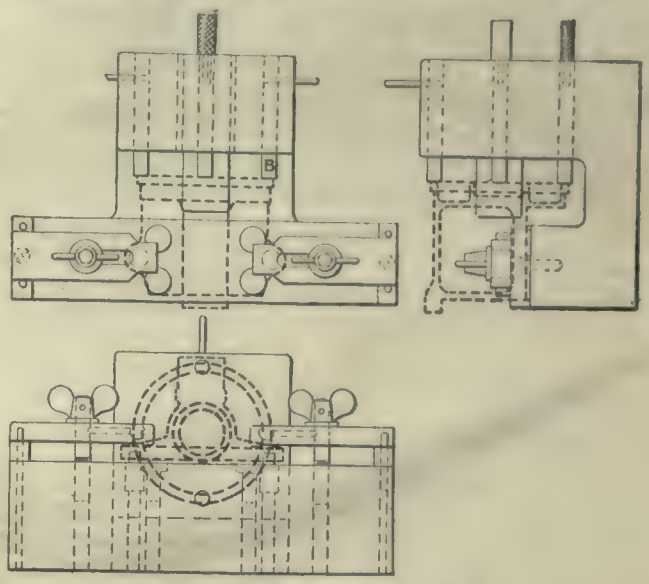


FIG. 125. A FLUSH-PIN GAGE

manufacturing are of the same general design. The gage in Fig. 127 is a tool made specifically for the airplane model. It tests the accuracy of the position of the three holes drilled and reamed in the jig in Fig. 126. The work is located over the two position pins *D* and clamped lightly on its seat formed by the six hardened plugs *C* by two screws *B*, which are provided with large collars and knurled heads as indicated. The collars, or flanges, of these clamp screws are milled away at one side to allow the work to be placed in position and removed by simply turning the screws sufficiently to permit the flatted edges to clear the ends of the piece.

The two plugs *E* for testing the position of the piston hole in the locking piece are a close sliding fit in the hardened and lapped bushings *G*, which are pressed into the uprights of the fixture. The whole gaging fixture provides a very rigid test for the positions of the three holes referred to both as regards their center distances in respect to each other and their heights above the table of the locking piece.

Profiling Fixtures

There are a number of profiling fixtures used for various operations on the locking piece. One of these is illustrated here as having some unusual features that suggest an effective method of machining other classes of work where interior surfaces are to be finished which are difficult to reach with ordinary tools. The fixture is shown on the profiling machine in Fig. 128, and this view also gives a clear illustration of the American model locking piece as it approaches completion. The locating lugs at the sides have not as yet been cut off and certain other cuts remain to be taken, but in the main the piece closely resembles the finished part.

In the illustration the profiling machine is in operation in cutting out along the inside wall of the locking piece and in the corner along the inside of the table. The shape of the form plate under the guide pin of

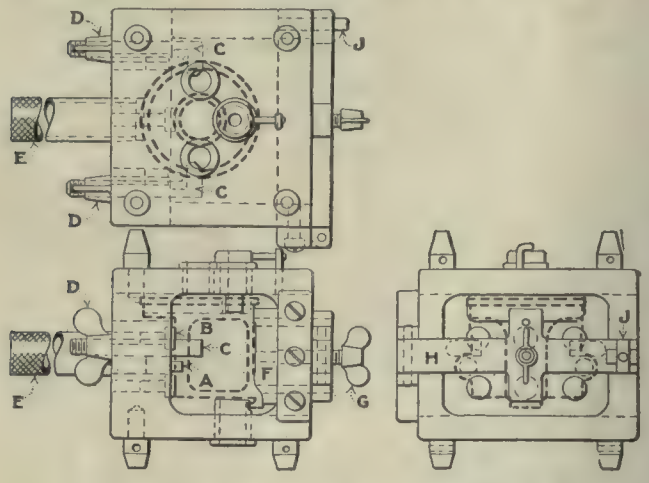


FIG. 126. A DRILLING AND REAMING JIG

the profiling head shows the contour to be milled in the work. The locking piece to be profiled is held in its fixture by locating pins as before and by three hook bolts drawn back by the pin-handle screw at the rear, which acts upon a three-cornered plate so that all three bolts are operated at once and with uniform degree of pressure.

The profiling is done with a small end mill, which is mounted as represented in a short spindle carried in a vertical position at the outer end of a projecting arm with sufficient reach to carry the cutter to the rear end of the work. The drive for the cutter is taken from the regular profiling spindle by a spur gear and a series of small gears mounted upon short shafts or spindles.

The method of mounting the entire attachment upon the profiler head will be understood without explanation.

Following the cutting off of the locating lugs the under side of the table is profiled and then there are

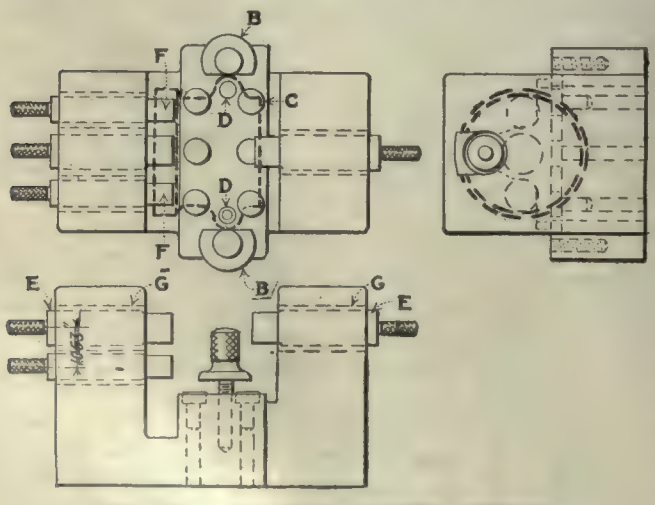


FIG. 127. A POSITIVE GAGING FIXTURE

one or two hand operations, after which the barrel seat is counterbored, the table ground to match the receiver and the locking piece is then ready for hardening and polishing.

The magazine is made up of a sheet-steel pan to which is riveted the cartridge spacer ring carrying the interior separators. Inside the pan is the aluminum magazine center, while outside is the top plate which houses the magazine latch and latch spring. The magazine center and the top plate are fastened together by means of rivets. The wall of the magazine pan is formed with vertical corrugations, which on the inside serve to space and retain the cartridge bases while on the outside they are engaged by the feed, stop and rebound pawls.

The cross-section of the feedway channel is an approximation of the section of the bullet, so that in feeding down the cartridges will be guided smoothly into the receiver. The forming of the channel is accomplished on a multiple-spindle machine which mills six magazine centers at once, although all spindles are independently controlled so that as fast as one magazine center is cut another may be slipped in place without affecting operations under the five other spindles.

The machine is illustrated in Fig. 129. The centers are already bored and sized before being brought to

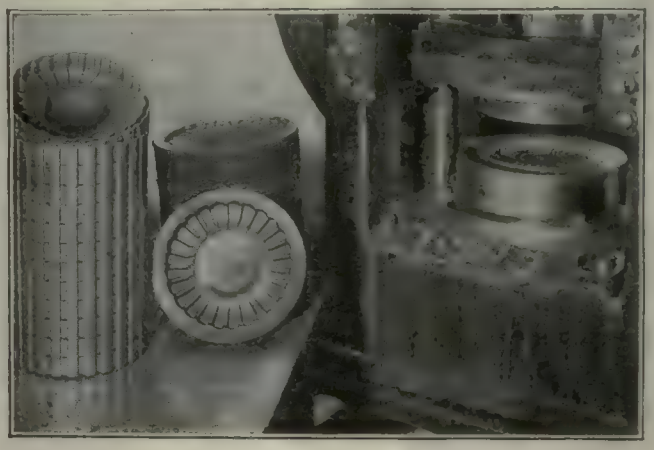


FIG. 130. DRAWING THE MAGAZINE PAN

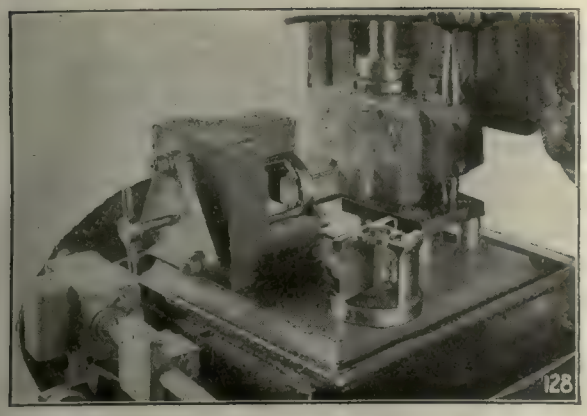
this machine. They are slipped on the machine spindle, the feed thrown in and the cut started and controlled automatically until the feedway has been milled out upon which the spindle stops and the grooved center is removed and replaced by another blank.

The cutter spindles are operated at a high rate of speed and the work is milled very rapidly. The horizontal spindle for carrying the blank is actuated by suitable worm gearing to rotate the work past the vertical cutter, and at the same time the work is fed axially to produce the cam-shaped portion of the slot by means of a master form or cam.

Drawing the Pan

In Fig. 130 the work of drawing the pan with its corrugated walls is illustrated as accomplished in a powerful Bliss press of the toggle type. The first operation press forms the work into a shallow pan with corrugated bottom and starts the forming of the side-wall corrugations as shown by the stack of work near the left side of the press. The work is drawn up to depth with side corrugations complete in the second operation in Fig. 130.

The retainer clips attached to the interior of the walls of the pan are shown in large numbers in the tray in front of the press in Fig. 131. These are





FIGS. 128 AND 129. UNUSUAL PROFILING AND MILLING OPERATIONS
Fig. 128—Interior profiling of locking piece. Fig. 129—Milling channels in magazine centers

blanked, formed and pierced to provide two triangular clinching points or riveting tongues by which they are later secured to the interior of the wall around the pan. The two openings for receiving and securing the clip points are shown clearly in the pan seen on the horn of the press. This engraving illustrates the riveting operation, which is accomplished very rapidly by slipping the retainer clips into place in the pan and striking one blow with the punch in the press.

The quantities in which the magazines are manufactured can be seen in Fig. 132, which shows the pans and centers assembled on the long benches.

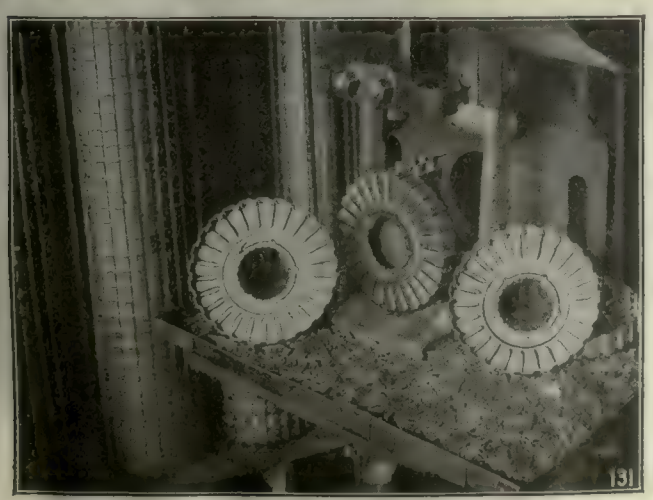
Two Unusual Milling Cuts

In Figs. 133 and 134 a method is illustrated for taking unusually awkward cuts which have to be milled in a forging known as the gear case. This part houses the main spring and the gear which meshes with the rack that forms part of the operating rod, the rack and the striker. This striker is carried by the top projecting lug of the rack, and the piston is screwed into the rack and held by an assembling spring. The gear casing is machined out from the top to form a pocket which incloses the gear for nearly its full diameter, and it therefore presents an interesting problem in manufacture for its interior at the bottom must be swept out to a radius a little larger than the outside diameter of the gear. There is a central opening through the side walls, but this does not allow any ordinary type of recessing tool to be applied. The character of the work can best be seen by referring to Fig. 133 where a partly finished case is shown in front of the milling fixture.

Milling of the greater portion of the chamber in this gear case is accomplished with a novel cutter application. The forging is held in a clamping fixture on the table of the milling machine, and its correct location assured by suitable supports and by side stops against which it is secured by a swinging clamp and screw at the front. The machine spindle is fitted with an attachment carrying a short arbor on which is secured a gear for driving the cutter, and the latter is rotated by direct action of the gear teeth which mesh into the teeth of the cutter itself. The cutter teeth are of special form to allow the gear teeth to drive it with smooth action and without contacting with the cutting edges and so injuring their faces. The driving pressure is taken at the backs of the cutter teeth and the backs of the gear teeth are relieved to special contour to provide sufficient clearance to prevent injury to the edges of the cutter teeth as the tooth curves roll apart.

The Cutter Used

The milling cutter is recessed in each face so that the ends of the teeth have considerable overhang beyond the body. A short stud is provided for supporting the cutter, and its ends are housed in a forked support extending downward from the attachment, as clearly shown by the engraving. It will be noted that the forked sides are bent inward to a close fit to the





FIGS. 131 AND 132. RIVETING AND ASSEMBLING MAGAZINES
Fig. 131—Riveting retainer clips on pans. Fig. 132—Assembling magazines

recessed portion of the cutter body and they are finished to a dimension that enables their outer faces to clear the width of the gap milled out in the work when the cutter is fed down into the forging. In other words the total thickness of the supporting bracket forks for the milling cutter is less than the width of the cutter teeth, hence the necessary clearance is obtained for the sides of the cutter carrier.

SEQUENCE OF OPERATIONS

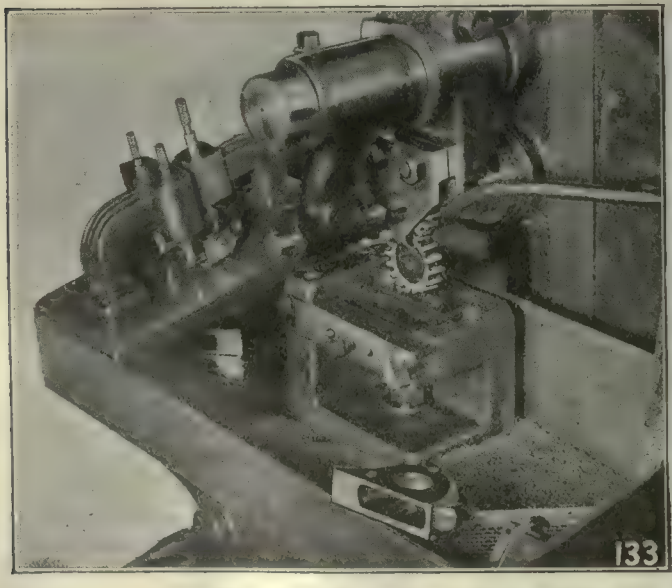
1. Rough-mill for operation 2.
2. Mill surface on top of taper, leaving 0.010 to finish later.
3. Spot, drill, ream and bur.
4. Mill front and rear end.
6. Profile inside shape to size, right side.
7. Profile inside shape.
8. Profile inside shape to size, left side.
9. Profile inside shape to size.
10. Mill form shape over locking slot.
11. Rough under side of radiator brace.
12. Rough locking face.
13. Straddle-mill bottom brace on both sides.
14. Drill and ream barrel hole and face rear end.
15. Bore face, ream casing hole, turn outside to size and tap radiator clearance hole (rough).
15½. Bore face, ream casing hole, turn outside to size and tap radiator clearance hole (finish).
16. Drill and ream piston hole and assembling hole.
17. Grind face.
18. Shave rack clearance.
19. Straddle-mill rear boss.
21. Profile radiator clearance hole.
22. Profile air-clearance cut, roughing cut.
23. Profile right and left corners of air space.
24. Finish profile air-clearance cut.
25. Profile sides to match receiver at rear end.
26. Profile rounded corners on bottom brace.
27. Butt mill corner, right and left, under sides of table.
28. Rough under side of radiator table, stopping at beginning of round corners.
29. Profile right and left corners on under side of radiator table.
30. Finish under side of radiator table.
31. File to fit radiator.
31½. Rough-polish platform.
32. Finish locking face.
33. Rough cut locking slot.
34. Finish locking slot.
35. Drill and ream locking-pin hole.
36. Mill locking-stop shoulder.
37. Profile top side of radiator table finish.
38. Profile sides of radiator table, cutting off position lugs on sides.
39. Profile under side of table.
40. File body of locking piece.
41. File under side of table.
42. Counterbore barrel seat.
43. File to fit receiver.
44. Disk-grind table to match receiver.
44½. Corner sides.
46. Harden.
47. Polish radiator casing locking piece (complete).
48. Bur corners and file to fit rear casing and screw on rear casing.

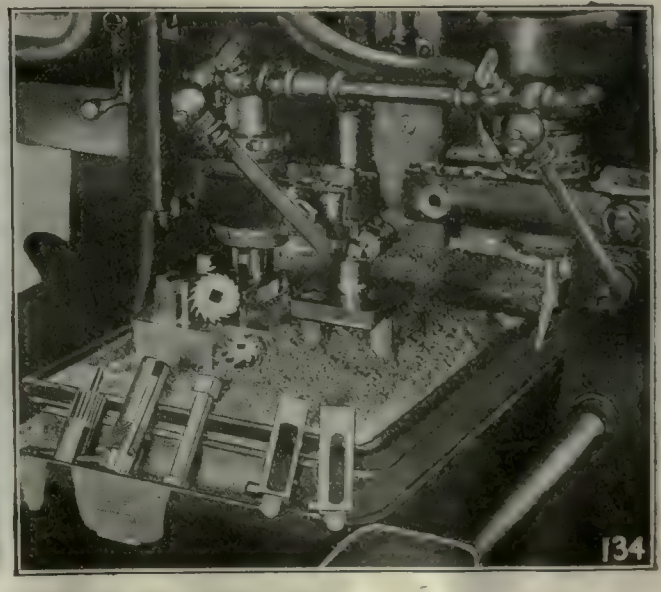
Following the milling of the gear casing the work is gaged by the fixture shown to the left. This is applied to determine if the side walls are milled internally to correct dimensions and in one plane. The test is carried out by means of the three plugs mounted in the upright brackets on the gaging fixture. These plugs are finished with shoulders that are intended to come flush with the top face of the brackets. If a piece of work should be slightly off from its required position in relation to the center line or wall of the forging the flush pins would show this condition immediately. The width of the cut is checked for accuracy by means of plug gages slipped in from the open end.

After this milling operation has been performed a second cut is taken on a profiling machine to sweep out the lower portion of the case and finish the corners without widening the chamber produced by the operation as described above. For this second cut a type of tool is employed which will be noted in Fig. 134.

The large opening at the left side of the gear case has been counterbored before work comes to the profiling machine for finish-milling the interior, and this opening through the side wall allows the profiling principle to be made use of; that is, with a cutter inside the work profiling movements with guide pin and form control may be utilized to control the action of a cutter operating at a point entirely inclosed and obscured from observation.

The cutter lying on the face of the fixture on the profiling machine is convex and of the radius desired inside the work. Its central hole is square instead of round, and its faces are smooth so that it cuts only on the circumference. The square hole is to allow it to be driven by a shank of similar section formed on the lower end of the cutter arbor. The cutter is slipped into the chamber as already milled and the squared arbor fed down by the spindle to enter the similar hole in the cutter. This gives the driving connection, and the work from now on consists in operating the machine table as for any regular job of profiling, the operator controlling the movements by the guide pin in the form plate at the right. The operation is rapidly performed, as only a limited amount of material remains to be swept out by this second cutter.





FIGS. 133 AND 134. MILLING AND PROFILING OPERATIONS
Fig. 133—Sweep milling the gear case. Fig. 134—Profiling the gear case

Elliptic Gears Built Up From Segments

By ROBERT MAWSON

A brief description of the tools and methods used in machining a part that is a little out of the ordinary routine and for the purpose of stimulating the ideas of mechanics who may be called upon to produce similar parts.

THE movement of the printing bed of the Whitlock "pony" printing press is accomplished by elliptic gearing for the purpose of securing an even, rapid traverse while the paper is under impression, and a smooth reversal at the end of the stroke with the least possible shock or jar. The gears used for this purpose are built up from segments which have been cut separately, and are then bolted to a flange or web.

The jig for drilling this web is shown in Fig. 1 with the web casting attached. A stud on the under side of this jig fits into the bore of the web, which has previously been bored and faced, and the contour of the web is brought to match that of the jig. In this position any convenient hole is drilled, and a plug is passed through both jig and web to definitely establish their relation while the rest of the holes are drilled.

The segments have corresponding jigs to locate the holes necessary to bolt them to the web. One of these jigs is shown in Fig. 2. It will be noticed that the segment is located with reference to the drill bushings by two hardened-steel tooth profiles *A* fitting into opposite end tooth spaces of the segment. The work is held in contact with these locating blocks by the thumbscrew *B*, while two hook bolts *C* hold it against the pressure of the drill. The surfaces *D* are ground to a true plane extending slightly above the work, and it is upon these surfaces that the jig rests, as shown at *E*, during the operation of drilling.

An assembling stand is shown in Fig. 3, which can be set at any convenient angle to enable the operator to handle the job most efficiently. The tilting baseplate has two fixed studs located at the proper center distance, upon which the flanges, or webs, are placed and mating segments bolted to each of them. These two segments

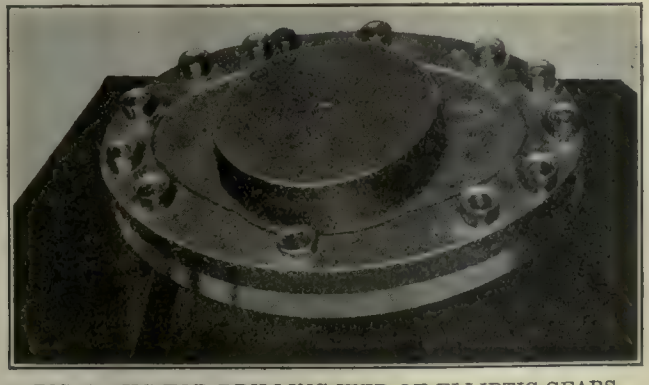


FIG. 1. JIG FOR DRILLING WEB OF ELLIPTIC GEARS

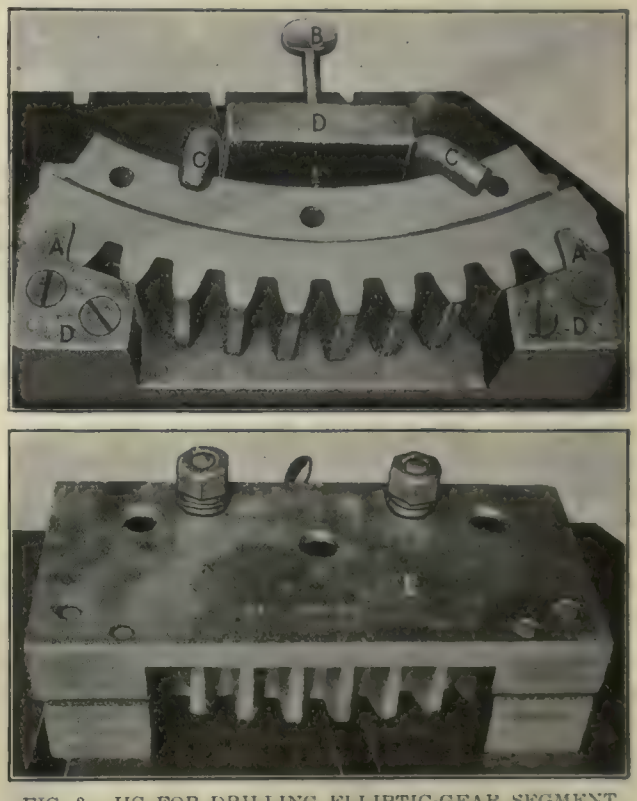


FIG. 2. JIG FOR DRILLING ELLIPTIC-GEAR SEGMENT

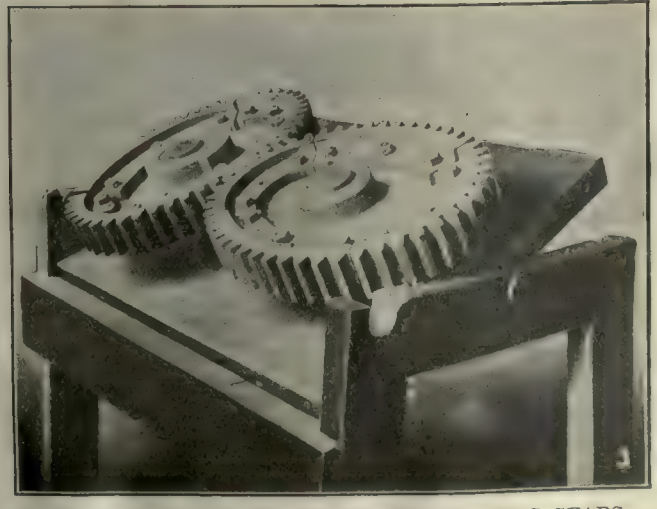


FIG. 3. ASSEMBLING STAND FOR ELLIPTIC GEARS

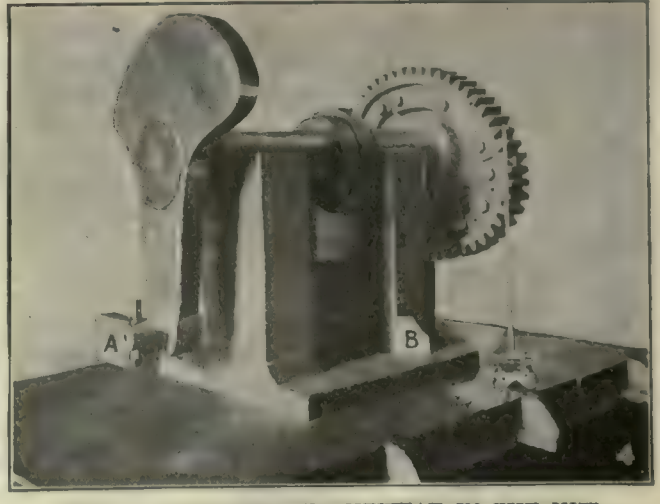


FIG. 4. LOCATING THE KEYWAY IN THE HUB

then receive such slight adjustment as may be necessary, the high spots are filed and the segments made to work smoothly together. Similar treatment follows with each additional segment until the completed gears may be rotated without appreciable backlash or binding.

The accurate relation of every part of a printing press is absolutely essential, and to assure this the location of the keyway in these gears is determined after the gears are finished. A crankshaft and crank are mounted in the fixture shown in Fig. 4 and the crankpin brought to bear against the block *A*. The gear is then put in place on the outer end of the shaft in which the keyway is already cut.

A gage (shown standing on the base of the fixture at *B*), which is made in the form of a gear-tooth profile and has a center line drawn across the back, is then placed in the tooth space at the junction point of two certain segments and the line on the gage brought to coincide with the scriber of a height gage which has been set to the exact center height of the shaft. The position of the keyway is then scribed in the hub of the gear in the usual manner.

Inventing as a Business

By JAMES LESLIE LANE

Inventing does not consist only in "getting the wheels to run" and forwarding a list of claims to the Patent Office. Many a machine that fulfilled all that was expected of it in a mechanical sense never had a chance to repay the man who conceived it because the field of its usefulness was too limited. The tyro is here given advice by the man of experience.

"WELL, Mr. Lake, what do you think of them?" As Robert spoke he leaned across the table toward his companion and studied the prints before him with no little pride. They had been worked out with the greatest attention to detail and were well drawn, for whatever he laid his hand to Robert had a habit of doing well. If it had not been for this thoroughness and a considerable natural aptitude for mechanics he would not have been at 23 the head designer of one of Chicago's largest special machinery builders and spoken of among his associates as a chap who would undoubtedly be heard from later.

Although he already had several minor inventions to his credit, which he had developed for his firm and which had all proved unusually successful, this was his first venture into the inventive field as a free lance. The sheets were the working drawings of a filler wrapping machine, the idea of which he had hit upon several months before while doing some consulting work for an outside firm.

The field had seemed a promising one, and after consulting a banker who had agreed to finance matters he had plunged into the task of designing it with his customary energy, doing the work at home evenings on a table in his room. The idea called for a continuous wrapping mechanism to replace the slow piece-by-piece hand method, and involved several complicated movements that had taxed his ingenuity to the utmost. However, after three months of persistent effort he had finally solved the problem to his satisfaction.

When it was finished Robert took the drawings to Mr. Lake for his friendly inspection before handing them to the banker. Several years before the older man had set up in business for himself as a consulting and developing engineer and had built up an extensive practice in the industrial field. He had known Robert since he was a boy and had more than once aided him in difficult problems when he was appealed to, for not only did he admire the boy's energy and clean-cut ways, but, being a free lance himself, he sympathized with his ambitions.

For several moments he sat studying the prints with a speculative eye. Then tilting back in his chair he removed his glasses and wiped them carefully, an unconscious habit of his when he was trying to settle some abstruse point.

"Before answering your question Robert," he said at length, "I want to ask one. Is this machine the only one you have in mind? Did you work it out because you thought there would be money in it, or was it because you wanted to get into that line of work—to take up the development of new ideas as a business?"

Robert had been expecting something entirely different and for a moment he was nonplused. He began to wonder what the other was driving at.

The True Reason

'It was mainly the latter reason," he replied. "Of course I did expect to make a little money at it, but more than that I hoped it would prove a stepping stone to something else. It's the only kind of work I would care to spend my life at, but getting started is a difficult job. Unless a fellow has something to show, no one is willing to give him a chance. And if he has never had a chance how is he going to convince others of his ability? That is what I hoped it would do—prove an entering wedge that would get me a hearing on something bigger later."

Mr. Lake smiled, for having once been in the same predicament he realized what the boy was confronted with. "I thought so," he replied. "And now I'm ready to answer your question."

"You like it?"

"From a mechanical standpoint, yes," was the reply. "I'd go on with it by all means."

"And you think it will prove a success?"

The older man smiled.

"Well," he laughed, "that depends a great deal on what you mean by success. As a mechanical proposition I have no doubt it will do all you claim for it. The idea is a good one and the design excellent. Still, from a financial point of view, I hardly think it will prove a gold mine. Indeed I should say that if you broke even on it you would be lucky."

"But why?" Robert demanded, somewhat crestfallen. "It will cut labor cost in half and the call for it is there."

Lake nodded.

"I know," he said, "but a great many things besides mechanical perfection determine the money possibilities of an invention. Development of special machinery is a business—a profession in itself. It has to be studied just like story writing or architecture if an engineer is to be successful at it. He must learn not only design, but what to work at and what to let alone. If he doesn't he will be wasting about half of his time on nonessentials.

"The best illustration of what I mean," Mr. Lake continued, "is an incident that occurred early in my own career. Shortly after I had hung out my shingle a chap came along with some rough sketches of a machine for sewing on buttons. He was a tailor by trade, and having conceived the notion that he could monopolize the suit-making industry with it he brought the idea to me to be worked out. If I had been older at the game I could have told him offhand what I came to realize only after the machine had been built—that the call for it was more imagined than real!

Cost Percentages

"What we both failed to see was that since the cost of sewing on buttons was an infinitesimal item compared with the manufacturing price of the whole suit a saving of labor on this operation alone would not give the manufacturer any appreciable advantage over his competitors."

Robert saw the point.

"You mean then that if such a machine is to be valuable it must effect a saving on some major operation?"

Lake nodded.

"Exactly," he replied. "If its cost is to be justified the saving must be a real one. In other words the net expense a manufacturer is put to in turning out a finished article must be reduced, allowing him a larger profit than before.

"A good example of this is the manufacture of small nuts, studs and capscrews. Many years ago, although the automobile industry had not created the enormous demand for them that we see today, the annual number required ran into the millions. The process of making them was slow. Each had to be turned out on a small lathe by hand, the various operations being separate. The result was that the money expended on labor per piece was high, even though such labor was then comparatively cheap.

"The call for the product was real and the manufacturer did not need to spend a great deal in advertising. Usually it was just enough to keep his name before the public, since one brand was about as good as another. His main expense was for labor, material and overhead. When it came to determining the actual cost of each part it was generally found that the labor cost exceeded that of both material and overhead combined.

"Here then was a real demand for improved production machinery, and when the development of the automatic screw machine placed such an instrument in his reach the manufacturer was not slow in adopting it. The reasons for doing so were obvious. It secured to him greater profit, due to decreased labor cost, and better still it gave him an advantage over his neighbors, since he was now able to undersell them and increase his sales—a tremendous asset where competition was so keen.

"Added to this was the fear that if he did not take advantage of the opportunity and keep abreast of the times other and more progressive competitors would, and undersell and outdistance him."

Robert nodded his appreciation.

"Practically forced into it, eh?"

"Precisely," said Mr. Lake. "And since he could well afford to do it the inventor profited accordingly. The main thing, from his point of view, was that there were a great many such manufacturers. The cost of drawings, patterns, experimental work, etc., made the expense of building the first automatics so high that they barely repaid him. Where he made his profit was in duplicating them later for other firms after the machines had been standardized.

"There are probably a dozen other good examples," he continued, "but this illustration is sufficient to enable us to lay down certain conditions that must exist if the inventor is to receive any great return for his work. The first is that the labor per piece expended on the product must be considerable; second, the demand for the article must be wide, and third, the number of manufacturers engaged in producing it must be large."

"That, you think, is the reason my machine is not likely to prove a success?"

Condition of the Sales Field

"Yes, it's one reason," admitted Lake, "but there are others. To begin with the conditions in the field are entirely different from those in the one just referred to. There the demand for the article was established; here it is not. Where the screw manufacturer expended a great deal on labor and little on advertising, the people you propose to deal with find things exactly the opposite. The demand for their product, since there are other things on the market that serve the same purpose, has to be created. Their manufacturing methods are inexpensive now, and for every dollar they spend in making their product they spend a hundred in advertising it.

"In the nut and screw industry competition lay in the matter of production; here it is competition in advertising. And this burden so far overtops the other that even if you could cut their manufacturing cost in half you would not give them any considerable advantage over others in the field. As it is your machine only effects a saving at one stage of the work.

"Now if it were the advertising burden you were cutting in half it would be a different story. You get the idea, don't you?"

"I think so," said Robert. "And I see now why the returns probably would not pay for the cost of patterns and drawings. It's because there are only two or three manufacturers who could use the machine, even if it proved a success. What I don't see though is why you advise going on with it after what you've told me."

"Because," replied Lake, "you are anxious to get into the game of developing as a life business. You must

make a start somewhere; must, as you remarked a moment ago, have some tangible evidence of your ability to show people. This piece of work will do that for you. It will bring you in touch with men and get you a chance later at something really worth while. You will have to learn all the ins and outs of the game just as I did, and there is nothing better than a financial failure to teach a man that."

Robert folded the prints and rose to go, but Lake restrained him.

"A moment more," he said. "While we are on the subject we might as well finish it, Robert. You expect to protect the idea, don't you?"

"Yes, I did intend to," his visitor admitted. "However, after what you've told me, I don't know whether to or not. It seems like a waste of money."

"Not if it teaches you anything," was the rejoinder. "And I'm sure it will. A clear conception of how to set about protecting an idea is as important as knowing how to handle the mechanical end of it.

"I have always thought," he went on, "that this was one weakness of the ordinary run of inventors. They know how to originate but not how to secure their rights. The majority imagine, along with the general public, that all there is to be done in such a case is to go to a good lawyer, have him draw up a lengthy petition with an imposing list of claims and forward it to the Patent Office."

"Isn't it sufficient if the lawyer consulted is a good one and knows how to draw up his claims? If he makes them broad so that the idea is fully covered?"

Lake shook his head.

"Far from it, Robert, except where the idea is simplicity itself and there is no other practical way of accomplishing the same end. An engineer that is on to his job never contents himself with taking out a patent. He takes out several."

"Why more than one?"

"Because," replied the older man, "practically every end can be attained in various ways. If you are to reap the advantage that comes from being able to produce a thing more cheaply than a competitor you must protect all the different ways by which this might be achieved."

"It's like keeping burglars out of a house," he concluded. "Locking the front door is useless if the windows and rear door are left open. He would get in anyway. The thing to do is to bar them all."

Two Tools for Heavy Lathe Work

By Vilas H. Jackson

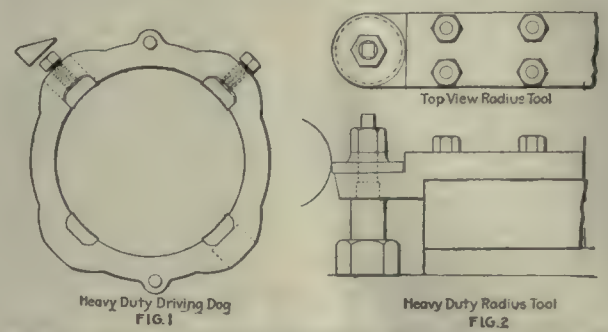
Much of the heavy lathe work that falls to the lot of the machine shop handling marine repairs consists of propeller and thrust shafts, rudder posts and connecting-rods, the forgings for which, of wrought iron or machine steel, are very rough and considerably over size, there being as much as 3 in. of stock to be removed in places, and the contour of the forging at times resembling a relief map of the Rocky Mountains.

Fig. 1 is a driving dog, the frame of which is a steel casting having tool-steel gripping pieces with serrated bearing surfaces inserted in the frame to do the driving. Brackets for the driving studs are cast integral with the frame, and there are two holes in the latter for bolting the dog to the faceplate when it is desired to swing up the work in the steadyrest.

In turning shoulders in these parts it is necessary to leave generous fillets, and to accomplish this efficiently I designed the filleting tool shown in Fig. 2.

The holder is made to fit over the toolholding studs with which these heavy-duty lathes are usually provided and is made of machine steel. The cutter is a disk of high-speed steel with its upper surface ground concave and with one quadrant serrated or toothed in order to break up the chips on the roughing cut.

This disk is mounted on the holder by a stud which



FIGS. 1 AND 2. HEAVY DRIVING DOG AND TOOL FOR LARGE FILLETS

extends through the latter and is fitted with a nut on its lower end to bear on the surface of the cross-slide and thus furnish a point of support directly under the cut. A nut on top of the stud holds the disk in whatever position required. The serrated quadrant of the disk is presented to the work until the surplus stock is removed, and then by loosening the binding nut another section of the tool is brought into service for finishing.

By this means one quarter of the tool may be kept sharp indefinitely and used only for the final scraping cut each time.

Top Rake for Threading Tools

By Toni Fazio

Here is a little suggestion in cutting V-threads, especially if the pitch is coarse or on long screws where there is a tendency to spring.

Instead of grinding the tool to an angle of 60 deg. a better way is to grind away the right side so that it will do no cutting, and to grind a top rake on the remaining lip, virtually making it a side-cutting tool. Then set the compound rest on the lathe to 30 deg. and instead of feeding in with the cross-feed screw use the compound screw so as to follow one angle of the V.

At the end of each cut back out with the cross-feed and for the next cut, return the cross-feed to the same position as indicated by the micrometer dial (which must be set on the first cut) and advance the compound screw for the feed.

The idea is that the V-shaped tool has a greater cutting surface than the side-cutting tool, thus causing a greater strain on the work. The rake on the side-cutting tool cuts the metal off more readily. For cutting left-hand screws the tool would have to be ground the opposite way and the compound rest set to the left instead of to the right.

Special Graduating Machines

By J. V. HUNTER
Western Editor *American Machinist*

Machine-tool manufacturers who have made use of machines for graduating the dials and scales on their machine parts have usually built them because there has never been sufficient market to justify their manufacture. One machine-tool manufacturer has built two machines for this purpose which are here described.

THE machines described in this article were designed by the Oakley Machine Tool Co., Cincinnati, Ohio, for graduating circular and flat parts of its universal grinding machines.

The machine built for graduating circular parts is illustrated in Fig. 1, and the part to be graduated is shown at *A* with the graduations at *B*. The tool *C* used for marking the graduations operates with an up-and-down stroke and is actuated by a ratchet cam *D*, Fig. 2, having four short prongs and one long one, so that every fifth stroke gives a long line for division mark. The part to be graduated is mounted on an arbor *E* supported by the sleeve *F* in which it revolves.

The dividing movement used on this machine is shown at *G*, and will be fully decribed later in conjunction with the same type of movement used on another machine. Suffice to say that this movement gives one-quarter turn to the shaft *H* to each revolution of the handwheel *J*. When the shaft *H* receives this 90-deg. movement it operates through the worm drive at *I* to give a 1-deg. movement to the arbor *E*.

When movement of the work from one division to another is completed, the ratchet cam operates on the graduating tool to lift and make the required mark, whereupon the tool again drops down into its rest position while the next division is being made.

The drive for this work is all done by means of the handwheel *J* and the operator must give this handwheel one complete turn for each graduation mark made.

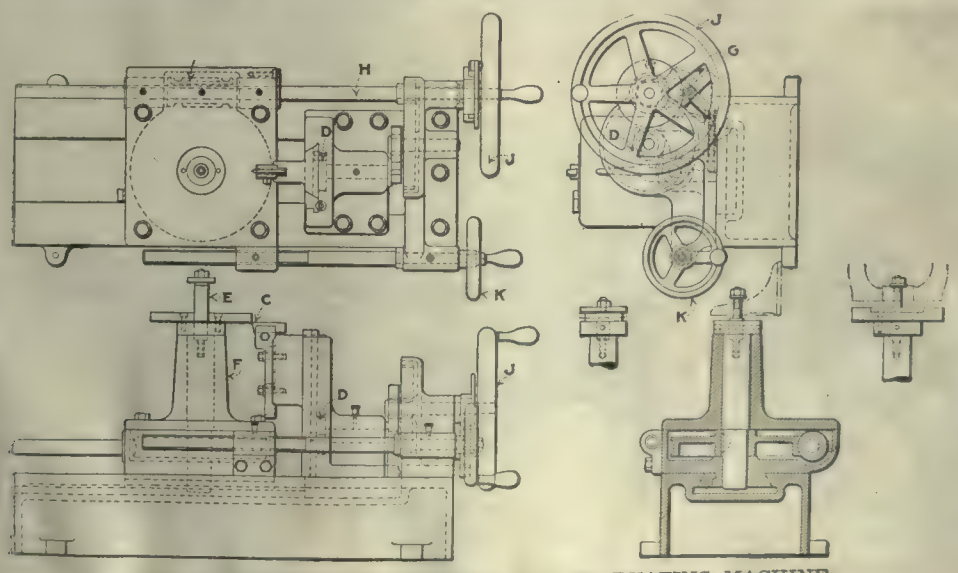


FIG. 2. DRAWING OF CIRCULAR-DIAL GRADUATING MACHINE

It will be seen that the sleeve *F* which carries the arbor is mounted on sliding ways on the base of the machine; this provides for adjustment within wide limits so that great variations are permissible in the sizes of parts which may thus be graduated. This adjustment, which also brings the work into contact with the cutting tool *C*, is done by means of the small handwheel *K*. When this sleeve is moved the worm *I* is at the same time carried along the shaft *H* upon which it slides.

After the graduating has been completed the part is

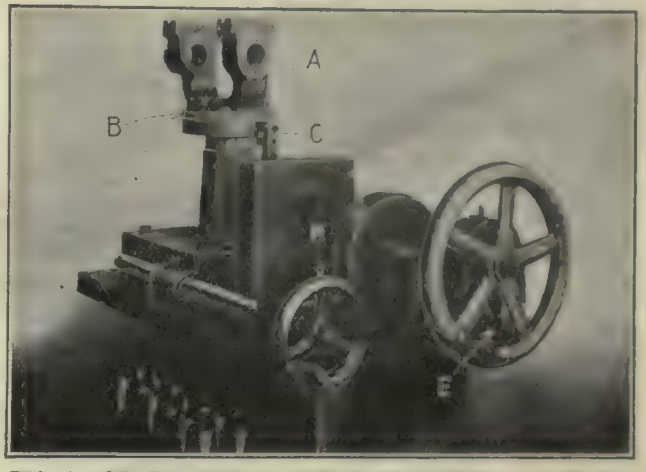


FIG. 1. GRADUATING MACHINE FOR CIRCULAR DIALS

taken to the machine shown in Fig. 3, where the numerals are pressed into the surface above the corresponding graduations. In this illustration the graduated part is again shown at *A* with the graduations showing at *B*. The part which does the marking of the numerals is the ring *C* which carries small dies *D* projecting slightly from the ring and bearing the proper numbers in sequence. These are removable so they may be replaced in case of damage. It will be seen that the part *A* is mounted on a revolving arbor *E*, and when it has been placed in the proper position with regard to the numeral-marking device the dies *D* are forced into contact with it by means of the handwheel at the left.

The operation from this point is very simple, consisting merely in turning the handwheel *G* at the right, which operates through gearing to turn the arbor *E* and the ring *C* with uniform motion, and thus roll in the numerals above the corresponding graduation marks.

It will be well at this point to consider the indexing movement before taking up the description of the sec-

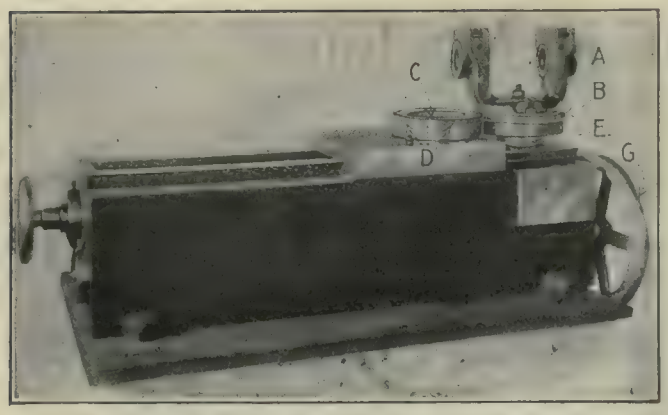


FIG. 3. DEVICE FOR ROLLING IN NUMERALS

ond graduating machine. At *A*, Fig. 4, is a sort of cam with four slots extending radially and spaced 90 deg. apart. Motion is imparted to this cam or sprocket by means of the revolving disk *C*, which has on its back a roller *D*. The disk *C* is in turn driven through a suitable set of gears by means of the handwheel *E*. As the disk *C* revolves, the roller *D* enters the slot on the right of the sprocket at *F*. When the disk *C* has revolved through 90 deg. from the point where the roller *D* first entered the sprocket groove it has revolved the sprocket 90 deg., so that the groove *F* will be standing in a vertical position, at which point the roller leaves it and continues its circular travel with the disk *C* through 270 deg. before it again enters into the next groove, which is then at the position *F*. Fig. 5 shows a machine for marking the scale graduations on the swiveling table of a grinding machine, and the indexing sprocket is shown at *A*.

The part to be graduated is the table *B* which receives its graduations on the portion *C*. The graduating tool is at *D*. It may be seen that by means of the slots *E* the tool may be adjusted in all directions.

Motion is imparted to the graduating mechanism of this machine by the handwheel *F*. One of the teeth on the ratchet cam shown at *C* in Fig. 6 strikes the lug *E* on the slide which carries the graduating tool and pushes it forward the required distance. As the slide moves forward the tooth slips under the lug which it has been working against and the springs *D* return the marking tool to its original position. Like the ratchet cam on the previously mentioned graduating device one of the teeth is longer than the others.

In order that the graduation shall start right on the table it is set with its center line under the graduating tool. By releasing the stop pin *G* and turning the handwheel the pointer *H* is brought to zero without disturbing the table setting. Replacing the stop pin connects the pointer with the graduating mechanism so that the operator can tell at a glance which line he is graduating.

As it might be desired to use this graduating machine for smaller pieces than that shown a means is provided for shifting the table by a screw shown at *I*.

The arbor on which the work is mounted is shown at *O* and the table upon which the part rests at *J*. A key at *K* fits a slot in the work and keeps it from turning on the arbor. The screw and washer *L* and *M* are for clamping the work down into a secure position.

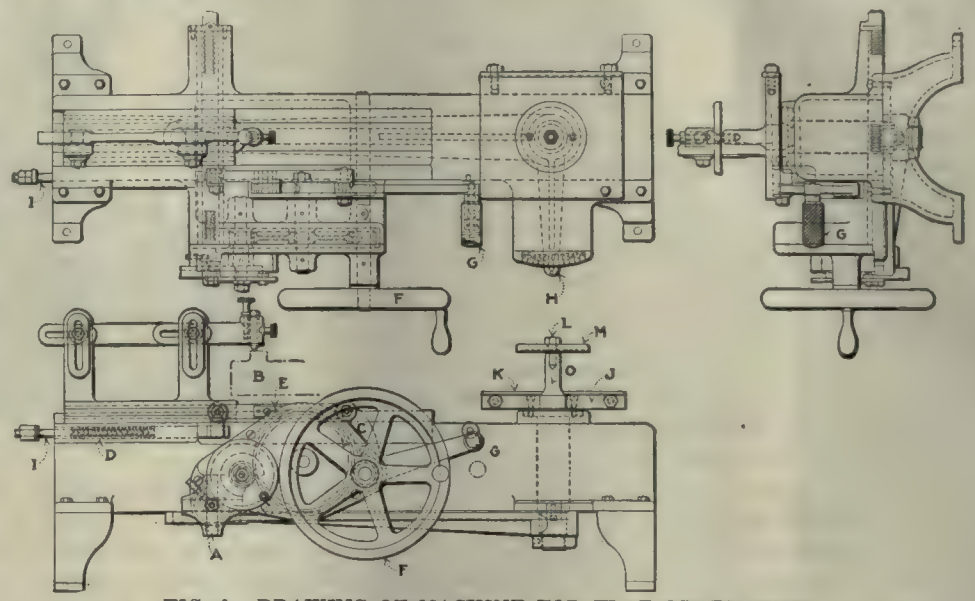


FIG. 6. DRAWING OF MACHINE FOR FLAT GRADUATING

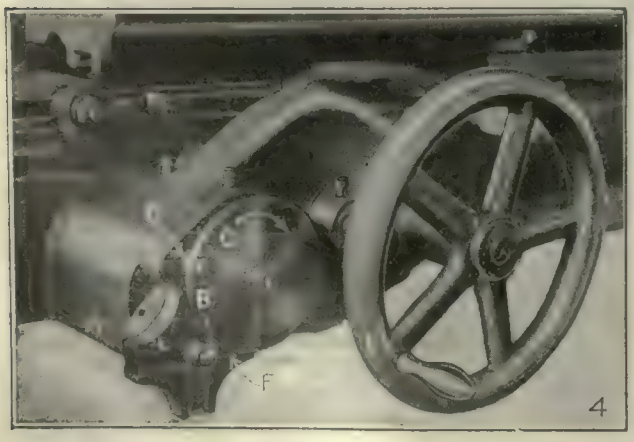


FIG. 4. THE INDEXING MECHANISM

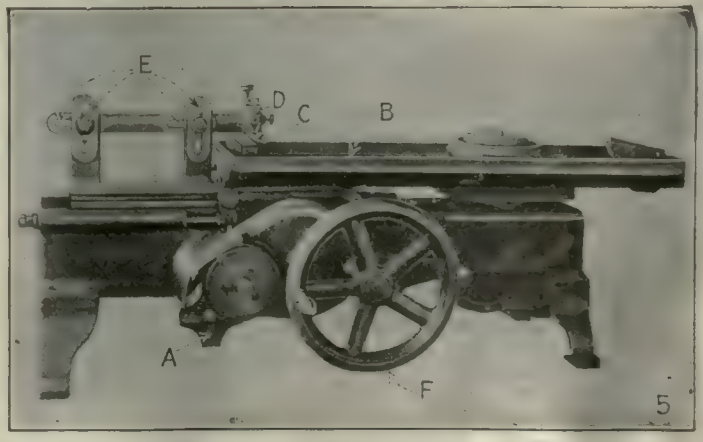


FIG. 5. MACHINE FOR FLAT GRADUATING

"Pre-Existing Condition" of the Workman and Its Relation to Compensation for Injury

By CHESLA C. SHERLOCK

The physical condition of a workman at the time of an injury is usually a factor in deciding compensation cases. Many courts hold that an abnormal condition resulting from a claimant's wilful or habitual neglect to observe the common rules of health should act as a bar to recovery, while others contend that an accident should be considered apart from such physical condition of the employee, even though said condition may be contributory to the accident or tend to hasten the death of the injured person.

COMPENSATION is payable under the workmen's compensation acts for injuries resulting from accidents "arising out of and in the course of" the workman's employment. Death is an "injury" so far as the statutes are concerned, and a man killed while at work is deemed to have received a compensable injury so that his dependents may recover from the employer.

Where the injury or death is caused entirely by the accident received while at work there is slight difficulty in determining the law in the matter and in applying the relief afforded, but it is different when it can be shown that the workman was suffering from some condition prior to the accident, which really caused the death.

If a workman having heart disease, for instance, is killed by shock caused by a heavy box falling behind him while at work, is he entitled to compensation? Has he suffered an injury "arising out of and in the course of" his employment?

Take another instance, that of a 65-year-old workman who for years has been employed at moving heavy cases that were too heavy for him and who eventually suffers a cardiac breakdown. It is admitted that no sudden strain or overexertion took place; he just naturally came to the "end of his string" because his outraged physical being was unable to serve him further. Was this man entitled to compensation?

Or, again, suppose a workman suffering from an occupational disease so that it is only a question of time until he will be incapacitated from work. He has been warned to take care of his health, and he leaves his employment to try to regain that which he had lost. His employer is in need of labor and offers him higher wages if he will come back and work a few weeks. The workman goes back and receives an injury which aggravates his disease so that the latter kills him. Is this man entitled to compensation?

These are only a few of the many problems that are constantly coming up in regard to compensable injuries under the statutes.

It is a fundamental proposition underlying the compensation laws that if a man is injured while at work, having contributed something to society's wealth, it is up to society, through the employer, to compensate him for the injury suffered. This cost of human wreckage is to be considered as a part of the cost of production and to be borne by society as other costs of production are borne. But this broad and generous principle is restricted by the statutes in some particulars. Diseases are not to be considered as compensable unless they are the result of an accident "arising out of and in the course of" the workman's employment. Occupational diseases are not considered compensable, except in Massachusetts and those other states specifically mentioning the subject in the statute, because an occupational disease is not an "accident" as that word is used in the statutes. Not only that, but a workman cannot recover compensation for something which is entirely premeditated on his part, as the statutes do not allow recovery if the accident is caused by the workman's own "serious and wilful misconduct."

In view of all of these exceptions to the general principle underlying the compensation acts, it is altogether out of reason for employers to contend that the preëxisting condition of a workman should be taken into account, and if it is found that the accident would not have killed him or injured him if he had been in full possession of his health and vigor then no compensation should be paid.

Why should the employer be called upon to bear the burden of something which he is not rightfully supposed to bear? Why should industry be taxed with such a load when it would not have been taxed if the trivial accident had not taken place? Recovery is predicated upon injury by accident due to the employment, and not to something that the workman has contracted outside the employment and having no connection with it. These are considerations which employers are urging almost daily, and they cannot be taken lightly, as they go to the very foundation of compensation practice and theory.

What does the term "preëxisting condition," as applied to compensation cases, mean? To treat the matter roughly it means that the workman is suffering from some disease or impairment which has greatly undermined his health so that he is no longer an able-bodied person and is susceptible to injury or death where a man in good health would not be in serious danger.

Often heart disease is a preëxisting condition, or it might be venereal disease, hernia, varicocele, blood poison, etc.

Our compensation acts are founded largely upon the compensation act of Great Britain, and as the British courts were brought to a consideration of these questions long before our courts, we have naturally looked first to their decisions to see how they treated the matter.

One of the first expressions to be found upon the subject of preëxisting condition was handed down in England in 1908 in the case of Ismay versus William-

son, 1 B. W. C. C., 232. Said the court: "Compensation is not necessarily barred merely because the workman's impaired physical condition at the time rendered him more susceptible to injury than a normally healthy man."

But this should not be taken to mean that the door is closed to the plea of preëxisting condition. The courts have said again and again that compensation cases cannot be determined by established precedents of decided cases, but in order that they may be tried in a spirit of helpfulness each case must be determined by the facts immediately surrounding it, and not in view of some other decision or opinion handed down.

And the English court, while ordinarily precedent-bound in common-law actions, recognized this as good law so far as compensation matters were concerned. In the case of Hensey versus White, 1 Q. B., 481, we find the court saying: "No compensation is recoverable in respect to an incapacity primarily caused by a disease or the impaired physical condition of the workman at a time when he is doing his ordinary work in the ordinary way."

Absence of Proof

Also in Wood versus Wilson, 6 B. W. C. C., 750, the court said: "There can be no compensation in the abscence of proof that the death resulted from a disease which was caused by the accident."

In Coe versus Fife Coal Co., decided in 1909, the court said: "And no compensation is recoverable for incapacity caused by cardiac breakdown which was not due to any sudden strain, but was the natural result of the workman continuing to do work which was too heavy for him."

With this slight background of English decisions in mind we can proceed to consider American cases with a clearer understanding.

The Iowa Industrial Commissioner has said: "Where a claimant under the law was at the time of accidental injury capable of performing the labor of an able-bodied man preëexisting conditions are not successfully plead in bar of compensation."

Predisposing Physical Condition

In Hartz versus Hartford Faience Co., 90 Conn., 539, and 97 Atl., 1020, it was held that "whatever predisposing physical condition may exist, if the employment is the immediate occasion for the injury it arises out of the employment because it develops within it. When the exertion of the employment acts upon the weakened condition of the body of the employee or upon an employee predisposed to suffer injury in such a way that a personal injury results, the injury must be said to arise out of the employment. An employee may be suffering from heart disease, aneurism, hernia or any other ailment, and the exertion of the employment may develop his condition in such a manner that it becomes a personal injury. The employee is then entitled to recover for all the consequences attributable to the injury."

In re Brightman, 220 Mass., 17, it was held that "where a cook on a lighter overexerted himself while removing his effects from the sinking ship and died soon after of heart disease hastened by such overexertion the accident was the cause of his death, since any act which would have been reasonable for anyone to do when leaving a sinking ship, which was his temporary home, was within the scope of his employment."

In a New York case it was held that "even though a diseased condition of a workman's veins existed before the accident, compensation may be awarded if the injury hastens to a fatal close the disease with which he was afflicted." In another case decided by the New York commission it was held that "though a workman had a cancer prior to the accident it was undeveloped, and he had been in good health and had passed an insurance examination shortly before, and the medical testimony was that such a cancer might have continued for a long time without causing illness, the workman having died very shortly after the accident from hemorrhage due to the cancer, it was held the accident increased the virulence of the cancer and caused death to occur sooner than it would otherwise have done, and therefore the case was compensable."

In Wisconsin the commission held that "where a workman in a weakened condition on account of a previous operation was struck in the side by a crane hook, the blow not being sufficient in itself to cause the empyema which followed, but exasperated or hastening the disease, the blow was the proximate cause of the injury."

An English Case

In the English courts a case came up regarding the preëxisting condition of a workman due to the excessive use of alcohol over a long period. It was shown that the workman's brain, liver and stomach were in a diseased condition due to this use of alcohol. He received a slight injury, but because of the condition of these organs he died. He would not have died had he been free from the effects of liquor, for the injury was sufficient only to incapacitate a normal man for a short time. The court, however, held that if the accident caused death to occur sooner than it otherwise would it was a compensable case.

In another English case a unique proposition was decided. A workman received a slight injury and was temporarily unable to work. Compensation was being paid him, and during this period a cardiac infection supervened, which incapacitated him for further service. The question was, Is this to be considered a part of the original accident? The court so held and awarded the workman additional compensation.

In the case of Milwaukee versus Industrial Commission, 160 Wis., 238, it was expressly held that "a blow on the head, which in all probability would have caused no serious injury to a normally healthy man but which caused the death of the workman who was suffering from an advanced stage of arterial sclerosis, may be held to be an accident."

In an English case it was held that compensation is recoverable for incapacity due to accident, although there might also have been incapacity had there been no accident. In another case it was said: "The mere circumstance that a particular man, in doing work arising out of and in the course of his employment, meets with an accident which a perfectly healthy man would not have met with, is no answer at all." And, again, it was held that the consequences of the injury were aggravated by the workman's physical condition

at the time the injury was received does not prevent a recovery of compensation.

It has been urged if the courts and commissions hold that preëxisting condition of a workman is not to be taken into consideration in computing compensation, that it will react to the injury of the workman himself; that employers will refuse to employ workmen who are not in normal health in the future, and that as soon as a workman reaches a condition where a slight accident or injury will incapacitate him or cause death, due to this existing condition of his physical being, employers will discharge him. It is urged that this would do more harm to society than to recognize the fact that preëxisting condition is not properly chargeable to the employment and that some allowance should be made because of it.

But the courts are not influenced by this reasoning. The Iowa Industrial Commissioner has said that he has too much confidence in the good faith of employers to believe that they will break faith with the compensation service by following any such course. And it has been pointed out elsewhere that should such condition ever arise in our industrial life, as where workmen were regularly examined and turned away when they developed diseases or disorders, that some sort of legislation would be devised to take care of these unfortunates.

Employers have missed the spirit of the statutes when they resist these cases. Preëxisting condition should not receive any more consideration where the workman is apparently able bodied and able to do the work of a normal healthy man than the fact that a workman was ill at some time in his life or was incapacitated in any other manner.

If a man can do his work as well as he could if in normal health, and something happens arising out of and in the course of his work which robs him of his life or his health even though a little sooner than might have been the case had he been in good health, he is, in the eye of the law, entitled to the full benefits of the compensation statute.

This is the spirit of the decisions everywhere. I do not think a proposition has been more universally argued and agreed upon by the courts than the question of preëxisting condition. These cases should not, however, be confused with those where a workman in poor health is incapacitated while doing his ordinary work in the ordinary way and no accident takes place. Such cases are not compensable.

Squaring the Ends of Shafts in a Special Fixture

By Charles K. Salisbury

We had about 100,000 ends to square on propeller and axle shafts used in military trucks. The shafts were of chrome-vanadium steel and heat-treated before machining, which made it difficult to obtain accurate work, as the material varied considerably in hardness. The limits were close, considering the nature of the material, and to prevent danger of spoiling the shafts it was found necessary to mill the squares about 0.0015 in. over size and later bring them within the required limits by hand finishing.

The method used for a considerable time was to mill one face at a time with a 2½-in. plain milling cutter, using an accurate dividing head for indexing, one No. 2 and several No. 1 Kearney & Trecker milling machines being used.

While this method gave good results, there came a time when it was necessary to increase production, and as milling machines could not be obtained, the attachment here described was designed.

As the No. 2 machine was intended to mill two shafts

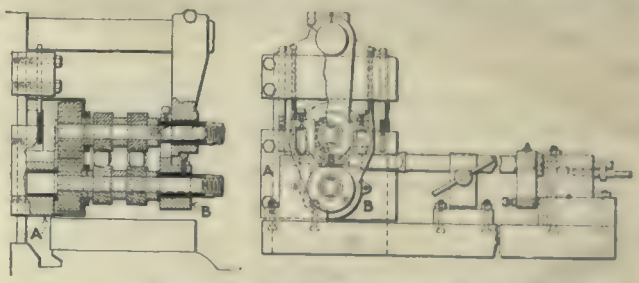
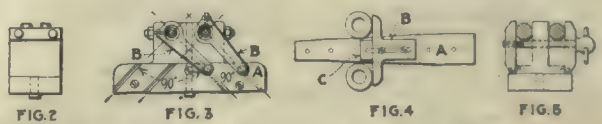


FIG. 1. FIXTURE FOR SQUARING ENDS OF SHAFT

at one time, arbors, cutters and collars of ample size were provided to reduce springing to lowest point. The No. 1 machines were intended to mill a single shaft, but it was desirable that the cutters, driving gear, etc., be interchangeable between the different machines, thus 1¼-in. arbors with 3 x 1½-in. spiral flute cutters of high-speed steel were used on all machines.

The No. 2 machine attachment for two shafts developed many difficulties in operation that did not show up with the single-shaft attachment, and for this reason the double attachment is the one shown and described.

The attachments for milling single shafts were of



FIGS. 2 TO 5. DETAILS OF FIXTURE

Fig. 2—The tailstock. Fig. 3—The headstock. Fig. 4—Setting gage. Fig. 5—Supporting vise for center of shafts

identical design, with the exception that the head and tail stocks carried single centers.

Fig. 1 shows the fixture assembled. The second cutter arbor was located directly beneath the regular machine arbor and was supported at its inner end by part *A* and at its outboard end by part *B*, both of which were vertically adjustable within very close limits. Part *A* was rigidly securable to the milling-machine column and *B* to the supporting arm, which was reversed on the machine to permit easy attachment of *B* to the studs. The lower arbor was positively driven by a pair of 8-pitch gears 2 in. wide mounted directly on the respective arbors. Each arbor carried two cutters properly spaced by a collar.

Outside of the cutters at either end of each arbor were sizing collars carbonized and carefully ground. These collars had to be true, fit the arbor perfectly and all of one size, as the accurate setting of the cutters depended upon them. These and the spacing collars were as large in diameter as practical to use and allow for grinding the cutters to their lowest diameter.

The tailstock, Fig. 2, carried two fixed centers and

the headstock, Fig. 3, two adjustable centers, which latter could be locked in position, their location with reference to their relative movement being determined by the tool-steel index plate *A*, which was doweled to the headstock. This index plate was grooved with radial slots spaced at 90 deg., being corrected after hardening.

When used with the dogs *B*, which were secured by a nut to the tapered end of the propeller shafts, it was possible to get very accurate indexing and to allow the shafts to lie very close together. A careful inspection of this system will show that the taper of the shaft may be off center to any extent without effecting the accuracy of the indexing.

The setting gage, Fig. 4, consisted of the $\frac{1}{8}$-in. thick steel plate *A* narrowed toward one end and having the edges ground straight and true. To this was secured the sliding cross-piece *B*, which could be secured at any desired point.

The method of setting the cutters was to measure their diameter (which was the same for all four cutters), calculate the distance between the sizing collars and set the cross-piece *B* by micrometer measurement, the end *C* of the slide corresponding to the center line of the collars when in contact with the gage. By then inserting the gage between the sizing collars it was easy to set the cutters to very close limits by means of the various adjusting screws. After a trial cut corrections were easily and quickly made by use of the setting gage.

Supporting the Table

As the longest shaft was over 50 in. it was necessary to extend the table, and to properly support this extension a column of cement was built up, carrying at its top an adjustable roller device which could be used to raise or lower the end of table within close limits. This was found necessary as the square was required to be parallel with the axis of the shaft.

A shaft-supporting vise of special design was used with the long shafts to prevent vibration and deflection of the shaft during the operation. It was rigid, quick in action and did not spring the shaft in any way that would effect the accuracy of the squares. It is shown in Fig. 5.

The lower cutters were lubricated by the excess oil with which the work was flooded and no trouble was experienced from this source.

The gears were carbonized to minimize wear and were protected from chips by a metal guard having heavy felt packing rings at the collars. The guards were in two pieces to allow the cutters to be adjusted and were filled with hard oil which served to lubricate the gear and to exclude minute chips.

The gears were each of 35 teeth when the cutters were new, but gears of a lesser number of teeth were substituted as the cutters were ground down. It was found however to be necessary to limit the variation of the meshing gears to one tooth (as a 33 and a 34 tooth gear), as the machine arbor did not run true and a series of ridges and hollows, the depth of which corresponded to the amount that the cutters run out, resulted where the gear teeth varied. By limiting the variation to one tooth the ridges were quite close together and were removed in the hand-finishing operation.

Where exact work is required the mating gears must have the same number of teeth, and by cutting them deeper than normal in some cases and not so deep in others close adjustments may be obtained. This work does not demand that the gears run exactly on the pitch circle.

The shafts when placed in the machine were of the temperature of the room, but the temperature began to rise steadily as the operation proceeded until the variation from this cause amounted to 0.001 in., distributed from the starting to the finishing point. This was one reason for hand finishing. To overcome this we contemplated cooling the oil and establishing a comparatively low point at which the temperature would become stable, then heating the shaft to that temperature before placing it in the machine, but this was not done.

The shafts were $1\frac{7}{8}$ in. and $1\frac{3}{4}$ in. respectively, and were milled up from 2 in. on some to $4\frac{1}{2}$ in. on others. The measurement across the flats was 1.373 in. with a tolerance of 0.0005 in. The rotative speed of cutters was about 40 r.p.m., with 0.9 in. per minute table feed. This gave over 30 hours' work before changing the cutters, which took about two hours.

The average production ran from 6 to $8\frac{1}{2}$ ends per hour, according to the length to be finished. As a comparison of the output of the double-shaft attachment compared with that of the single, the latter milled at the rate of 3.8 per hour against over 6 per hour for the same shaft on the double machine.

In an attachment of this kind close and careful work is required on the fixture itself. The limit of its work will be determined by the cutters and the power of the milling machine.

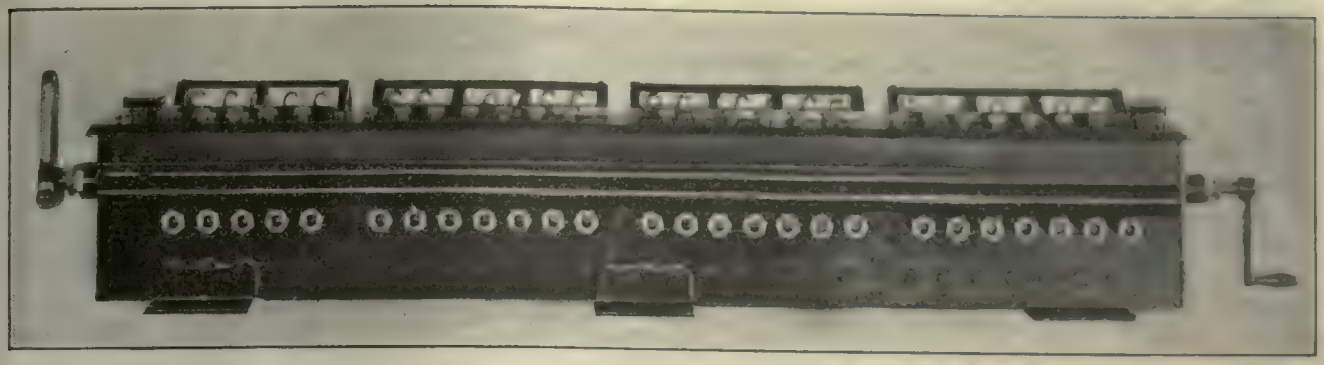
Recutting Files

By S. A. Inscoe
Wolverhampton, England

With regard to recently published articles in the *American Machinist* concerning the recutting of files A. Leigh, page 456, Vol. 49, says that there is no reason why a recut file should not be as good as a new one.

A skilled fitter or toolmaker knows a recut file at a glance and certainly has a prejudice against it. After a file has been used to its limit and sent to be recut a considerable amount of steel has to be ground off before it can again be cut; it then becomes so thin that it cannot withstand the blows of the cutting without changing its shape somewhat, with the result that when rehardened it will in most cases be found to have warped and twisted and any latent flaws intensified. Another point: Some time ago I was in an old-fashioned shop where recutting was done and I was watching a man grind the teeth off some worn files preparatory to recutting. This was not done mechanically, as I expected, but by hand on a large wet grindstone, with what results may be imagined. I have seen 8 and 10 in. flats, half-rounds and three-squares issued with which it would be a sheer impossibility to file a piece of work flat, and on account of being so light they could not be used for rough work. The only files that pay for recutting are the heavier types, such as large squares, known in some trades as "rubbers," and large three-squares.

The sandblasting and acid methods of cleaning are very crude, and in fact not much more efficacious than the wire brush, and the men who could be deceived by files so recut were probably war-time mechanics.



Manufacturing a Mechanical Lubricator—III

By M. E. HOAG

This article, the third of a series upon the methods used in the manufacture of a mechanical lubricator, goes somewhat into detail in the matter of operation upon the smaller parts which require to be finished to a high degree of accuracy. It contains a description of several sets of very ingenious tools which have been devised to secure accuracy and interchangeability of these parts, and though they are specially made for this work they embody principles that may be adapted to other work of a similar nature.

THE adjustable sleeve for the sight-feed measuring plunger, as shown in Figs. 19 and 20, is a steel drop-forging and must be very accurately finished. The piece is first drilled and reamed in the jigs shown in Fig. 21, which are of very simple construction. The body *A* of each jig has a recess to receive the work, which is held in place by the clamp *B* and the two threaded studs shown in *A*. Two slotted nuts serve to clamp the piece.

Owing to the shape of the sleeve it is not necessary to remove the block *B*, loosening the nuts giving sufficient room for inserting and removing the piece. Six jigs are used on a four-spindle drilling machine, the jigs being made to slide on the ways *C*, which are V-shaped on top and have two bearing surface on the front, as shown in the illustration, allowing the jigs to be lifted off the ways. Thus two jigs can be used on each pair of drill spindles while two extra jigs are being loaded. The drill bushings are carried on separate supports back of the ways. This combination of jigs gives a very high rate of production on this work.

After being drilled and reamed the pieces are slipped onto a plug arbor in a hand milling machine and the outside diameter rough-turned, the lug faced and the piece necked for clearance next to the lug as seen in Fig. 19. The small hole in the lug is then drilled and the piece is ready to be slotted. Reference to the drawing, Fig. 20, shows three slots which are $\frac{5}{16}$ in. long by 0.081 in. wide and irregularly spaced around the barrel of the sleeve. The making of these slots, owing to their small size, the small diameter of the sleeve bore and the thickness of the wall constitute a difficult problem for the tool designer. To perform this slotting at a reasonable cost,

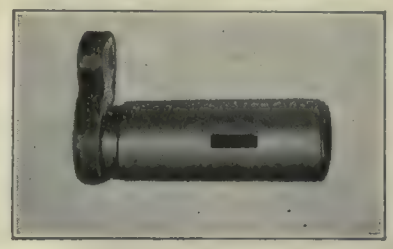


FIG. 19. THE ADJUSTABLE SLEEVE

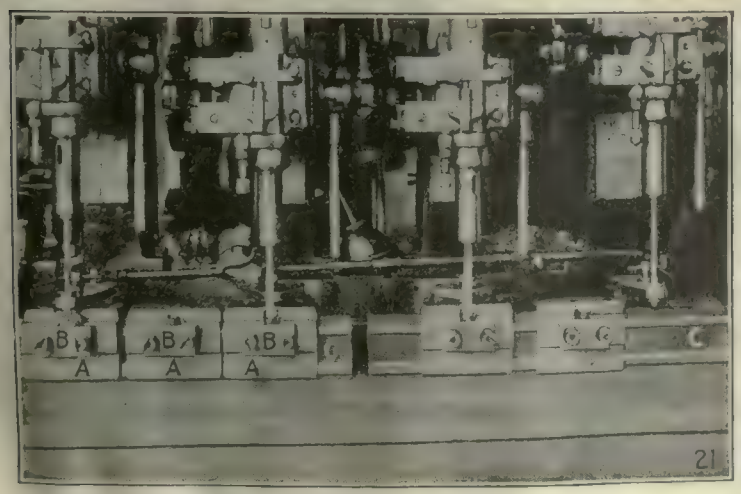


FIG. 21. DRILLING AND REAMING JIGS FOR SLEEVE

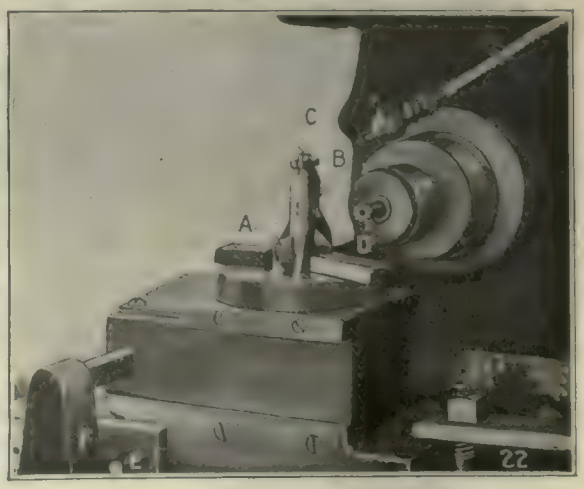


FIG. 22. FIRST OPERATION IN SLOTTING

the pieces are put through two operations. In the first one, shown in Fig. 22, which is performed on a hand milling machine, the sleeve is dropped over a hardened plug in the base *A* of the fixture, which also carries an upright *B*, on the end of which is a pin *C* which enters the small drilled hole in the lug, locating the sleeve properly on the fixture. No clamping devices are necessary, as the tendency of the milling cutter *D* is to hold the piece down onto the fixture.

The cutter is special, but it is shaped much like a Woodruff keyway cutter and it cuts the slot part way

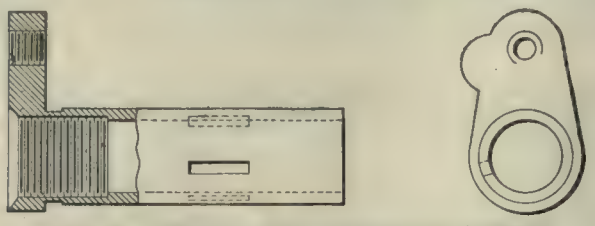


FIG. 20. DETAILS OF ADJUSTABLE SLEEVE

through the wall of the piece. The milling-machine table is operated by a hand lever, and as the work is brought back from the cutter the pin *E* strikes a stud on the fixed arm *F*, automatically indexing for the next cut. The return of the table after the last cut thus leaves the fixture ready for the first cut on the next piece. This is one of the operations handled by women, and it is surprising to note the speed attained.

After this operation the metal remaining in the slots is punched out and the openings brought to size with which receives the sleeve and the block *B* which supports the sleeve and arbor during the punching operation.

The plunger *E*, Fig. 23, and a spring located inside of the sleeve *G* holds the work in position against a block containing a locating pin in the portion of the tool *F*. To load the die the operator pulls out the plunger *E* and passes the sleeve to be punched into

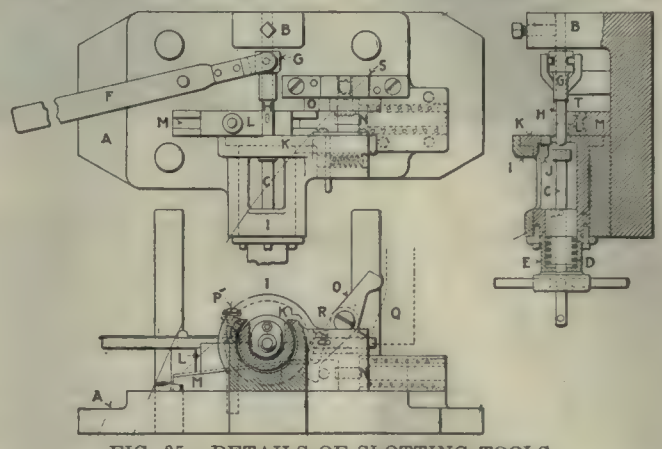


FIG. 25. DETAILS OF SLOTTING TOOLS

the opening seen in the top of the die under *F*, then through an opening in the piece *F*, onto the end of the arbor. The pin in *F* enters the small drilled hole in the lug of the sleeve and locates the slots with relation to the punch. Upon releasing the plunger *E* the spring holds the piece firmly in position.

Drawings of these dies are shown in Fig. 25. Referring to the various parts, *A* is the base, of which the

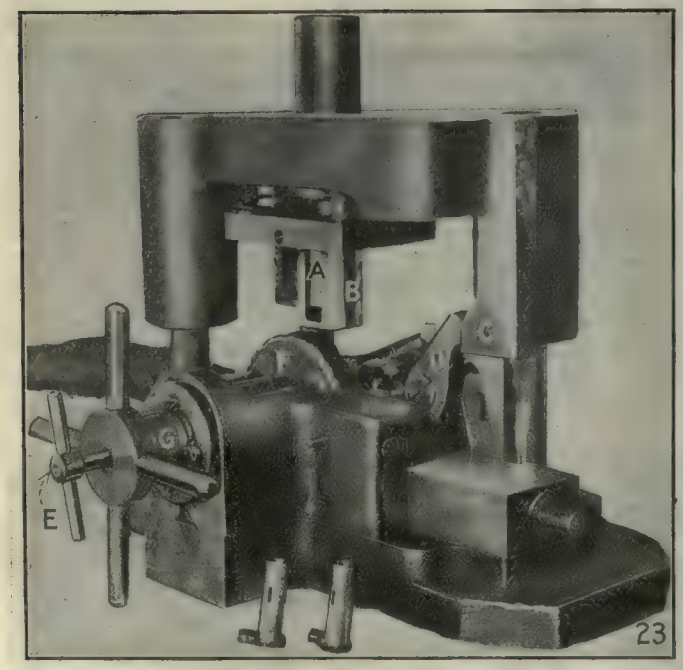


FIG. 23. TOOLS FOR THE SECOND SLOTTING OPERATION

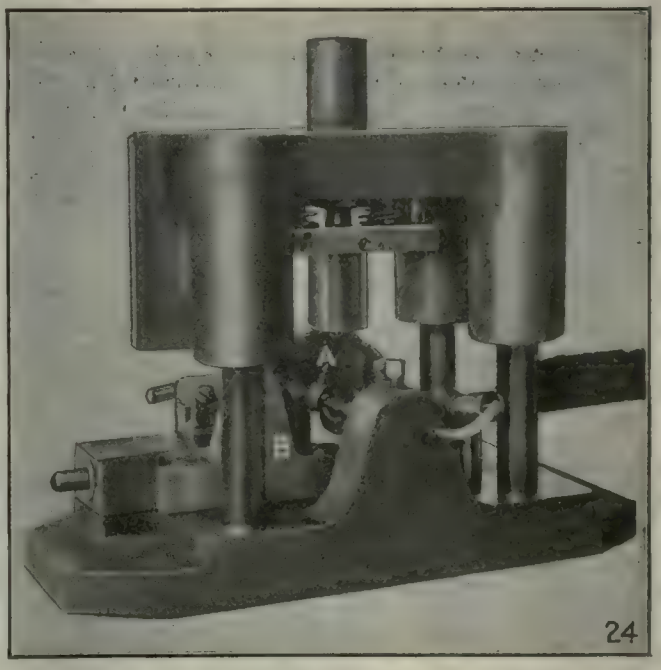


FIG. 24. BACK VIEW OF SLOTTING TOOLS

the tools shown in Figs. 23 and 24. The punch is made from ground tool-steel stock and is carried in the holder *A*, Fig. 23, being supported by the stripper *B*, which is free to slide up and down on the holder. and is backed up by suitable springs. A hardened-steel block *C* attached to the upper slide serves to operate the index lock *D*, as will be described later. The view from the back of the die in Fig. 24 shows the arbor *A* rings support *B* is an integral part; *C* is the plunger for holding the work in position through the action of the spring *D* which is held in the sleeve of the indexing wheel *E*. The hand lever *F* operates the knockout sleeve *G* which slides on the arbor *H* and forces the finished work back into the opening in the boss *I* which carries the indexing wheel *E*, the plunger *C*, the locating pin *J* and the index plate *K*. The

block *L* supports the work and arbor during the punching operation, and this block is backed up by the sliding wedge *M*, which is forced forward on the downward stroke of the press by the spring-actuated plunger *N*, being withdrawn on the upward stroke by the lever *O*, through the action of the steel piece shown in dotted outline at *Q*, which is attached to the sliding head of the tool. This same lever also operates the indexing pin *R*, which enters the notches in the index plate. The downward stroke of the press causes the piece *Q* to release the lever *O* which permits the spring-actuated plunger *N* to force the wedge *M* forward, raising the support *L* into position and at the same time seating the index plunger in a notch in the index plate, which has already been turned to position by the handwheel *E*.

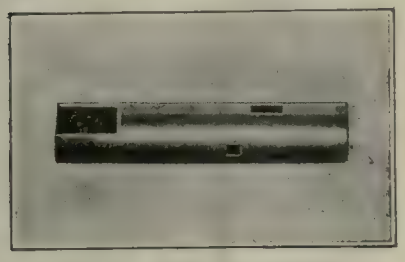


FIG. 26. THE SIGHT-FEED PLUNGER

The wedge *M* and support block *L* are held down by a spring on the stud *P*, and the lever *O* is held by a shouldered and threaded stud in the block *S*, which is doweled and screwed to the base.

An opening through the arbor *H* acts as a die for the punch and permits the punchings to fall through and pass down the incline in *L* shown at *T*.

After punching the three slots the principal operations on the sleeve are hand-reaming the hole, tapping, and grinding the outside to fit the barrel in which it is to work. This fitting must be very carefully done both on the sleeves and the plungers, for when operating against high pressure a slight variation between the diameters of the barrels and their plungers would cause a leakage of oil and the proper feed would not be maintained. The allowance for fit between these parts is about 0.0001 in., and as it would be impracticable to ream and grind the parts in lots and assemble from stock, each barrel is fitted with its own sleeve and plungers.

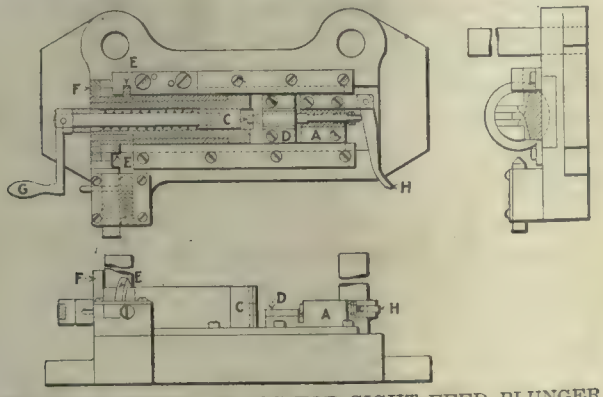


FIG. 29—SLOTTING TOOLS FOR SIGHT-FEED PLUNGER

The sight-feed plunger shown in Figs. 26 and 27 is somewhat similar to the sleeve just described in that it has three slots, but these slots are of different sizes, two of them being 0.09375 in. square, while the third one is 0.09375 in. wide by 0.21875 in. long, and they are located at different distances from the end.

The punching of these slots is done in a die somewhat similar to the one just described for the sleeves, but owing to the small diameter of the hole in the plunger no arbor is used, the punch piercing the walls and knocking the punchings through into the bore.

The dies for this work are shown in Fig. 28. It will be noted from the illustration that the punch is carried in a heavy holder and is supported by a stripper.



FIG. 27. THE SIGHT-FEED PLUNGER

The drilled end of the feed plunger is held by a spring-actuated rod in the sliding support *A* against a recess in the chuck *C*, which is formed to take the milled end of the work. A support block *D* is also provided under the work.

The most interesting feature in connection with these dies is the combination of cam and indexing plate which indexes the piece for punching and at the same time moves it endwise to obtain the correct location of the slots with relation to the end of the piece. A double throw on the cam causes the punch to make two strokes on one position of the index plate and so produces the oblong hole. The cam, index plate and handle

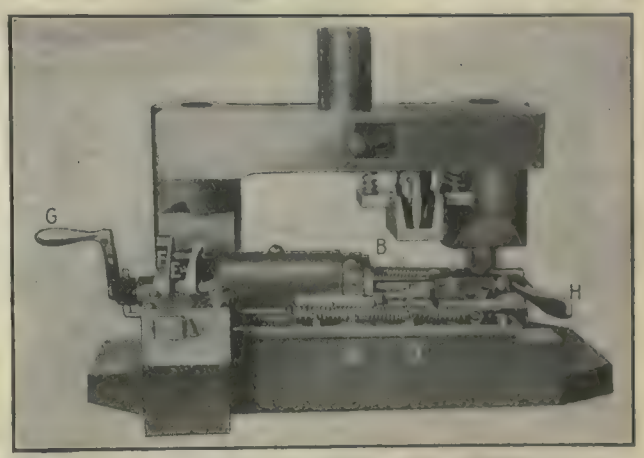


FIG. 28. TOOLS FOR SLOTTING THE SIGHT-FEED PLUNGER

which operate them are shown at *E*, *F* and *G* respectively. The lever *H* operates the plunger which holds the piece in position. The entire mechanism is moved back and forth in the base of the die by the cam which is at all times held in contact with its roller by two heavy springs *B*. Drawings of these dies are shown in Fig. 29, the various parts being lettered to correspond to Fig. 28.

In building the lubricator it is necessary to punch one or more sets of connection holes in the tanks, the number depending on the number of feeds to be served by the lubricator, and as these holes must be accurately spaced a set of dies for each size of tank would be a very expensive proposition. Also the distance from the ends of the tank to the holes varies in different lubricators so that the ordinary form of die would hardly handle the work in a satisfactory manner, therefore the adjustable die shown in Fig. 30 has been developed.

This die is built into the press and contains a number of features that might be of value on other work of

a similar character. After the steel for the tank has been sheared to size and the flange on one edge rolled, two large holes, one of which is seen at *A*, are punched. It is from these holes that the location is taken for the connection holes.

In the piece shown, two sets of these connection holes may be seen in two groups of five pairs of holes each. To punch these connection holes the stock is passed under the punches behind the piece *B*, and the large holes *A* located by the hardened plugs *C* and *D*. One of these holes, not shown in the illustration, is larger than the one that is shown, and in the case of a left-hand tank their positions are reversed, so for this reason the plugs *C* and *D* are removable and may be reversed for the purpose of handling left-hand tanks. A series of holes is provided on the right end of the carriage to accommodate tanks of various lengths. The punches are carried in the holder *E* and are supported by the stripper plate *F*. The dies are in the block *G* which can be readily removed to sharpen or replace. The rod *H* carries a number of movable pointers which are used to locate the position of the work under the punches, the position being determined by moving the carriage until the pointers come over the centers of the plugs *C* and *D*. The piece *B* operates a ratchet under the bed of the press and feeds the carriage ahead automatically as each pair of holes is punched, a rack and pinion being provided for that purpose.

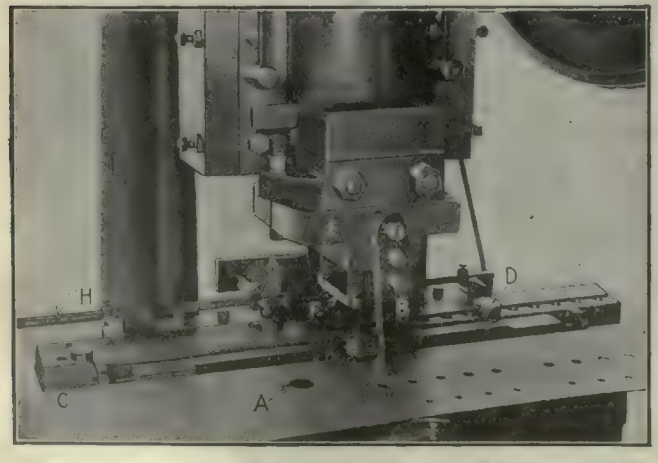


FIG. 30. ADJUSTABLE PIERCING TOOLS FOR TANKS

On the back of the carriage a heavy rack is cut for the proper spacing of the holes in the tank. Heavy springs operate a plunger which enters the spaces in this rack as the press ram starts down, positively locating the carriage which has been brought as nearly as possible to the correct position as indicated by the pointers.

A lever is provided under the bed of the press by which the workman can disengage the feed rack and ratchet, and by pushing in on the handwheel *I* and turning it at the same time can, by a clutch which is thus operated, feed the carriage in either direction to any desired position. These features are made plainer by the drawing, Fig. 31, in which the index rack is shown at *A*, the index plunger at *B* and the carriage with the holes for the locating plugs at *C*. The feed ratchet is shown at *D* and the lever which operates it at *E*. At *F* is shown the hand lever by means of which the ratchet is disengaged to permit feeding by hand.

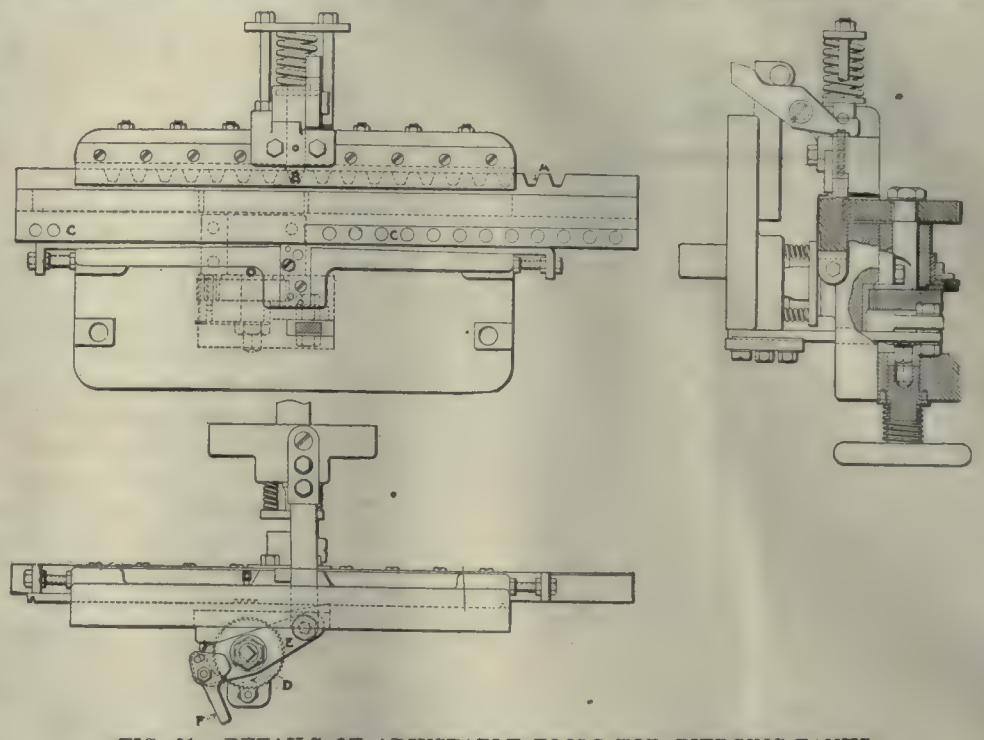


FIG. 31. DETAILS OF ADJUSTABLE TOOLS FOR PIERCING TANKS

The end view shows the arrangement of the handwheel, clutch, ratchet, and rack and pinion, and it also shows the arrangement by which the indexing mechanism is operated. It will be noted that adjustable wedges or gibs are provided for taking up wear between the carriage and the ways in the base of the die.

Fewer Business Failures in November

Business failures during November numbered only 560 compared with 674 failures the month before and 972 failures in November, 1917. Total liabilities of the failed concerns were less than $12,000,000 compared with slightly over $12,000,000 in October and slightly over $12,000,000 in November of last year. There have never been so few business failures in any month since the panic period of 1893, a full quarter century ago. In the readjustment of business to peace conditions some failures are inevitable, but every indication points to a lesser number of failures than in the corresponding months of the preceding years unless we are deluged with shipments of manufactured goods from Central Europe—goods which they have on hand and which they need much less than they need money and foodstuffs.

Markets for the American Machine Tool

By L. W. ALWYN-SCHMIDT

The effect of the late war on the machine-tool industry of the United States is of course problematical. However, it seems reasonable to suppose that during the reconstruction period which must necessarily follow the devastation of the past four years Europe would have her hands full in supplying her own needs, and other countries, especially those of South America, would naturally look to the United States to meet their requirements.

MACHINE-TOOL makers interested in foreign trade should find valuable reading in the export statistics for the last four years just published by the United States Department of Commerce. Excluding the rapid export growth of machine tools and metal-working machines to England, France, Italy and Russia caused by the war, and which most likely will subside now that the conflict is over, there has been increased exportation to markets not immediately connected with war trade which promise further growth.

England, France and Italy will not cease to buy American machine tools, and might continue to be the most prominent of our customers, but it would be a mistake for our machine-tool manufacturers to rely entirely on the good-will of these three industrially strongest of our allies and neglect to secure connections in the less active markets of Scandinavia, Spain, Portugal, South America, the Asiatic East and other parts of the world. These markets are now undergoing a great industrial reorganization which is reflected in our foreign commerce in machine tools.

Reports of Commerce Experts

There is hardly a week that United States consuls and commerce experts in Scandinavia and the Netherlands do not report some evidence of increasing industrial activity. Cut off from their usual markets of supply—England, Germany and France—they have settled down to manufacture what they require themselves. Sweden now makes piano strings and electrical, agricultural, wood-working and other machines. Norway has spent during the last year $7,000,000 in expanding her metal and mechanical industry. Nearly $2,000,000 were invested in electrical equipment, and millions more in new textile enterprises, mining, etc. Denmark has taken up the manufacture of typewriters; has extended its famous cream-separator industry, and is making electrical appliances in increasing quantities. The Netherlands has made great progress in the building of machinery; strengthened its shipbuilding facilities, founded new photographic apparatus and appliance factories and established other industries.

None of these four countries had been big customers for American machine tools before the war. The Netherlands in fact had several factories making machine tools and even has been a successful exporter. The proximity of the Belgian, German and English machine-tool industries further made it unnecessary for Scandinavia and the Netherlands to come to the United States for anything but the best machine tools, and only the latter were imported before the war from the United States.

Now the supply of European machine tools has ceased, and with a growing demand the four countries turned to American supplies. Manufacturing methods have undergone considerable change. Men have not been available because these countries took their armies off a peace footing, so production had to be speeded up to keep pace with the national demand. American labor-saving machinery was not merely a convenience but a necessity.

Denmark, which before the war averaged about $80,000 in orders for American machine tools, placed orders in 1915 amounting to $247,000 and to $338,000 last year. Norway increased her orders from $80,000 in prewar times to $356,000 in 1917. Sweden kept her purchases at about the same level as ordinary times, except that in 1915 $621,000 worth of machine tools were bought, though it has been intimated that part of this purchase was for German buyers. In 1917 the Swedish industry bought American machine tools to the amount of $313,000.

The Netherlands

The Netherlands appeared late in the American machine-tool market, as it had an industry of its own which was able to cope with the local demand during the first years of the war. Its first orders of importance was for $331,000 in 1916. In 1917 the machine-tool purchases rose to $436,000, making her the largest purchaser of American machine tools among the four leading north European neutrals.

Incomplete statistics for 1918 show that the demand for machine tools from these countries has remained about the same as in the preceding year. The question now is, Will these countries continue to buy on the same scale in future? The machine tool shipped by this country to England, France and Italy and that going to the Netherlands and Scandinavia has been a totally different kind. The first mentioned received principally special machines built for the munition industry, while those supplies to Scandinavia and the Netherlands were mostly automatic tools for general manufacturing. None of these will have to be scrapped after the war, but on the contrary they will form part of the after-war industrial equipment of these countries. It is not known whether the machine tools so far supplied have been sufficient to meet the demand, but it is thought that the American tools supplied during the last two years have been just enough to keep manufacturing going, and that all four markets will try to buy more tools as soon as they can. Having got acquainted with American tools it is almost certain that the American types will be continued with the result that American machine-tool makers will find a permanent outlet for their product in this direction.

Spain is another of the neutral countries of Europe

which has adopted American machine-tool equipment since the war began. Spanish manufacturing methods were undergoing a gradual change at the time the war broke out, and manufacturers had started to test American tools. Being thrown on their own resources by the interruption of supplies of many industrial products formerly purchased abroad their manufacture in Spain became necessary, and this immediately brought large orders for American machine tools. Spanish trade in this line, amounting to about $100,000 in prewar times, suddenly increased to $776,000 in 1916 and $1,686,000 in 1917. Conditions in that country seem to be different from those in northern European neutral countries. Unlike these Spain has accepted large orders for war materials on behalf of France and recently also the United States, and part of the machine-tool equipment sold to Spain consists of special equipment for armament factories.

Antedating the war the German machine-tool industry had in Spain one of its best customers. Now the American machine-tool industry has taken the place of the German. Recent Spanish purchases of machine tools have been larger than ever, and this may be explained by Spain not having been able to buy her usual quota of machine tools to renew her industrial equipment during the first years of the war had to increase her orders during the following years. Coupled with Portugal, which also has bought more American machine tools than ever, the Iberian Peninsula should become a very valuable customer.

Switzerland a New Market

Among the new markets for American machine tools in Europe is Switzerland. In 1917 this country bought American machine tools to the amount of $117,000, or more than six times its prewar purchases.

The sale of machine tools depends on industrial development. Only where manufacturing is done on a large scale can machine tools be employed in great numbers, and the demand of a country for them is an indication of industrial progress. The export trade in American machine tools, the only ones obtainable in the open market since the beginning of the war, should therefore be of interest to the student of international markets not only as to its effect on home industry, but as showing the industrial development undergone by many countries during the last four years. The little state of Panama, for instance, which had practically no industries in the past, is now a large buyer of American machine tools, her trade amounting to $97,000 in 1917 against $10,000 in previous years.

In Cuba numerous factories have been started, and a good deal of machinery has been imported, which in turn has raised the demand for repairing facilities. There are several shipyards on the island, and the sugar plantations require much special machinery. The effect of all this has been a machine-tool business with the United States in 1917 amounting to $334,000.

Up to 1913 the principal consumer in South America was Brazil, which took $346,000 worth of machine tools in that year. Argentina took $112,000, and Chile $43,000. Before the war South America relied almost entirely on the European manufactured goods. The then existing industry was satisfied to do repair work, and manufacturing was very limited. Conditions now are entirely different. Industries that in prewar times were merely supplementary are now principal ones. Brazil makes press buttons, toys, ships, locomotives and even machinery. Argentina, it is said, has nearly doubled its industrial capacity during the last four years. But the greatest progress seems to have been made on the South American west coast, in Chile and Peru, where American capital has been very active. Foreign commerce in South America has invariably followed investment of capital.

Brazil, being industrially the most progressive among South American countries, has been able to get along with comparatively little new machine-tools, only $55,000 having been sent by American manufacturers during the last year. Argentina, being not so well provided as her northern neighbor, took $154,000 worth. The most important buyer was Chile, which spent in 1917 on American machine tools $426,000, nearly 10 times more than her requirement five years ago. Peru raised her purchases from $40,000 to $71,000.

South American Market

The future of the South American market for American machine tools raises an important question: Will South America return to the use of European machine tools, or will it continue to purchase the American product? The reasons why European tools have found preference in South America are many. Price, design, local industrial methods and so on have favored the European article. Comparatively no doubt the American tool was more expensive. In the meantime, however, things have changed. Europe will not be able to manufacture as cheaply as before, and European machine tools will consequently become more expensive. Of course American machine tools are also more expensive than formerly, so it must be left to the future to show whether the American price increases are high enough to neutralize the increase of European prices.

The South American market requires a tool of simple design, more or less foolproof. There is a lack of trained men to handle the more complicated American machine tools. American manufacturers may decide to make special machine tools for the South American market or they may elect to send to South America engineers trained in running American tools with the object of training men there for their special work. The latter course most likely will appeal to American enterprise and it is doubtless the best.

Already there is a demand for American engineers in many parts of the world. They may go to take charge of American-owned machine shops or as representatives of American manufacturers. Other countries have followed this practice for a long time, and America may be compelled to do likewise. The engineer not only is much better enabled to sell a new machine, but he can assist in putting it up and in making necessary repairs.

As to Asiatic countries the principal markets in that part of the world have increased their purchases of machine tools in this country. China bought to the amount of $3192 in 1913 and raised her requirements to $119,245 in 1917. British India increased her purchases from $43,717 to $273,744 and Japan from $119,588 to $1,092,317. A practically new market has grown up in the Dutch Indies, the trade with these islands

being $245,000 in 1917 compared with $6366 in 1913.

The demand from Australia and New Zealand has undergone little change, but Australia offers as a whole a larger market today than before the war. South Africa on the other hand has developed a greater interest for American machine tools, having purchased to the extent of $143,582 during 1917 against $27,671 four years ago.

This all is a very good showing for the American machine-tool industry. Allowing that $50,000,000 of the total export value of $84,000,000 for 1917 consists of so-called war business the exports to markets indirectly affected by the war has more than doubled. The American machine-tool industry has had its great chance. American tools have been introduced in many shops where they were not found before and they are bound to stay. They will help to speed up manufacturing in many countries, with the result that demand will arise for additional American equipment. So the outlook for the American machine tool industry is very good even though the great war exports come to a sudden end.

Draftsman or Engineer

By E. H. Michaelis

After reading the article by G. J. White on page 907, Vol. 49, of the *American Machinist*, and that by B. H. Walker on page 1075, it does not take a clairvoyant to see, that Mr. Walker is a practical shop man while Mr. White is a college graduate. Mr. White calls attention to the scarcity of draftsmen, which he says never existed before, and later he refers to the product of night courses as half-baked draftsmen.

Let us look at the development of the kind of draftsmen we used to find in every drafting room before the war and maybe will find again. A boy having a grammar-school and possibly some high-school education or a graduate of a manual training school is taken on as an apprentice. He is shown how to make blueprints, and during the time not taken up in this work he is taught to make tracings. After he has learned how to use his drawing tools he is given some detail work, which means as assembly drawing made by an experienced engineer, in which every part is shown, his work being to copy the different parts on detail sheets. He is then shown how to give the necessary dimensions, and after more or less of this experience he feels that he has mastered his trade as a draftsman and is the equal of any college graduate.

This is the kind of draftsman of which there never was, is not and never will be any scarcity. His species is the root of nearly all the trouble existing between the shop and the drawing room, and he will exist only so long as he is given no real engineering work to do. When the war came and the Government insisted on speedy and accurate work he was unable to meet the requirements—then there was a scarcity of draftsmen.

The product of the above-described course is never anything but a so-called draftsman. He cannot fill a responsible position, and if he wants to become more than an underling, always having to be told what to do and how to do it, he must acquire some certain knowledge.

This knowledge consists of two essential parts, one the theoretical and scientific, of which Mr. White is the exponent, and the other the practical shop knowledge, of which Mr. Walker is the champion.

There has always been antagonism between the shop and the office engineer, and the reason therefor is on the one hand the contempt of the shopman for the man with the white collar, who gets his knowledge out of books and is afraid of dirtying his hands, and on the other the conceit of the college graduate and his associate, the draftsman, that he is superior to the shopman in knowledge and social position.

Both are wrong. The shopman needs the knowledge of the office engineer and the latter requires the shopman's experience. The theoretical man is as valueless without practical knowledge for the purpose of producing good work, such as designing practical tools, as the shopman would be without theoretical knowledge should he undertake to do the work of a designing engineer. I purposely use here the word "engineer," because any dub can do the work of the so-called draftsman.

A college education however is not necessary to gain theoretical knowledge. Mr. Walker is right. Any ambitious man with a little money can become as good a designer as any ever graduated. But just the same he must get the theoretical knowledge. He must study mathematics, mechanics, etc., which he can do by taking a course in a good correspondence school or by studying a good technical library. And if he has sufficient willpower to stick to his studies he can become just as good an engineer as the college man.

And just as the practical man has to acquire theoretical knowledge if he wants to become a designer so must the college graduate acquire practical knowledge before he reaches practical efficiency. His college may have given him the title of engineer, but in order to be an engineer he must have acquired a considerable part of the shopman's experience. For that reason it is advisable for him to start his career as a detailer in the drafting room, but he should be given the opportunity to follow up the work that he puts on paper. In order to gain the practical knowledge necessary to supplement his theoretical education he should be allowed to study methods in use in the shop and get whatever information he can from the viewpoint of the shopman.

To become a real designer a man has to spend at least four years in school and three in the shop, or he has to learn his trade as a machinist, which takes four years, and then study evenings and in spare time to get the theoretical knowledge.

What inducement has a man to spend time, money and work to gain the knowledge necessary to fill a designers position? A draftsman receives at best but $90 or $100 a month to start with—in normal times only about $75—and after four or five years' experience he may possibly get $125 a month, and that is about the limit.

There are a few exceptions, where through some cause or other a draftsman makes better money, but these exceptions are very few.

Why should anybody want to stick to a losing game year after year? Why should a college graduate work for a pittance when he can get better pay in other lines? Why should a toolmaker or machinist spend time, money and energy to become a designer, when he knows that the additional knowledge not only does not pay him more, but rather less than he earned before?

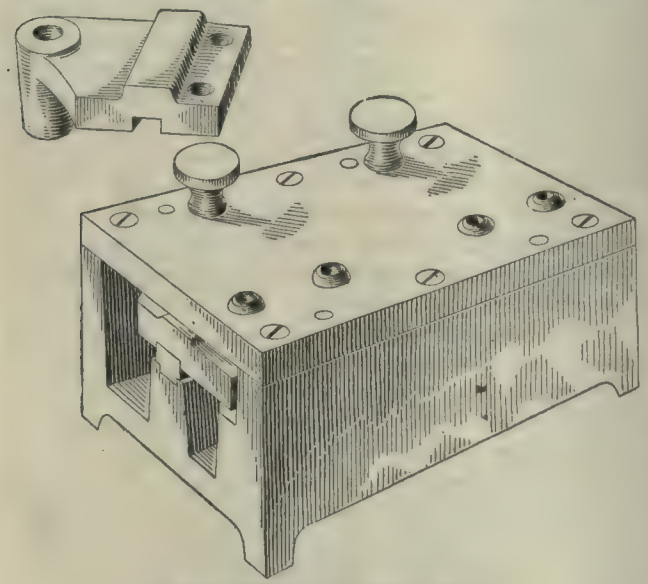


A Duplex Drilling Jig

By H. E. McCray

An example of a reciprocating or alternating drilling jig is shown in the sketch. Its purpose is to drill two $\frac{21}{32}$-in. holes $\frac{5}{8}$ in. deep in cast iron, and it delivers the parts at the rate of 200 finished pieces an hour.

It is used in a two-spindle drilling machine with automatic feed, and the operator can be removing a drilled



A DUPLEX-DRILLING JIG

piece and substituting an undrilled one at one end of the jig while the drills are working in the other one.

As the drilling is completed the operator raises the drills, moves the jig to the other position, bring the drills down to the work and engages the feed.

The pieces are located in the jig by the hardened and ground plug which enters a hole that has been drilled and reamed in previous operations.

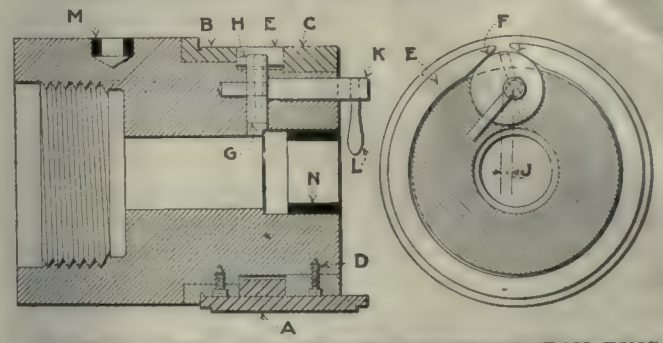
A Special Expanding Ring Chuck

By Herbert Mather

A special form of chuck for turning rings made of wrought-iron pipe is shown by the illustration. The rings indicated at *A* are first gripped in a regular chuck and the hole bored to size, which is a slip fit over the rings *B* and *C* of this fixture. These latter rings are hardened and ground and are held in place by screws *D*. Between these two rings is placed a third ring *E*, which is made of tool steel hardened and spring tempered. This ring is split and has the edges beveled back as shown at *F*.

In the body of the fixture at *G* a slot is cut, and a disk *H* having a hole in it which is off center, as indicated by *J*, is placed in the slot. The disk is pinned to the stud *K* and can be turned by the handle *L*.

In operation the work is held by the ring *E*, which is



A SPECIAL CHUCK FOR TURNING WROUGHT-IRON RING

expanded within the bore of the work by means of the eccentric action of the disk when the latter is turned by the stud.

Other details of the fixture are the hardened bushings *M*, in which a spanner wrench or pin is used for putting it on the spindle nose, and the hardened and ground bushing *N*, which is used to support cutting tools while turning the work.

Two Ways of Molding a Casting

By M. E. Duggan

In an article on page 510, Vol. 49, of the *American Machinist* I described how a certain cored casting could be produced without the necessity for a core box, and on page 752, Vol. 49, F. L. Sylvester "fully agrees with me," but doubts that "any foundry would have a box to make up stock cores like *C*." For Mr. Sylvester's benefit I will try to describe how these cores were made without a box.

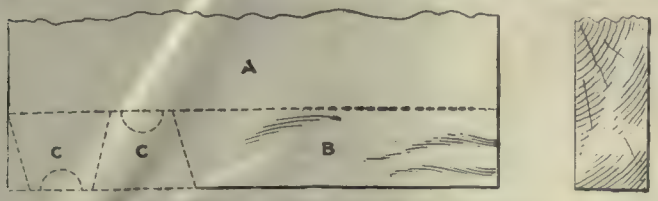
Every general jobbing foundry keeps on hand stock cores—rounds and flats—of various sizes and shapes, a flat, or "slab," core being shown in the cut at *A*. To make the cores described in the above-mentioned article a strip *B* was sawed from the slab and the cores *C* sawed out as indicated by dotted lines.

The thickness of the slab is not important; it may be more or less than the core print, but preferably more. The 16 cores required for this casting were made in 20 min. They were located on the pattern exactly as wooden prints would have been except that they were

loose. The drag and cope were rammed in the usual way with these loose cores in place, then after lifting the cope the cores were taken out, the pattern drawn, the round cores set, and the slab cores put back in the mold before closing.

The casting described by me on page 551, Vol. 49, and criticized by Sandy Copeland (page 766, Vol. 49) involved the application of the same method.

Mr. Copeland wants to know how much further down the sand would have hung had the mold been parted in the middle, and how much more it would have weighed. The answer in both cases is "Not any," nor would gaggers have been needed to support it, but if the mold



CUTTING CORES FROM A SLAB

had been made in the usual manner by parting at the center there would have been nothing out of the ordinary for me to write about.

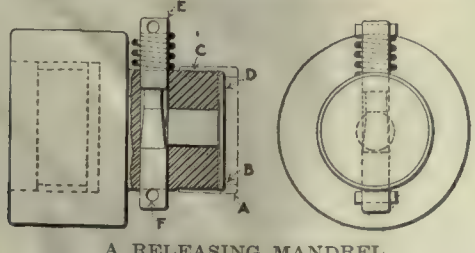
If Mr. Copeland had been "looking in at the foundry window" about this time he might have discovered that this was an unusual case where a casting was required to repair a breakdown, and if the pattern had been returned to the pattern shop (which was a mile and a half away) to make the necessary changes, including the making and fastening of 16 core prints, there would have been slim chance of pouring that day.

As there was no time to be wasted in looking up special flasks the two parts of the casting were nailed together and the pattern molded along with another pattern in a large flask, the cope half of which was a "flat back" with sand bars 5 in. center to center. This is the standard arrangement for sand bars in this foundry, and perhaps Mr. Copeland knows how the pattern in question could have been molded in the regular way without cutting away these bars.

Mandrel for Thin Threaded Pieces of Brass Tubing

By George W. Cooper

The piece shown at *A* in the sketch is made from brass tubing bored and threaded inside, after which it is necessary to turn the outside concentric with the in-



A RELEASING MANDREL

ternal thread. The finished thickness of the wall over the root of thread was but $\frac{1}{32}$ in., thus making the piece a very delicate one upon which to operate, and when an attempt was made to do the work on an ordinary screw mandrel the piece clung so tightly at the shoulder *B* that it was found impossible to loosen it without distortion.

After some experiment the present mandrel was evolved. The mandrel *C* was bored and reamed for the plunger *D*, which had a large head on one end while the other end was beveled to about a 7-deg. angle. The pin *E* fitting a cross-hole in the mandrel was tapered to match the beveled end of *D*, and a coil spring held it in the position shown with the cross-pin *F* resting on the mandrel, thus pushing the plunger *D* slightly outward.

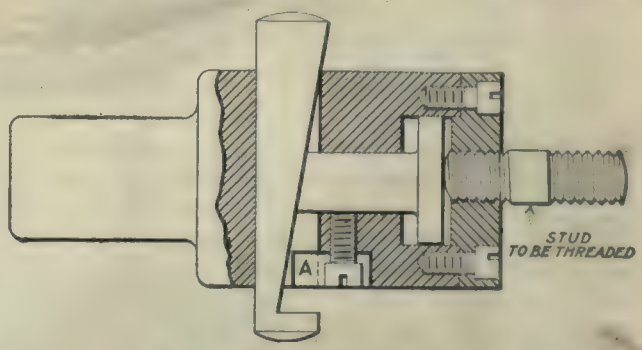
When a piece of work is completed a slight blow on the spring end of the pin *E* loosens the plunger *D*, allowing the work to be removed from the mandrel without difficulty.

Chuck for Nipples and Studs

By C. W. Putnam

On page 954, Vol. 47, of the *American Machinist* William Forray described and illustrated a chuck for holding nipples and studs while threading, in which the work was released by driving back a key which had supported the thrust upon the threaded end of the work due to the pressure of the cut.

Having occasion to use a tool of this kind I adopted



CHUCK FOR NIPPLES AND STUDS

the idea embodied in the above article, but substituted a round key for the square one used by Mr. Forray and set in the small piece shown at *A* in the sketch to prevent the key from falling out.

It is interesting to note the efficiency of this tool in service in comparison with a simple threaded sleeve from which the studs are removed with a Stillson wrench.

A Rod-Straightening Fixture

By Christian F. Meyer

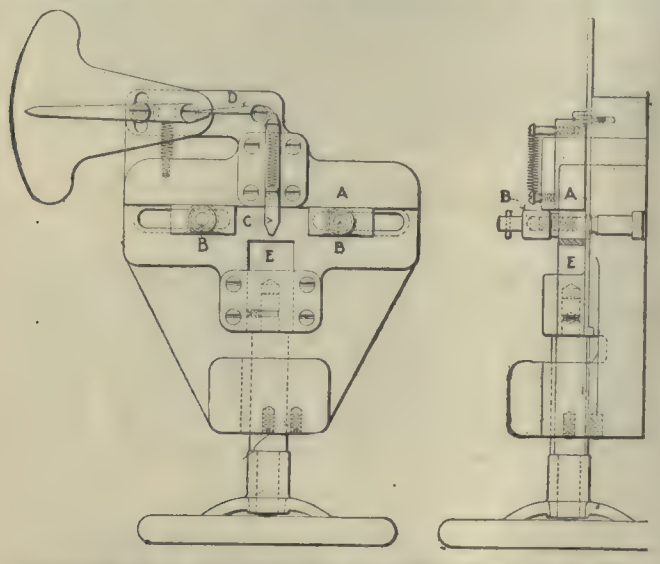
The sketch shows a rather unusual fixture used for straightening long, rectangular rods that are used in certain textile machinery. These rods are of cold-rolled steel 32 ft. long with a cross-section of $\frac{3}{4}$ x $\frac{3}{16}$ in. and they are made by joining two rods of commercial length, which is about 16 ft. The rods slide in slotted bearings lined up for that purpose, and it is therefore necessary to remove the small bends and kinks that are always found in the commercial bar.

They were formerly straightened on a long surface plate by men specially skilled in this work, the only equipment being a hammer and good eyesight.

The fixture consists of a cast-iron baseplate which is fastened to the bench. Two steel blocks are fitted to

slide along the finished-front face of the raised portion *A* and can be held in any desired position by the screws *B*. The outer surfaces of these blocks are in perfect alignment.

The gaging pin *C* projects from the face of *A* between the two blocks in position to bear upon the rod as it is passed through the fixture. To this gaging pin is attached an indicating pointer through the medium of the multiplying lever *D*. The proportions of lever and



FIXTURE FOR STRAIGHTENING RECTANGULAR RODS

pointer are so calculated as to give a ratio of 36 to 1 between the indicating scale and the gaging point.

Opposite to the gaging point is a movable steel block *E* operated by the screw and handwheel. As the work is moved along the face of the block the gaging point is always in contact with it, and the smallest deviation from a straight line being shown by the pointer this bend is removed by applying pressure on the opposite side through the medium of the handwheel, screw, and pressure block. It takes very little practice for any man to become proficient in the operation of the fixture since the pointer is an infallible guide. When the bends in one direction are removed the rod is reversed in the fixture and the other side straightened in the same way. The blocks may be adjusted to the average lengths of the short bends, which are practically always the same for any lot of rods rolled at the same time.

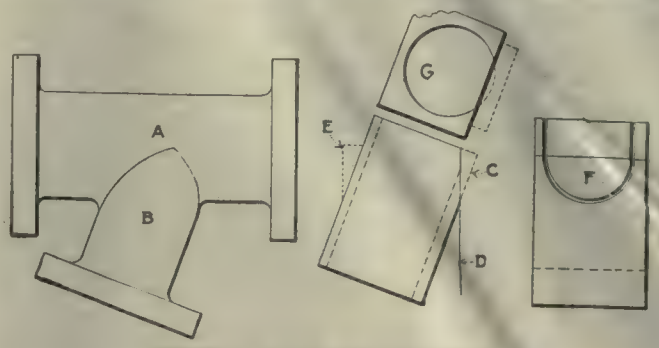
Kink for Making Angle Pattern

By M. E. Duggan

Patternmakers in a shop where fittings are made understand this class of patterns and how they should be constructed much better than I can tell. But there are times when patternmakers who seldom have any of this class of work are required to make a pattern for straight or angle T-fittings and it is then that some simple kink helps to get the pattern out in jig time if the casting is wanted in a rush, as is often the case.

Take a block of wood, split or solid as needed, large enough to make the member *B*. If split fasten the two halves together temporarily. Saw off the piece *C* on the line *D*, fastening the piece in reverse position as at *E*. Mark the circle of the body *A* on the face of this block *E*, and with the piece resting on the surface *D* saw out the piece *F*.

Leave *F*, which has just been sawed out, in position and fasten it temporarily. Take off piece *E* and fasten



FITTING AN ANGLE PATTERN

it at *G*. Mark off on end of block at *G* the diameter of the member *B* and saw it to line.

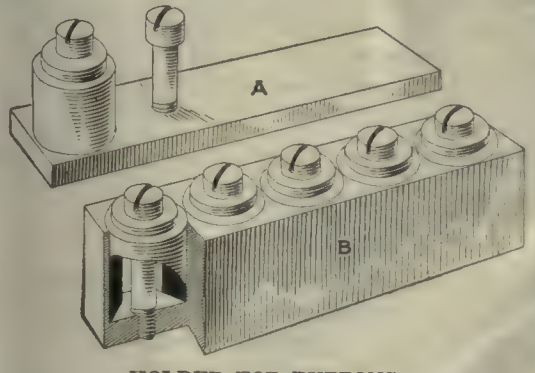
If the marking and sawing are correctly done the *B* member will be an exact fit on *A* and at the correct angle.

Improved Form of Holder for Toolmakers' Button

By Donald A. Baker

The usual form of button holder for toolmakers' use is shown at *A* in the cut with one button attached. This is simply a flat strip of metal with the requisite number of tapped holes in it to which the buttons may be fastened with their screws. This is all right so far as keeping them all together is concerned, but it offers no protection against damage from contact with other tools, etc.

To retain all the features of compactness of the design and at the same time fully protect the buttons



HOLDER FOR BUTTONS

from injury from bruising or abrasion the design shown at *B* is recommended. The author has had one of this kind in use for the last 10 years and has found it to be very satisfactory.

It is made from a square bar of cold-rolled steel into which holes were bored to receive the buttons. These holes were bored just deep enough for the button to come flush with the top, enough stock being left at the bottom so that a hole could be drilled and tapped to take the end of the retaining screw. With this arrangement the buttons may be thrown around anywhere without fear of injury.

CRIPPLED WORKERS in the MACHINE INDUSTRY



By ARTHUR J. WESTMAYR, LL.M.

This article, which tells of what is being done toward fitting the maimed for useful occupation, should be read and digested by all employers. We are now face to face with the tremendous problem of rehabilitating our war-maimed soldiers and sailors. Some are already here and thousands more soon will be. Their employment at a living wage is not a charity but a duty. We owe everything to them, for had not they gone into the front-line trenches and stopped the brutal Hun this country would now be overrun with a horde of murderers—and worse.

TIME was when every war produced its quota of cripples who eked out a precarious existence through public and private charity. But there were both excuse and justification in the past for this lack of method of caring for the disabled. No provision was made to rehabilitate them or to marshall their remaining physical powers for successful productivity. But we have learned through this war to conserve what formerly would have been waste; the salvage of man power has begun, and by rehabilitating the cripple, the shortage of labor will be greatly reduced. Today the handicapped man can reënter the ranks of labor and is accepted for what he is worth and is paid accordingly. He is no longer dependent on the benevolent appraisement of his work. He stands erect and selfreliant and demands as his due the wage his labor has justly earned. At the outset let it be understood that the disability of which we are speaking is to the extent of at least 50 per cent. of a medical nature. The disabled soldier or sailor is not necessarily a man without legs or arms. He may suffer some injury that has left no outward sign or may be a victim of gas or shell shock. Even the blind could turn their other faculties to profitable account. The employer who accustoms himself to this way of thinking broadens his views of the war cripple to his own advantage. He need not consider an operation in his factory as a possibility for a one-legged man. A great many other forms of physical handicap, involving whole men, can be drawn upon. In the machine trade a great many processes have been found in which the cripple can compete with the able-bodied man. A report prepared by the Trade Advisory Committee of the engineering trades and issued by the Ministry of Labor in collaboration with the Ministry of Pensions, England, states: "The machinist's trade is one of the most widely spread of all industries, and is at present carried on in all parts of the country in close relationship to practically all other forms of industry. As one of the key industries it plays



ONE-ARMED MAN AT WORK AT A FOOT-OPERATED SHEET-METAL-WORKING MACHINE

a very important part in the economic life of the country and predominates in large industrial centers, where it is allied to other important industries."

Any man who can get around on artificial legs can do all but the heaviest work in machine shops. This is the opinion of instructors in technical schools. One-armed men can do lathe work, planing, drilling and milling machine work, soldering, shaping, cutting, oxy-acetylene welding and drafting. Men with leg amputations can become electricians, oxyacetylene welders, engineers and firemen. Among the minor mechanical operations they can operate turret lathes and light drilling, grinding, milling, planing, shaping, slotting, tapping, sawing and boring machines.

Even men with both legs amputated can be employed in this industry. They can be polishers, lacquerers, inspectors, testers of electric apparatus, drilling machine hands, punching machine hands, coil winders, assemblers of small machines, bench lathe hands and draftsmen. While all the foregoing occupations for leg cripples require the use of arms and hands the loss of several fingers would not disqualify the worker. The skilled trades the physically handicapped are able to follow include coppersmithing, fitting, turning, brass finishing and pattern making. Not only can machinists help the cripple by giving him employment, but they can be of even more value in giving thought to the designing of machinery with simple auxiliary control devices that will enable men who have lost a hand to operate the machines by their feet. The problem of designing machinery for the use of cripples will never be of greater importance than now, and it should receive immediate attention from designers. Leading machinists have already expressed their willingness to coöperate in adapting their products to the use of men who have been more or less crippled.

In Toronto, Canada, there was erected one of the largest steel plants in the world, comprising furnaces, buildings, presses, saw shop, railways, etc. A Cleveland, Ohio, man superintended the erection of this plant and tells how he employed about eight hundred returned crippled Canadian soldiers, and made the world's record in construction. He writes in part as follows: "Of course a little patience had to be used at first, but the men soon got used to the change and would respond quickly to kindness, sympathy and justice, and these they must have. They did not want coddling or charity, but a chance to get into the swing of civil life again."

Among the men he employed were some who had a leg or an arm amputation, men who had suffered the loss of an eye, also shell shock and gas victims. One man who had lost his right arm and left eye became a master mechanic. Before his injury he had been a pipe fitter. A lumber jack, badly wounded in the legs and ...t and with a plate in his skull, made a very good lathe hand without any other training than being a helper in a machine shop. A former clerk, with shrapnel wounds in his back and side, operated an electric crane. Many such cases could be told of men whose earning capacity has increased since their injury. To these men with "their wonderful discipline, their quickness in obeying orders and their loyalty" was due the splendid world's record in construction. They not only made a record as fighting men in France, but given a chance they will make a record in the industrial world.

In the early stages of the war Belgium, France, England and Canada realized the necessity of rehabilitating the crippled soldier. Profiting by the experience of the allied countries the United States, immediately after the declaration of war, began an advanced study of how best to rehabilitate and make independent the maimed and permanently injured of our own army. No one has seen or must see an American veteran of the world war rattling pennies in a tin cup on the street corner. Schools are ready to train him and long before surgeons and doctors are ready to dismiss him he will be well on the way of preparation for his life work. The returned American soldier who has been disabled will receive not only appreciation, encouragement and financial assistance, but also a training that will prepare him to be independent. America will give her returning soldiers not merely sympathy but justice and a fair chance.

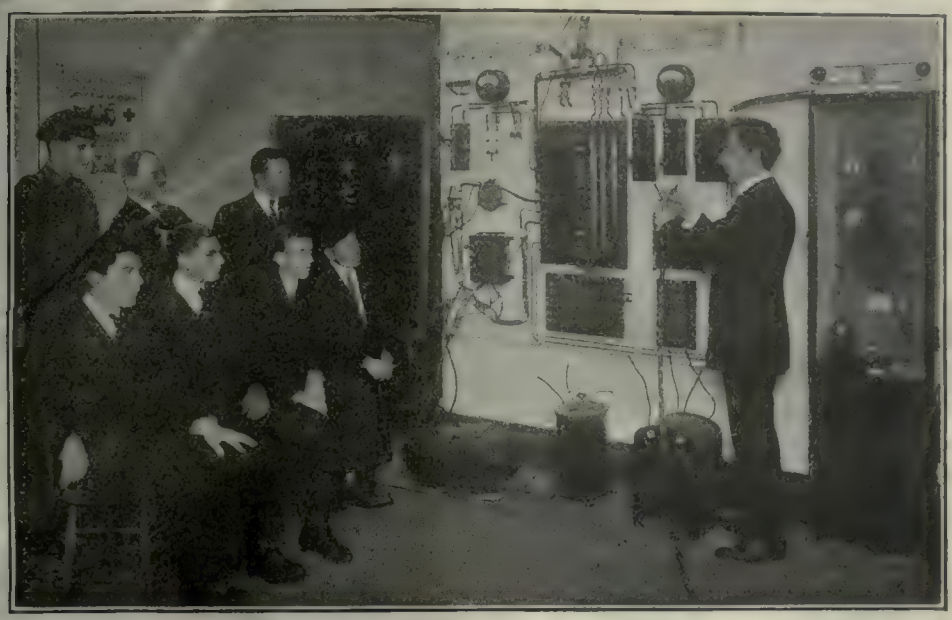


OXYACETYLENE-WELDING CLASS FOR CRIPPLED AND DISABLED MEN

According to the Vocational Rehabilitation Act recently enacted by Congress those disabled in the military and naval forces of the United States have been placed under the joint authority of the Surgeon General of the Army and the Federal Board for Vocational Education. The Surgeon General has jurisdiction from the time the person is injured until he is restored to good physical condition, when he receives his honorable discharge from the service. The Federal Board then offers him vocational reëducation and training which will enable him to return to useful active employment, and the United States Employment Service will coöperate in finding him work. While men are taking special courses, compensation will be allowed them and the allowance will

be paid their families precisely as if they were still in active service.

The Red Cross Institute for Crippled and Disabled Men of New York was established to pave the way for the war cripple. The work of the institute has heretofore been mainly with the industrial and civilian cripple. The making of artificial limbs, mechanical drafting, oxyacetylene welding, printing, motion-picture operating and the manufacture of jewelry are some of the courses which are offered free to cripples, and many skilled workers have already been turned out by the various classes. There is also an employment bureau in connection with the institute. Hundreds of crippled men have been placed in positions through this bureau, and it is receiving frequent requests from employers who have experimented with this new labor asking for more. They speak of this new kind of labor in the highest terms and tell us that its productivity stands up well against the highest standards. These men approach their task with a new and better spirit, while the application and care they bestow upon it makes for the very best results both in quantity and quality of the work.



TEACHING THE FUNDAMENTALS OF ELECTRICITY IN THE MOTION-PICTURE CLASS

The illustrations show cripples at various kinds of employment, also the classes for instruction.

While public interest is easily focused on the war cripple it is not so easily directed sympathetically to the case of workmen who are injured in the shops. These cases have been so common that they have attracted little attention. Yet they greatly outnumber the cases of soldiers permanently hurt in battle.

Stinging the Stinger

By John R. Godfrey

It sounds like a fairy story, but it's vouched for by an old friend of mine who never lies when the truth will answer—and he generally makes it do. It's just one of the exceptions which prove the rule.

It begins with the old, old story of the youthful and trusting inventor who was trimmed to a fare-you-well by his business partners manipulating the books and getting all his stock away from him. This isn't the strange part of it—it's happened hundreds of times—but it's the prelude, as they say in the theater, to the real and unbelievable part of the story.

This young inventor was a shark on mouse traps that really worked. They sort of had a personality like a hunk of cheese and attracted the mice whether they were hungry or not. And so, while the h.b.p. (meaning heartless business partner) was selling mouse traps, making money and gloating in the regulation manner, the inventor got busy and outdid himself in the invention of a brand-new breed of mouse trap—with so many new ideas and attractions that the mice vied with each other for the privilege of being caught. Its strength of attraction was about in proportion to real live limburger as compared with cottage cheese. But before springing this world beater on the market another business friend of the inventor made overtures to the h.b.p. and secured the first mouse trap on a liberal royalty contract. It looked like easy money with none of the worries of manufacturing in these strenuous days when labor is beginning to sit up and take notice, and the h.b.p. fell for it. It looked so good that he even failed to note the absence of the minimum-royalty clause. The stage having been duly set, the first mouse trap was captured on a royalty basis, the new and doubly useful was sprung and began to sell like the proverbial hot cakes. When the h.b.p. inquired as to royalties he, like the newsboy and the apple, found there "wa'n't goin' to be no core" because they quit making the trap.

It's a low-down trick in any case. But it's been done to the poor inventor so many times it gives you a sort of unholy glee to see the biter bit.

There's one way to prevent this sort of thing, which has been modestly advocated at various times. This is to make all patents available to anyone who will pay a respectable royalty to the inventor. Everyone pays the same royalty, so there can be no monopoly. Quality and manufacturing methods would determine the selling price and the sales. The nearest approach to this is the law in various countries which makes it necessary to manufacture a patented article within three years—or some other given period.

Of course the real solution is to have everybody honest and willing to play the game squarely and with all the cards on the table. But it's going to take more than a league of nations to get this into active operation, and in the meantime we can get a little satisfaction whenever the smart Aleck who tries to put over a raw deal gets stung good and proper as was the h.b.p. in the mouse-trap deal. Once in a long time the h.b.p. does get the worst of it.

British Transportation











1, Railway Through a House.
2, British Motor Truck Transports.
3, Lifting Bridge to Pass a Boat.
4, Taking Rails to the Front.
5, Transporting Shells on Hand-Cars.

Methods in France

PHOTOS BY BRITISH PICTORIAL SERVICE







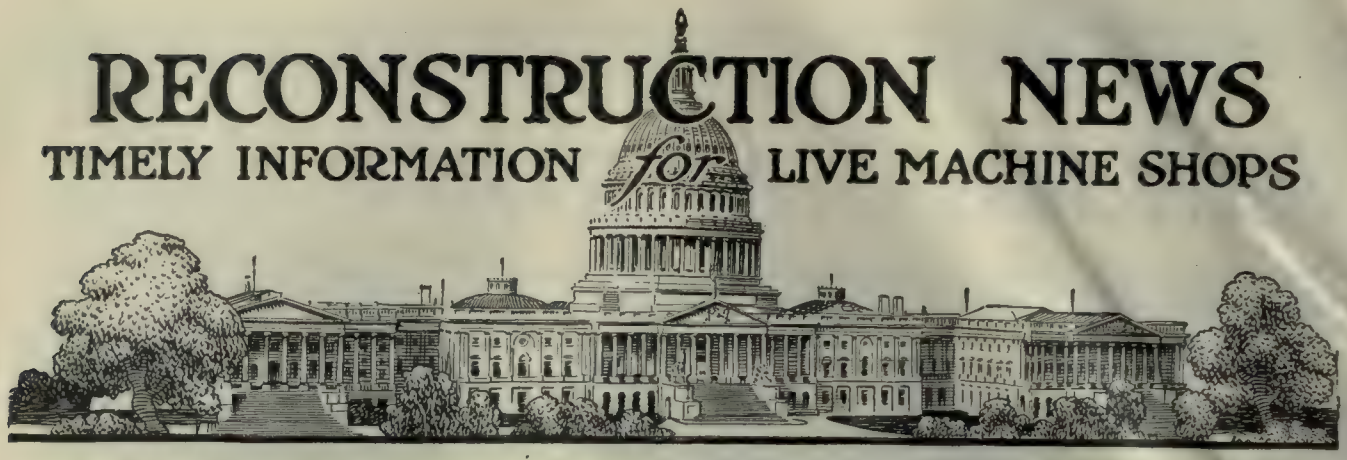




6, Motor Lorries Going to Front.
7, London Buses as Transports.
8, Transporting in Canal Boats.
9, Laying Railroad Track.
10, Clearing Debris-Covered Tracks.

RECONSTRUCTION NEWS

TIMELY INFORMATION for LIVE MACHINE SHOPS



ON ITS surface the chief purpose of the Smith-Sears Vocational Rehabilitation Act appears to be merely trade training. But careful examination will show much greater possibilities in it. The principal function of the law is education, and education of a different quality than that heretofore given or commonly understood. It is a type of education which goes to the heart of democracy—an education which will bring more opportunities and greater mobility and freedom.

If the Germans had won, industrial slavery instead of freedom would have been the lot of all men in all lands for an indefinite period. In the days of reconstruction now before us the defenders of America who have been disabled in the cause of industrial liberty must be our chief concern. These men must be so trained and so educated that they will be free to come, go, select or act in the employment they have chosen. Self-employment, one of the great ideals of democracy, will be advised whenever and wherever possible. In cases where this is not advisable they must be so completely trained as to insure for them the greatest possible measure of industrial freedom.

The Smith-Sears Act will, it is believed, remove, in a large measure, the great danger of allowing any one man or set of men to have the opportunity of dictating how another man shall work, how much he shall do, how much he shall be paid, when he shall work, when he shall not work and how long he shall work. It is believed that organized labor thoroughly understands the human problem of retraining the disabled soldiers and sailors and that it can be depended upon to make them welcome in every vocation which they may select for their life work.

The United States Employment Service

There is no doubt as to the good which can be accomplished by the United States Employment Service in the placing of soldiers back into industry and the shifting of others from war jobs into the paths of peaceful pursuits. But, as we have pointed out before, this cannot be accomplished without broad-visioned men in charge of the work, not only in Washington but in the district branches. Even with these it needs close cooperation between the manufacturers, labor organizations and the employment service, for it must be remembered that the service can neither create men nor jobs, but can only act as a clearing house to bring the men and the jobs together.

The community labor boards which have been established in various centers can be utilized to advantage in this work and can do much to assist the readjustment of employment, but they must be supported by efficient employment offices and these have not had the support they deserve from headquarters. The former director of the service is fortunately not now active in this work, but there are indications that the present officer has a real interest and a real understanding of the work in hand. Perhaps the weakest part in the organization at present is in the management of the largest and most important branch office—that of New York City. This office represents perhaps 10 per cent. of the total work of the country and needs one of the strongest men at the head of it. Instead of this, however, the former chief at Washington began its disruption before his removal and the work has gone on with amazing rapidity.

There was no doubt as to the good intention of the director who has just resigned; his past record is excellent in every way. But in common with many managers who are smitten with system and efficiency he did not and evidently could not understand that the problem of the United States Employment Service is a human problem and not one which can be measured by slide rule or guided solely by card indexes and mathematical formulas. Theoretically he seemed to grasp the idea, and according to a recent interview he was just beginning to see that it may be a permanent instead of a temporary institution.

The New York Office

Those familiar with the New York office know, however, that it became thoroughly disorganized in the short space of two months; that the trained personnel has been scattered and that the esprit de corps which was so noticeable under the state organization has almost disappeared. In spite of high-sounding phrases the office is not doing its job with the same real efficiency and understanding as before.

There seems to be no good reason why the various employment-service offices should not be operated by the various states under the supervisions of the Federal Employment Service. Local sympathy and coöperation can best be secured in this way, and in this case at least a much better handling of the whole matter was secured under the old order. Better salaries must be paid however, if they are to succeed, and the best talent must be secured for the work.

Whatever may be the outcome, however, it is absolutely necessary that the New York office be restored to somewhere near its old standing. This will be difficult because important work had been put in the hands of inexperienced men. If the new director can see the light and really grasp the human side of the problem he may succeed. It is not a question as to his ability; it is only a question of his fitting in this particular job.

We have entered on this particular case simply because it is the most important office in the country and one which will in a measure be looked upon as a model for the rest. The employment service can be of great help to the industries of the country in many ways. Every manufacturer should see that it serves his community in the way that is best for all concerned.

Preventing Price Depressions

Although we have felt sure that every precaution would be taken to prevent the disturbance of the price of various products by the dumping of large quantities of material purchased by the Army and Navy for their various needs it is gratifying to have further assurances from those in charge of this work. In a recent speech before the Chicago Association of Commerce L. H. Hartman, chief of the Surplus Property Division of the office of the director of Purchase and Storage, stated that no secret policy was to be pursued and that every means will be taken to have all those interested understand thoroughly the conditions regarding the sales.

We have his assurance that every possible effort will be exercised to avoid business casualties, sudden price depressions, sudden decrease of production and the consequent disturbance of labor conditions. The Army will, so far as possible, find a market for its surplus material outside of the usual channel. Arrangements have already been made for the disposal of a large amount of their surplus material to the Navy, the Post Office Department, the Department of the Interior, Panama Canal, the Red Cross, the Y. M. C. A., the Emergency Fleet and the Belgian Relief Commission. Arrangements are also being made with the Russian Bureau of the War Trade Board to send millions of dollars' worth of clothing to Siberia, and large orders for Montenegro, Ecuador and other foreign countries are under consideration. As an example of this several thousand trucks are being transferred to the Post Office Department and large quantities of other material will be transferred to the Forest Service of the Department of Agriculture and to other Government departments.

Nothing will be offered for sale until every possible consideration has been given as to the effect such offering will have on normal market conditions and on the maintenance of normal prices and labor conditions. Future depreciation is to be preferred to upsetting the present condition.

It is the purpose to divert everything as far as possible to its original and proper channels so that manufacturers need not regard it as being competitive. Wherever practical the manufacturer who furnished the article to the Government will have the first opportunity of repurchasing, so that none of his goods need reach the open market except through his own channels and by his own sales force.

The Purchase and Storage Division is well aware that after other wars jobbing or scalping concerns have sprung up overnight for the purpose of procuring Government surplus at ridiculously low prices and then reselling considerably below the market. This has always upset business, and it is fully realized that the elimination of all such projects is highly desirable. Conditions will not be allowed to arise where small groups of men can become especially familiar with operations respecting surplus stock and be in a position to make huge profits.

Hundreds of Inquiries

This department has already received hundreds of inquiries from concerns throughout the country that desire to purchase material from it. The law gives no authority to negotiate a private sale and all these requests must be denied. The department has in each case urged the purchase of the material asked for through regular sources. The delay in sending out a list of articles on hand has been intentional to some extent, as it was not desired to rush the placing of these goods on the market. A complete inventory of all supplies belonging to the Government is being taken, and it is hoped that definite information may be available about January 15. When this information is at hand and careful consideration has been given to the amount of material needed by the Army which must be maintained for some time the remainder will be disposed of in a slow and safeguarded manner so as to affect as little as possible the regular sources of supply, as this department fully realizes the serious consequences of disturbing conditions any more than is necessary.

Executives

By Rudolph Bloom

How many of us have ever stopped to think why is it that "there is plenty of room at the top" and why is it that a few of us lead but most of us are led? Shakespeare tells us that we are either born great, achieve greatness or have it thrust upon us, but no matter how greatness comes to us there are certain prime qualities we must possess to retain it.

Greatness means the ability to influence the minds, works and affairs of our fellow beings. A man may be a renowned leader in constructive work or he may be a notorious robber chief, but whether the one or the other he must possess the power to sway men to his purpose; in other words, an executive. We may not admire a political boss, but we must concede that he possesses attributes that make him a leader of men, much as we feel that were his energies directed by unselfish motives he could be more useful to society.

An executive is a man who never wastes time on details, but successfully delegates them to someone under him. In order to distinguish him from the "buck passer," the word "successfully" is used, because "buck passers" dodge responsibility and are never successful. The executive on the contrary accepts responsibility and the more of it he accepts the greater executive he is.

The executive is concerned only with results and receives credit for the capable performances of his underlings or censure for their failures. He is a

broad-gage man; he chooses his own organization and stands back of it, and if a member of it fails in his task he blames only himself for not having chosen the proper man.

If the sales of a company fall down it is the president's fault in that he did not choose the right sales manager, and in facing an irate board of directors he will be a big enough man to take upon himself the punishment. Or maybe it is a shop foreman who is taken to task for some spoiled work. True he did not himself spoil it, but he did not choose the right man to do the job; hence his the blame. If he is a "two-by-four" type of man he will try to shift the blame. Maybe the labor in the shop is inferior. However, if he can obtain results despite this handicap, all the more credit. He is a poor workman who blames his tools.

Dodge Bros., the automobile builders, were asked whether they could build recuperators for gun carriages, a job which every other manufacturer had turned down. They answered "Yes, what are they?" and then built them. They carried their message to Garcia not by asking how, but by just doing. This is another quality of an executive, namely, ability to perform tasks without asking how to do them. It is not "How should the new factory be built?" or "Should I use a hog-nose or a diamond-point tool in machining the casting?" Large or small questions, the executive knows only one command and that is Do!

A Very Odd Request

The president of a large firm once asked an applicant for a position to bring a baby carriage from the former's residence to his office. To be sure an odd request, but the applicant asked no questions, but brought the perambulator to the office in a few hours, together with a bill for $6 in taxicab fare. "If that chap had asked me how to get the baby carriage into the subway he would not have got the job, but it was worth $6 to me to know that I was hiring a man who could execute an order without asking why or how," were the president's words.

The executive has been reviewed up to now only from the standpoint of the performance of duties, which is synonymous with his relation to those placed over him. What must his relation be to those under him? What qualities give him the leadership of men? He must have their confidence by having a sound knowledge of his trade, profession or business, but without a domineering or intolerant attitude toward the ideas of those he commands. With his knowledge of the work he can pick the right men; then with his confidence in their ability he stimulates them to do their utmost. By bowing to the counsel of those skilled in special jobs he does not lower himself in the least, but creates a certain pride among his workers.

Many executives fail because they have no confidence in their assistants. They work many hours each day performing trival tasks merely because they believe in that rusty adage, "If you want a thing done well do it yourself," instead of modernizing it by saying, "If you want a thing well done choose the right man to do it for you." A young man employed as assistant to a production manager of a large firm told his manager he was "going to the mat" with the purchasing department regarding some difficulty. The manager merely replied: "Do whatever you think is right and I'll back you to the limit." This statement implied that the assistant knew his job, and that the manager placed implicit confidence in his actions, and also that if a mistake were made the executive would shoulder the responsibility. One can easily realize the feeling of loyalty engendered by such a policy.

To be successful in managing men one must possess personality that creates in the subordinate a desire to do his chief a personal favor. An executive who acts on the theory of results by blind discipline is a Prussian. His workers are ruled by fear and they work mechanically. Familiarity breeds contempt, but courteous treatment, together with the proper degree of personal warmth, will win anybody. Merely being courteous and cold at heart is the incorrect attitude.

How often do we see subordinates shifting uneasily under the cold scrutiny of a fish-blooded boss! I recollect two superiors, one of whom, although thoroughly fair and conscientious, would allow you to stand at his desk for several minutes before he would deign to look up, and the other who no matter how busy or harassed always bade you a pleasant "Good morning" and asked you to sit down.

Both were capable executives, but the subordinates of the kindly man were his friends, and their loyalty to him was personal as well as dutiful. The cold-blooded man achieved results, to be sure, but those under him subconsciously hated him.

One may be just a section boss over a gang of "hunkies" or a president of a railroad, but the essence of good executive ability is the same in either case. Have confidence in yourself, in those over you and in those under you; let your relations with employer and employed be firm but tempered by the milk of human kindness, and even if you do not reach the heights of fame or power you will have the satisfaction of doing and causing others to willingly do for you.

Accurately Spaced Drilled Holes

By Willbur L. Coble

I recently discovered a method of spacing drilled holes which combines to some degree the accuracy of the button method of locating with the speed of the drilling machine.

The centers are located with the buttons in the regular way and a hardened-steel plate with a hole lapped to fit the buttons nicely is then clamped to the work with the hole fitting over each button in turn. After the plate is securely clamped the button that located it is removed and, using the plate as a jig, the hole is started with a drill of the same size as the hole in the plate.

Slip bushings may be made for holes smaller than the buttons, while for larger holes special buttons must be made, but if there is much of this work to be done the time saved by this method will warrant this extra work.

It is desirable after starting a hole to drill it through with a slightly smaller drill and finish it with a rose reamer that accurately fits the hole in the jig plate or one of the bushings. With a little ingenuity combinations of special buttons and bushings may be made to cover a wide range of work, and while the time saving at first may not be appreciable, as the stock of special tools accumulates the saving will become more apparent.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



The General Motors Corporation has brought out two new tractor models, one known as model A, which will cost $900 and the other model D, which is priced at $450. It is expected that about 10,000 tractors of this model will be turned out during the next four months. The company's ultimate capacity will be in excess of 100,000 tractors a year. To take care of this tractor the General Motors Corporation is building a large plant at Janesville, Wis.

The Zenith carburetors used on the Hispano-Suiza motors are equipped with a manually operated barometric control called the altimeter, by the use of which the mixture can be maintained at the best proportions of air to fuel in order to obtain the best possible motor performance at various altitudes. The actual function of this attachment is to vary the pressure in the float chamber which changes the amount of gasoline fed to the motor.

French auto-truck manufacturers made considerable progress during the war in the development of variable venturi-tube carburetors without spring air valves or other moving parts. Backfiring when using a lean mixture is prevented by automatically covering the jet when the throttle is opened. When the gasoline level goes down in the carburetor bowl, the balance is restored by having the suction of the motor intake lift the cover from the jet until the carburetor bowl is refilled. This of course refers to a surface carburetor.

A noninflammable gas, officially termed "argon," for the use of balloons and dirigibles has been discovered, which will eliminate the hazard of fire and explosion that always has accompanied balloon operations where hydrogen gases have been used. The gas from which argon is obtained comes from wells at Petrolia, Tex., owned by the Lone Star Gas Co. A pipe 94 miles long is proposed to be laid from the wells to a plant at North Forth Worth, where the gas will be compressed into cylinders for shipment to the balloon fields. The cost of this plan is estimated at $2,000,000.

The New York automobile show will be held in Madison Square Garden and the Sixty-Ninth Regiment Armory Feb. 1 to 15. The passenger cars will be shown Feb. 1 to 8 and trucks Feb. 10 to 15. Interest in the show on the part of the automobile manufacturers is running high and the local dealers have been assured that the various makes of cars exhibited will be the latest type. In all probability the show this season will reveal many novel designs and features of construction as the direct result of the war. This applies especially to cars of the commercial type.

Owing to the wide difference of opinion in the steel trade in regard to prices the quick action of some of the steel producers to adopt the suggested reduction in steel prices came as a surprise to the buying trade, the belief being that producers would endeavor to maintain Government prices as long as possible. One argument advanced in favor of the reduction is that a lowering of prices will set a good example to the sellers of other commodities, which will help the market and vitalize business. On the other hand it may have the opposite effect if it is taken to indicate further reduction.

M. Maurice Houdaille, a French inventor, invented an adjustable car suspension to secure the same comfort in an automobile whether the load be the minimum of one passenger or maximum of five or six. The general idea of this invention is to increase the stiffness of the springs as the load is increased. The result is obtained by using an elongated groove instead of the eye at each end of the rear springs and moving the eyebolts with a lever or wheel mechanism to the desired position. With a minimum load the bolts are at the other extremities of the rear spring grooves, and as passengers are added the bolts are brought closer together; that is to say, nearer to the axle, thus stiffening the spring. The experimental work was carried out on a five-passenger Renault touring car, moving the bolts in five positions corresponding to the number of passengers. The links by which the eyebolts are operated are carried inside the frame members, do not change the appearance of the car and are connected to a lever placed near the driver's right hand.

A glimpse into the airplane industry of the future would reveal three groups of airplanes, namely, pleasure planes (single-passenger and two or more passenger, or touring); commercial planes (passenger, mail and cargo carrying), and military planes (fighting and day and night bombing). Owing to the high cost of manufacture and maintenance, pleasure airplanes present the same problems now, which have been so successfully solved by Mr. Ford for the automobile field. From the construction point of view the future pleasure airplane will require an absolutely sure-acting automatic stabilizer and a device to eliminate the dangers of landing. The commercial airplane is already in its trial period. The cost of operating a mail-carrying airplane is computed by the United States Post Office to be 35½c. a mile. Without doubt the commercial airplane will be successfully developed by the Government or by one of our big corporations, keeping pace with which will be the mapping out of air routes, the erection of wireless signal stations, the establishment of harbors and landing places, etc. The military planes have made remarkable progress during the war and their future development will be bound up with that of the pleasure and commercial planes. Some of the difficulties to be overcome are a more efficient engine than the gasoline motor, a more efficient construction and form, a new propulsion mechanism and more improved safety devices.

A low-priced and most successful airplane, which is supposed to be equivalent to a Ford car, has been produced by Capt. James V. Martin. Distinctive features of this machine are the retractable chassis, which folds up like a bird folds its legs when in flight; the K-bar trussing to reduce the head resistance by eliminating struts and wires, and the wing-end ailerons having the advantage that they do not impair the efficiency of the aerofoil to which they are attached. The ailerons have a symmetrical double convex surface operated by means of a sliding rod running through the upper plane. The sliding movement of the rod, acting on a collar attached to the ailerons and having a spiral keyway through which a pin from the rod projects, causes a rotary movement of the ailerons, doing away with all exposed members generally used in the operation of ailerons. The upper plane has a 15-ft., the lower a 17-ft. 11¼-in. span, with a chord for both planes 3 ft. 6 in., having neither stagger nor dihedral. The fuselage has an over-all length of 10 ft. 10⅞ in. with a maximum depth of 3.6¼ in. The airplane is driven by an air-cooled two-cylinder opposed "Gnat" A B C motor, developing 45 hp. at 1950 r.p.m., having a fuel consumption of 0.56 lb. per horsepower hour. The total weight of the machine is 350 lb., with sufficient fuel for a flight of two hours. The selling price is proposed to be $2000.



Sparks from the

Market in Argentina for American Railroad Equipment

A Number of Extensions to Be Constructed Which Will Amount to a Cost of About Seventy-Five Million Dollars

The complete systems of railroads in the republic of Argentina is of 36,003 kilometers and same is divided as follows: 21,312 kilometers of wide gage of 1676 mm. (6 ft. 5 in.); 2838 kilometers of medium gage of 1435 mm. (4 ft. 9½ in.), and 11,686 kilometers of 1000 mm. (3 ft. 4 in.).

The Argentinian government owns and manages 6320 kilometers, which is almost 8 per cent. of the total of 36,003 kilometers of railroads. The respective department which runs this part of the system of the government is known as the "Administraccion de los Ferrocarriles del Estado," and same is in charge of an administrator who presides over the board composed of a chief engineer, chief of exploitation and an auditor general. The administrator is appointed by the president of the republic subject to the approval of the International Sènate. The other employees are appointed by the administrator.

Every one of the various systems of railroads in the Argentinian republic is under the control of the "Direccion General de Ferrocarriles" (Argentinian Administration of Railroads), at the head of which must be an Argentinian engineer, who is under the direct supervision of the minister of public works.

During the last four and one-half years none of the railroads in Argentina have been able to receive materials, and at present are in great need of all the various articles used in such enterprises. It is estimated that during the two coming years the importation of these materials into the republic will amount to more than one hundred million dollars, and same will be used exclusively to replace all that which has been used up and for accumulation of the indispensable reserve stock.

A number of extensions will have to be constructed, and if those of the greatest urgency are taken into consideration it will be not less than 3000 kilometers and will amount to a cost of about $75,000,000. Of this amount 75 per cent. will be expended for the acquisition of materials.

The Argentinian railroads have purchased heretofore 95 per cent. of their materials in Europe, especially in England, Germany and Belgium, but as these countries will no doubt have to give some very close attention for some years to come to their own necessities at home, it is therefore obvious that the American manufacturers should become acquainted with the characteristics of such an important market in order to be able to introduce into Argentina American products.

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Employment for Ship Workers

The Newark Bay Shipyard at Port Newark, N. J., is offering employment to a large number of men in shipbuilding. It has established a school for training workmen, who receive about 50 cents an hour during training in various branches of shipbuilding, such as bolting-up, drilling and reaming, riveting, chipping, and caulking. One thousand men a month have been graduated from the school, after which they receive from 50 cents to 80 cents an hour, and on piecework, it is said, from $7 to $15 a day, depending upon the trade which they follow.

Employment is offered to men of the Army and Navy who have received their discharge as well as other unemployed men, and whether they have worked in a shipyard or not, through the methods of training, in four to six weeks' time they can become skilled workmen.

Business Items

The Wellman-Seaver-Morgan Co., Cleveland, Ohio, has opened a San Francisco office at 415-417 Rialto Building in charge of Norman S. Ross.

Morris L. Cooke, Horace K. Hathaway, Boyd Fisher, Clyde L. King, Keppele Hall and John H. Williams have opened an office as consulting engineers in the Finance Building, South Penn Sq., Philadelphia, Penn.

The Skelton Sales Co., Syracuse, N. Y., will change its name to Skelton Tool Co. and will increase its capital stock to $100,000. It has purchased the plant of the Will & Baumer Co., Syracuse, and will move to the new location about Feb. 1.

The Shepard Electric Crane and Hoist Co. has opened an office in the new Lexington Building, Baltimore, Md. This office will be in charge of Norman P. Farrar, who for a number of years has been district manager of the Philadelphia territory.

The F. L. Schmidt Co., manufacturer of envelope and special machinery, 11th Ave. and 21st St., New York, by the action of the stockholders of the corporation and through a provision of the general corporation law of the State of New York has changed its name to F. L. Smithe Machine Co., Inc.

Engineers' Club of Philadelphia to Hold Interesting Meeting

The Engineers' Club of Philadelphia, 1317 Spruce St., Philadelphia, Penn., will hold its regular monthly meeting on Tuesday, Jan. 21, 1919, at Witherspoon Hall. A paper entitled "War Aviation in Retrospect, Commercial Aviation in Prospect," by G. Douglas Wardrop, editor of the *Aerial Age Weekly*, will be read. This paper will be illustrated with motion pictures.

Mr. Wardrop will speak of his experiences in France, Belgium and England during the summer of 1918, at the time when the aerial activities of the Allies were at their height; his participation in distance bomb-raiding exploits; his observations of some thrilling aerial battles and something of trench warfare on the Belgian front; his opportunities to study manufacturing methods in England and France, to review their plans for the commercial development of aviation and to discuss the subject with many authorities in France and England.

The members of the club and of affiliated societies are privileged to invite ladies to the meeting.

Following is a schedule of the Tuesday-noon luncheons up to and including Feb. 4, 1919: Jan. 14, Col. James B. Curtis, president of the American Manganese Bronze Co., "The Legal Engineer;" Jan. 21, Lieut.-Col. E. B. Morden, U. S. A., constructing quartermaster, Philadelphia, "The Construction Division of the Army;" Jan. 28, P. H. W. Ross, president of the National Marine League, "Public Participation in Maritime Development;" Feb. 4, William S. Twining, director of the Department of City Transit, Philadelphia, "Financing City Improvements."

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Tin Imports In October

Imports of metallic tin in October were 14 per cent. less than in August, decreasing from 5156 tons to 4443 tons. Only 50 tons of ore were received as against 683 in September. Pig tin dropped from 10,500,000 lb. in September to 10,000,000 lb. in October. This decrease occurred in shipments from the Dutch East Indies and from Hongkong, while England and the Straits each registered an increase.

For the 10 months ending Oct. 31, 1918, imports of metallic tin amounted to 64,723 tons as against 60,432 tons in the corresponding period of 1917. Shipments this year from the Straits Settlements and from Hongkong are much heavier than in 1917, while shipments from England and from the Dutch East Indies are much lighter.

World's Industrial Forge

By E.C.Porter, News Editor

New Association Incorporated In Dayton, Ohio

The Tool Manufacturers' Association of Dayton, Ohio, was incorporated under the laws of the state of Ohio on Dec. 16, 1918, with a charter membership of 30 manufacturers, and the following officers were elected: O. Garrison, Garrison Machine Works, president; J. S. Kepler, Automatic Machine Co., vice president; E. F. Moore, Moore-Eastwood Manufacturing Co.; treasurer. These officers, together with W. H. McBarron, McBarron-Mitchell Tool and Manufacturing Co., and Lee A. Jones, Vulcan Tool Co., constitute the board of trustees. Charles W. Saffell has been employed as secretary of the association with an office at 1200 U. B. Building.

The purpose of the association is the maintaining of the present high standard of efficiency which has been developed in the industry in Dayton and also by educational propaganda to better inform the trade of the large resources which are available in the tool industry in that city.

Personals

LIEUT. J. B. HOWELL has been mustered out of the Artillery Service and has rejoined the Bound Brook Oil-less Bearing Co. in his former position.

HUGO BURGMANN, formerly secretary and general manager of the Batavia Shell Co., Batavia, N. Y., has been elected general manager of the Beaver Tool and Machine Co., Newark, N. J.

J. J. MCKEE, formerly New York manager of the C. A. Dunham Co., Marshalltown, Iowa, has left the company to take up his work with the Machinery Utilities Co., 501 Fifth Ave., New York.

A. M. JORALEMON has been appointed purchasing agent of the American Ever Ready Works of the National Carbon Co., Inc., Long Island City, N. Y., to succeed J. W. VOORHIS, who resigned recently.

G. J. KELLER has recently become a member of the sales force of the Knox-Andresen Co., Pittsburgh, Penn., having been formerly associated with the Westinghouse Electric and Manufacturing Co., Pittsburgh.

PERCY A. MCKITTERICK, for 20 years with the Saco-Lowell Shops and the Lowell Machine Shop, has left to become assistant treasurer of the Parks-Cramer Co., Fitchburg, Mass. The Parks-Cramer Co. is a recent consolidation of two well-known firms, the G. M. Parks Co., of Fitchburg, Mass., and the Stewart W. Cramer, Charlotte, N. C.

GEORGE S. BLAKENHORN has resigned from the American International Shipbuilding Corporation as engineer of steam machinery and has gone to the Wilson-Snyder Pumping Machinery Co. as engineer of the Philadelphia, Penn., district.

P. E. FRANCIS, who has in the past conducted a railroad and industrial equipment business under the name of and in conjunction with Edward Jobbins, has severed his connection with Mr. Jobbins and his business in the future will be conducted under the name of P. E. Francis & Co., Marquette Building, Chicago, Ill.

HORACE N. TRUMBULL, who recently received his discharge from the Engineers Officers' Training School at Camp A. A. Humphries, Va., has been appointed advertising manager of the Wellman-Seaver-Morgan Co., Cleveland, Ohio. Before entering the service Mr. Trumbull was advertising manager of the SKF Ball Bearing Co., Hartford, Conn.

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Dates of Automotive Meetings, Shows and Conventions

Readers of the *American Machinist* should preserve the following information for future reference, as it gives the dates of meetings of the Society of Automotive Engineers, motor shows, tractor shows and conventions to be held during the year 1919:

S. A. E. MEETINGS

Feb. 4-6.—New York. Winter meeting. Society of Automotive Engineers, Engineering Societies' Building.

Feb. 6.—Victory dinner, Hotel Astor, New York.

Feb. 5.—Minneapolis Section, S. A. E., Hotel Radisson. "Radiator Cooling Fans."

Mar. 5.—Minneapolis Section, S. A. E., Hotel Radisson. "Tractor Service and Sales."

Apr. 2.—Minneapolis Section, S. A. E., Hotel Radisson. "Implements Designed for Tractor Belt Power and Their Characteristics."

MOTOR SHOWS

Jan. 11-18.—Los Angeles, Cal. Automotive Exposition.

Mar. 1-8.—Detroit, Mich. Detroit Automobile Dealers' Association. H. H. Shuart, manager.

Jan. 24-30.—Milwaukee, Wis. Eleventh annual meeting, Milwaukee Automobile Dealers, Inc., Auditorium. Bart J. Ruddle, manager.

Jan. 25-Feb. 1.—Chicago. Passenger cars, Coliseum.

February.—Grand Rapids, Mich. Grand Rapids Automobile Business Association. E. T. Conlon, manager.

Feb. 1-15.—New York. Automobile Dealers' Association. Charles A. Stewart, manager, Hotel Woodward, Broadway and 55th Street.

Feb. 3-5.—Chicago. Trucks, Coliseum.

Feb. 15-22.—Louisville, Ky. Louisville Auto Dealers' Association.

Feb. 15-22.—Newark, N. J. N. J. Auto Exhibition Co. Claude Holgate, manager.

Feb. 15-22.—Minneapolis, Minn. Minne-

(Continued on page 92)

Difference Between War-Risk Insurance and Compensation

Secretary Glass Says It Is Not Necessary to Prove Dependency to Collect Insurance, but Proof Is Required in Compensation Cases

Considerable confusion and much misunderstanding seem to prevail among the relatives and beneficiaries of men in the military and naval service as to their rights under the war-risk insurance act. Many mothers and fathers named as beneficiaries of the Government insurance applied for by their sons have gained the impression that they must prove dependency in order to receive payments of insurance. This is an entirely erroneous impression, probably due to a confusion of the insurance and compensation provisions of the act of Congress of Oct. 6, 1917, and to a mistaken assumption that the terms "insurance" and "compensation" are used interchangeably, whereas they represent two separate and distinct benefits.

Insurance is payable regardless of any dependency, and a beneficiary designated in an application for Government insurance, if within the permitted class of spouse, child, grandchild, parent, brother or sister, is entitled to receive the insurance in monthly installments without proving any dependency upon the insured.

Compensation, however, which is separate and apart from insurance and takes the place of the pensions provided under the old pension system, is payable only to a wife, child, dependent mother or dependent father of a man who is disabled or dies as a result of injury suffered or disease contracted in the line of duty while employed in the active service. Compensation may be payable in addition to insurance, but a mother or father must prove actual dependency in order to receive monthly payments of compensation, although they will receive the insurance in monthly installments if named as the beneficiary thereof whether they are dependent or not.

No dependency need be shown by any beneficiary in order to receive the Government insurance, but a mother or father must prove actual dependency upon their deceased son for the necessaries of life in order to receive the additional payment of compensation.

* * *

Buys Acreage for Huge Plant

The Standard Steel Tube Co., Toledo, Ohio, has purchased 40 acres of land in the outskirts of Toledo and will begin the construction of the plant and

homes for workers as soon as the ground can be broken in the spring. It is stated that the project will entail the expenditure of more than a half million dollars.

In addition to a huge factory with a capacity equal to three or four times that of its present plant a civic center and housing plan for employees is to be included.

Seven acres of the site is in timber and it is purposed to turn this into a park for the employees. A civic center having a library and a motion-picture theater are features of the plan. Twelve acres are to be platted and homes erected for workers.

(Continued from page 91)

apolis Auto Trade Association. Walter B. Wilmot, manager.

Feb. 17-22.—Des Moines, Iowa. Tenth annual meeting, Des Moines Automobile Dealers' Association. C. G. Van Vliet, manager.

Feb. 15-22.—Albany, N. Y. Albany Automobile Dealers' Association. State Armory.

Feb. 17-24.—Passenger cars; Feb. 24-27, trucks. South Bethlehem, Penn. Lehigh Valley Auto Shows Co. J. L. Elliott, manager.

Feb. 24-Mar. 1.—Kansas City, Mo. Kansas City Motor Dealers' Association. E. E. Peake, manager.

March.—Great Falls, Mont. Montana Automobile Distributors' Association.

March.—Philadelphia, Penn. Philadelphia Automobile Trade Association. Passenger cars.

Mar. 3-8.—Columbus, Ohio. Columbus Automobile Show Co., Memorial Building. W. W. Freeman, manager.

Mar. 3-8.—Buffalo, N. Y. Buffalo Automobile Dealers' Association.

Mar. 1-10.—San Francisco, Calif. Motor Car Dealers' Association. G. A. Wahlgreen, manager.

Mar. 10-15.—Syracuse, N. Y. Syracuse Automobile Dealers' Association. Harry T. Gardner, manager.

Second or third week March.—St. Louis, Mo. St. Louis Auto Manufacturers and Dealers' Association. Robert E. Lee, manager.

Mar. 15-22. — Boston, Mass. Boston Automobile Dealers' Association. Chester I. Campbell, manager.

Mar. 22-29, passenger cars; Apr. 1-5, trucks, Brooklyn. Brooklyn Motor Vehicle Dealers' Association. I. G. Kirkham, manager.

Third week March.—Trenton, N. J. Trenton Auto Trade Association. John L. Brock, manager.

March.—Pittsburgh Automobile Dealers' Association of Pittsburgh. John J. Bell, manager.

March.—Utica, N. Y. Utica Motor Dealers' Association. W. W. Garabrant, manager.

Feb. 15-22.—Cleveland, Ohio. Cleveland Auto Show Co. Fred H. Caley, manager.

Apr. 5-12. — Montreal, Can. — National Motor Show of Eastern Canada, Victoria Rink. T. C. Kirby, manager.

Not Decided.—Bridgeport, Conn. Auspices of City Battalion. B. B. Steiber, manager.

Not Decided.—Harrisburg, Penn. Harrisburg Motor Dealers' Association. J. Clyde Myton, manager.

Not Decided.—Hartford, Conn. Hartford Automobile Dealers' Association.

Not Decided.—Indianapolis, Ind. Indianapolis Auto Trade Association. John B. Orman, manager.

Feb. 10-15.—Kansas City, Mo. Kansas City Motor Dealers' Association. E. E. Peake, manager.

TRACTOR SHOWS

Feb. 10-15.—Kansas City, Mo. Fourth Annual Tractor Show. Sweeney Building, Kansas City Tractor Club. Guy H. Hall, seceretary.

Feb. 18-22.—Wichita, Kan. Annual Mid-West Tractor and Thresher Show, Wichita Tractor and Thresher Club. Forum.

CONVENTIONS

Feb. 4-6.—New York. Meeting. Society Automotive Engineers.

Feb. 25-28.—New York. Sixteenth annual convention. American Road Builders' Association.

Obituary

JOHN B. PALIZZA, late secretary of the Langelier Manufacturing Co., Arlington, Cranston, R. I., died on Dec. 25, 1918.

J. F. RENO died on Dec. 19, 1918, from influenza, followed by pneumonia. Mr. Reno was chief engineer of the Root & Van Dervoort Engineering Co., East Moline, Ill., and had been with this company for the past 12 years.

CHARLES W. ISBELL, chairman of the board of directors of the Isbell-Porter Co., manufacturer of gas-making machinery and builder of gas tanks, died on Dec. 24, 1918, at his home in New York in his eighty-eighth year. He was born in New Haven, Conn.

Catalogs Wanted

Caron Brothers, manufacturers of turned and stamped metal goods, 233-239 Bleury St., Montreal, Canada, desire to receive catalogs from various machinery manufacturers.

Trade Catalogs

Standardized Leather Belting. The Graton & Knight Manufacturing Co., Worcester, Mass. Catalog. Pp. 38; 5 x 7¼ in. Pages 3 to 6 give the history and advantages of standardization. Pages 8 to 22 show a standardized series of leather belting, and pages 23 to 30 give tables of belting standards for various industries.

Lathes. The Seneca Falls Manufacturing Co., Inc., Seneca Falls, N. Y. Catalog No. 27. Pp. 56; 9 x 6 in. A number of illustrations are given of the "Star" screw-cutting engine lathe, together with specifications and attachments for same. Several pages are taken up with illustrations of lathe parts; also a list of users of "Star" lathes.

Mechanics' Tools. The Cincinnati Tool Co., Norwood, Cincinnati, Ohio. Catalog. Pp. 56; 10 x 6¾ in. Loose-leaf catalog illustrating and giving the prices of various tools for mechanics, such as augers, brad awls, wrecking bars, bits, chisels, clamps, file cleaners, cutters, drills, drivers, gage bits, punches, wrenches, and other tools.

Pneumatic High Speed Hammer. H. Edsil Barr, engineer, Erie, Penn. Circular. Pp. 6; 3½ x 8 in. Information and description of the Barr pneumatic high-speed hammer. The circular will be sent on request to plant managers, superintendents, purchasing agents, etc.

Friction Clutches. Williams Foundry and Machine Co., 54-56 Cherry St., Akron, Ohio. Catalog. Pp. 32; 6 x 9 in. This catalog illustrates a number of friction clutches and clutch parts. Line drawings for ordering and tables of dimensions, sizes, etc., are given.

Drills. Buffalo Forge Co., Buffalo, N. Y. Catalog, Section No. 210. Various types of drills for a great variety of requirements are reproduced.

"Universal" Slitting Shear, Punch and Bar Cutter. Buffalo Forge Co., Buffalo, N. Y. Catalog, Section No. 325. Half-tone illustrations and a description are given together with tables and specifications.

Portable Electrical Tools. The United States Electrical Tool Co., Cincinnati, Ohio. Catalog No. 17. Pp. 78; 6 x 9 in. This catalog contains illustrations of electrical hand or breast drilling machines, radial drilling machines, grinding machines and buffing outfits of various types and sizes. A description and a table of type, volt, dimension, weight, horsepower and speed and a code of words are given.

The Fay Automatic Lathe. Jones & Lamson Machine Co., Springfield, Vt. Cloth-bound book. Pp. 85; 6¼ x 9¼ in. Fifty detail illustrations, both line and half-tone, of different types of machines and some examples of the work accomplished on the Fay automatic lathe are shown. The two last pages give some views and a description of the plant.

Reamers. Gisholt Machine Co., Madison, Wis. Circular. Pp. 4; 8½ x 11. Giving the prices and dimensions of shell reamers, hand reamers, taper, shank and chucking reamers and a part list of Gisholt reamer users.

Machines-Outils Americaines (American Machine Tools). Aux Forges de Vulcain, 3 Rue Saint Denis, Paris, France. Catalog. About 300 8 x 10 pages; fully illustrated. Bound in flexible, red leather. This is a very complete catalog of the various American machine tools handled in France by Aux Forges de Vulcain. It will be of interest to almost anyone doing or expecting to do business in France, and of aid to many whose knowledge of French machine-tool terms is limited. Various tools described include milling machines, and their attachments, lathes, turret lathes, plain drilling machines, multiple-spindle and gang-drilling machines, grinding machines, boring mills, shaping machines, planing machines, hacksaws, power hammers, power shears, bending machines, marking machines, bolt cutters and others.

New Publications

Industry.—A magazine edited and published by Henry Harrison Lewis, Wilkens Building, Washington, D. C., Vol. 1, No. 1. Semimonthly. Subscription price, $2 a year.

The purpose of *Industry* is to interpret current events, whether they be financial, economic, political or otherwise. It will follow up legislation and diagnose its meaning, its effect on the nation and its relationship to the great manufacturing and industrial problems of the day. *Industry* further purposes to keep the manufacturer, business man, banker and voter advised of conditions, and where possible to suggest remedies for the things that are of adverse import in the week-to-week developments.

Instincts in Industry.—By Ordway Tead. Two hundred and twenty-two 5 x 7½-in. pages. Published by Houghton Mifflin Co., Boston Mass.

This is an extremely interesting study of the psychology of workers in different industries and is directly in line with the present tendency to recognize the human qualities as well as, or bearing on, the productive possibilities of the men and women in industry. The 10 instincts considered are: Parental; sex; workmanship; acquisitiveness or possession; self-assertion; self-abasement or submissiveness; the herd instinct; pugnacity; the play impulse and the instinct of curiosity.

These take in about all the attributes of the individual, and examples from actual experience are given to illustrate each instinct and to show how each affects the individual worker, his work, his attitude toward his employer, toward his fellow worker and toward the community. No one who comes in contact with or handles labor in any way can fail to find information of value in this little book. It is full of suggestions which can be of great value to the student of this greatest of modern problems, the harmonizing of industrial forces for the greatest good of the nation.

The author cites cases from actual observation to bear out all of these instincts and to show their effect on industry. It seems evident, says the author, that the undercurrents of unrest and discontent which come to the surface with increasing frequency have had their source in an unconscious but effective repression of human aspiration and desire. The release of this energy and vigor, which is needed to clear the air, will not come until we see human nature as it is. He believes that the mind of the worker is grievously misunderstood; that a common knowledge of the motives and attitudes of its manual workers is most imperative; that we have too little real understanding of them. Efforts toward social justice and industrial democracy can hardly be most effective unless we understand the point of view of the worker.

This book should be read by every man and woman who is interested in the employment problem. The time has gone by when we can classify workers by numbers only—we must know their mental background and understand their attitude toward the many problems of the day.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Sine Bar and Attachment

Presto Machine Works, 124 Pearl St., Brooklyn, N. Y.

"American Machinist," Dec. 26, 1918



The sine bar is 4 in. long and the attachment is an accurately finished 4-in. cube. All faces of the cube are provided with a number of tapped holes for attaching work, clamps, etc. Five sides have accurate V-grooves for seating cylindrical work and one side has a T-slot quadrant for attaching the sine bar. The sine bar can be set to either the sine or the cosine of the angle, whichever is most convenient, and then by using the proper side of the fixture as a base the desired sine or cosine is placed in working position.

Welded Tools

Ready Tool Co., Bridgeport, Conn.



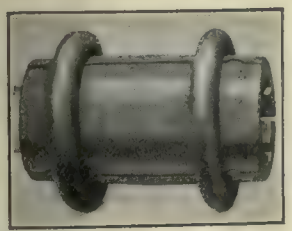
"American Machinist," Jan. 2, 1919

This company is now welding high-speed steel to low-carbon steel for the purpose of making cutting tools or for other like uses. The illustration shows a counterbore made by this method, the difference in color showing where the weld between the two materials occurs. The electric-welding process is used, and it is claimed that considerable saving is made by the use of the shank of lower-priced material and that considerable machining is saved. The company is prepared to do the welding and annealing for concerns that may desire to perform their own finishing operations.

Coupling, Compression Shaft

C. H. Clark, 60 Grand St., New York City.

"American Machinist," Jan. 2, 1919



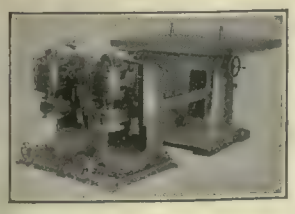
Additional compression rings

Consists of three pieces, which are laid against the shaft, and two rings. The outside of the three pieces forming the main body of the coupling are slightly tapered and the two rings are driven on from either end, and compression is thus secured that is sufficient to hold the shafts firmly together. In installing these couplings sufficient space is left between the ends of the two shafts to allow the rings to be slipped between and over them. It is also claimed that this coupling will line up the shafts, can be used if desired.

Motor Drive for Wood Shaper

Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," Jan. 2, 1919



A new compact motor drive for double-spindle wood shapers making use of standard vertical motors. A separate motor is used for each spindle, each motor being mounted on vertically gibbed ways, adjustable by means of a handwheel and screw so that the motor can be located at the correct height, as shown by the scale and as called for by the height of the spindle to suit the work. Each motor stand is independently adjustable to and from the shaper to adjust the tension of the belt. Another advantage is that either shaped spindle can be run independently. Makes use of standard vertical motors, doing away with the need of specialized built-in motors, and can be adapted for new shapers and also for those already in use. The motor-starting unit may be of such a type as is desired.

Thread-Grinding Attachment, Portable

American Standard Gauge Corporation, 7-8 Chatham Sq., New York City.

"American Machinist," Dec. 26, 1918

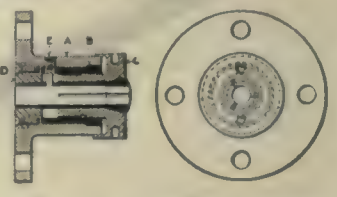


Intended to be attached to any lathe by clamping to the compound rest, and is for use on gages, taps and cylindrical work, but can also be used as a center grinder, for face grinding, chucking work, etc. For thread grinding there are two dovetail slides, one being a swivel slide for dressing the angle of the wheel, the diamond being mounted on this slide. The swivel slide is mounted on a second slide to meet the wheel as it is being dressed. This has brackets, or stops, and adjusting screws to hold the swivel slide while the dressing is in progress. The wheel spindle is hardened and ground and runs in phosphor-bronze bearings which have oil chambers and are adjustable to compensate for wear. Side play is taken up with a flat spring and a hardened-steel ball.

Chuck, Collet

E. W. Bemis Machine Co., Worcester, Mass.

"American Machinist," Jan. 2, 1919

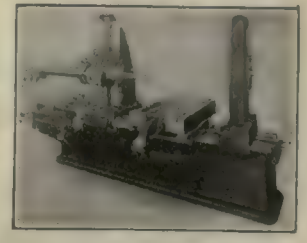


A distinctive feature is the method employed for operating the collet jaws, which have no longitudinal movement. They are held securely in the chuck body but do not ride upon it. The closing member rides upon the taper of the jaws in opening or closing them, and it is claimed that this construction makes for uniformity in the length of the work. Consists of a body *A* reinforced by the sleeve *B* which is threaded to receive the chuck-closing member *C*. This member is knurled for operation by hand and is also provided with holes for a spanner wrench. The collet jaws, which are interchangeable for varying sizes of work, screw into the steel nut *D* and are held firmly in place by the headless setscrew *E*. Also made in a style suitable for screwing onto the nose of the spindle. It is furnished in two sizes, the smaller taking collets from $\frac{1}{16}$ to $\frac{1}{2}$ in. and the larger taking collets from $\frac{1}{16}$ to 1 inch.

Boring Mill, Horizontal

Blomquist-Eck Machine Co., 1146 East 152d St., New York City.

"American Machinist," Jan. 2, 1919



Diameter of spindle, $3\frac{1}{4}$ in.; travel of spindle, 30 in.; taper in spindle, Morse No. 5; number of speed changes, twelve, 16 to 196 r.p.m.; number of feed changes for spindle or table, 9; number of feed changes for spindle or table with back gears, 18; feeds, 0.003 to 0.518 in. per spindle revolution; working surface of table, 24 x 54 in.; automatic longitudinal feed of table, 36 in.; automatic traverse feed or parallel movement of table with bed, 37 in.; maximum distance from spindle nose to outboard bearing, 5 ft. 5 in.; maximum distance from top of plain working table to center of spindle, 27 in.; maximum distance from top of bed to top of table, 10 in.; weight, crated, 11,600 lb.; horsepower recommended, 5; motor recommended, constant speed, 900 to 1200 r.p.m.

Lighting Fixture, "Adlight"

K. F. M. Lindblad, 65 Sudbury St., Boston, Mass.

"American Machinist," Jan. 2, 1919



Particularly designed for work in the shop or for other places where it is desirable to move the light around considerably in order to locate it at the most convenient point. The device is made of $\frac{3}{4}$-in. square steel tubing, the links swinging alternately sidewise and up and down and the cord being run on the inside. Is 42 in. long, but can be readily extended if necessary by the use of a piece of ordinary $\frac{1}{2}$-in. iron pipe. There are no slide points, wire loops or thumbscrews, it simply being necessary to take hold of the light and push it to the position desired.

Patented August 20, 1918

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York		Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.27	$4.20	$4.17	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	4.17	4.10	4.17	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	4.17	4.10	4.17	4.14	3.97	4.10
Soft steel bands	4.57	4.77	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.27	4.52	4.45	4.42	4.39	4.27	4.20

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.25
Warehouse, Cleveland	4.67	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.495	6.445	6.00	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.395	6.405	5.90	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.345	6.295	5.85	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.295	6.245	5.80	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.695	5.645	5.20	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.595	5.545	5.12	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.495	5.445	5.05	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.745	7.695	7.25	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.445	7.395	6.95	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.295	7.245	6.80	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 11%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	30%
Cleveland	35%	30%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	19.00	15.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
3/16, 7/32, 1/4, 5/16, 3/8 No. 8, 1/2 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14.00
5/16 No. 12		1/4 by 19 in. long	12.00
3/8, No. 14 and 1/4		5/16 by 19 in. long	10.00
No. 18		3/8 by 21 in. long	10.00
No. 20		* Special Welding Wire	
		1/4	33.00
		5/16	30.00
		3/8	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, 1/4, and 3/8	47%	20½%	1/8 to 1¼	36%	20%
1/2	51%	36½%			
3/4 to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD. EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	43%	25½%	1/8 to 1¼	36%	21%
1/2	48%	35½%			
3/4 to 1¼	52%	39½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¼ to 3 in. steel butt welded	40%	28%	43%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	36%	25%	39%	23%	37.1%	23.1%

Malleable fittings. Class B and C, from New York stock sell at list + 15%. Cast iron, standard sizes, 5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.00*	26.00	23.50
Tin in 5-ton lots	72.00	83.00	86.00
Lead	6.50	8.55	6.50
Spelter	8.40	9.50	8.00
ST. LOUIS			
Lead	6.15	8.25	6.35
Spelter	8.05	9.25	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	38.00	38.00	31.00	38.00	32.50	36.00	35.00
Copper wire (carload lots)	35.00	35.00	32.00	35.00	28.50	33.00	34.00
Brass sheets	39.75	39.75	30.75	36.00	33.00	33.50	35.00
Brass pipe	46.00	46.00	36.50	41.00	40.00	44.00	41.00
Solder (half and half) (case lots)	55.00	58.00	48.00	47.00	43.25	56.00	41.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$36.00	$25.00
New York	38–40	30.00
Cleveland	38.50	34.00
Chicago	29.50	37.00

January 16, 1919 American Machinist Vol. 50, No. 3

Instruments for Hardness Tests

By C. E. CLEWELL

This article lays stress upon the importance of hardness tests. Reference is made to the early form of Brinell hardness determination and also to two recent modifications. The scleroscope is described and several examples of its use are given. Notes are included on the use of this instrument as a check on the pyrometer in the heat treatment of steel. The methods suggested for holding the various materials when under test are shown by accompanying diagrams.

THE uses for instruments to measure the hardness of metals make a brief study of the methods for such measurements of considerable interest. Some of the measurements for which such instruments are desirable include, in addition to the measure of the hardness of metals, the determination of the degree of annealing, the test of material to see if it comes up to specifications and the detection of separation in an alloy. In experiments with new alloys such tests may be used as a guide in the change of hardness due to the addition or subtraction of any one element.

Other uses for hardness-testing instruments are measuring the hardness of carbon and similar substances, determining the nature of the grain in hardened steel, and measuring the so-called "red hardness" and the capacity of high-speed steel for metal cutting. By this means it is also possible to test the hardness of such special material as the steels for automobile parts and to ascertain the carbon content of steel.

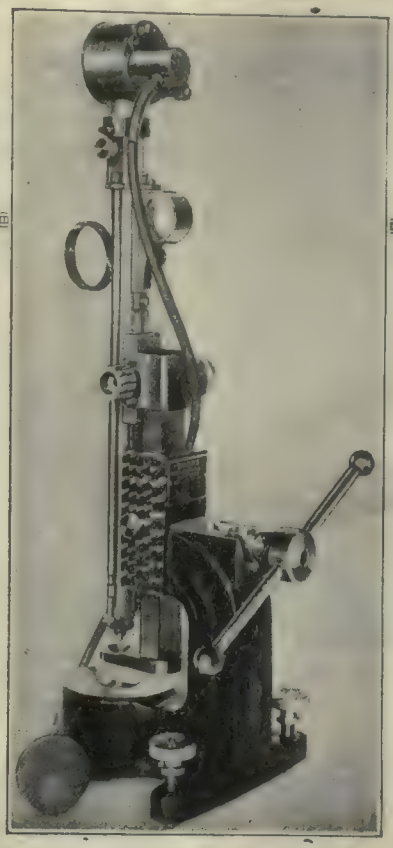


FIG. 1. A SIDE VIEW OF THE SCLEROSCOPE

Present types of machines for the Brinell hardness test are based on forcing a ball of standard diameter into the steel to be tested by a load of standard amount applied hydraulically. Previously hardness tests were made largely by indenting the surface of the metal under test by a conical point under a pressure of known degree, in which the depth the given point penetrated the metal was taken as a quantitative measure of hardness.

The modification of this earlier form of hardness test from a conical point to a steel ball was due to J. A. Brinell. Developments of this principle consisted in designing special presses and the accurate measurement of the dimensions of the depression caused by the steel ball as well as methods for calculating therefrom the factor of hardness. Both the earlier method of the conical point and the later use of the steel ball were limited in their application because of the inability to make a depression in metals that were as hard as the point or as the ball.

On the other hand the present types of Brinell machines are satisfactory under laboratory conditions and where hardness tests are required on a large scale, for example in the checking up of raw material. Where a high degree of accuracy is not essential simpler forms of the Brinell machine have been devised, as referred to in what follows.

About twelve years ago investigations were made in this field of measurement by A. F. Shore, who developed the scleroscope for hardness testing. Briefly stated, the principle of the scleroscope is based upon the rebound of a hard-steel hammer equipped with a formed diamond at its striking end. This small hammer is dropped on the surface of the metal to be tested, and after striking this surface the hammer rebounds to a height proportional to the hardness of the metal; this hardness is then read directly from the vertical scale along the side of which the hammer moves. When the hammer strikes the surface under test a dent, depending on the hardness of the metal, is made.

Fig. 1 shows a side view of a self-contained scleroscope, and Fig. 2 a front view of the same instrument. In the latter case the scale is clearly visible. For small or thin flat pieces the handle (shown to the right in Fig. 1 and in the rear in Fig. 2) is used to clamp the material to the anvil.

In the use of the swinging arm, as indicated to the right in Fig. 2, the scleroscope is mounted at the end of the arm and may then be used for testing on the surface of a large piece of metal or for measurements on pieces held in a bench vise and which could not conveniently be tested on a flat surface. The adaptation of this swinging arm to bench work is illustrated in Figs. 3, 4 and 5. In Fig. 5 tests are being made with the scleroscope for small parts without the stand and swinging arm.

The following notes apply to the practical handling of the scleroscope. In the operation of the small hammer the action is pneumatic. Thus, in pressing the rubber

bulb (Fig. 3) and then releasing it, the hammer is drawn up by suction to the topmost position and is there held mechanically. Pressing the bulb again releases the hammer and permits it to drop to the surface of the metal under test.

The actual method of supporting the instrument for

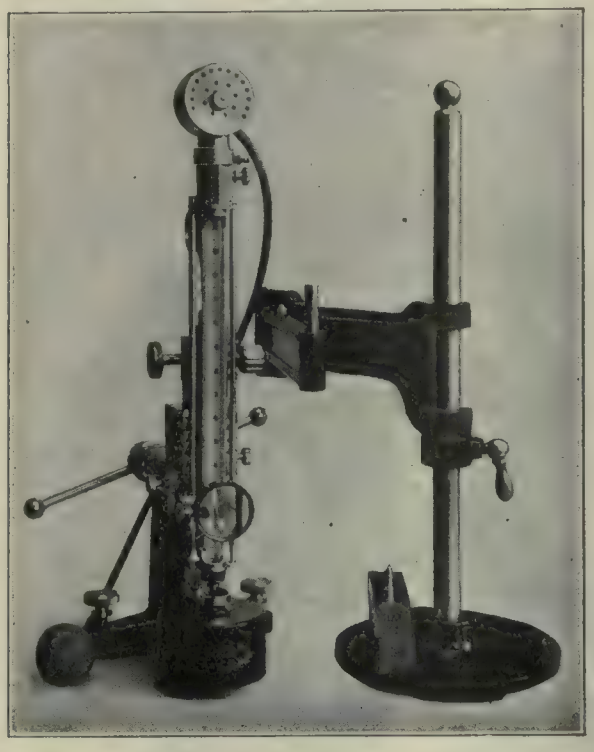


FIG. 2. SCLEROSCOPE WITH SWINGING ARM

thin, flat or other small pieces of work is explained in the foregoing, but in addition it is also possible to operate the scleroscope free hand and thus accommodate any size of work. To insure that the small hammer will drop freely it is necessary to have the instrument in a vertical position before the hammer is released. A bob rod (to the right of the scale in Fig. 2) is ordinarily used for leveling, the tripod screws being employed when the instrument is used in its own clamping stand as in Fig. 1. When used with the swinging arm or free handed a plumb bob is used for leveling.

A level surface should always be available in making the hardness test, especially so when the degree of hardness is high. This surface need not be more than a small spot at the point where the diamond tip of the hammer strikes. For very hard metal the tested surface should also be smooth, although it should not be an actual polish.

In observing the height of the rebound of the hammer after it strikes the metal surface some little dexterity is required at first to catch the exact height of the hammer at the instant before it again begins to fall after the rebound. It is suggested that when hardened steel is being tested the observer should look for this height at or near 100. In like manner, when medium hard steel is tested, the rebound will be near 50 on the scale. For soft metals it will probably be near 10 to 15. Good illumination is also a factor in accurate readings of this instrument, and the glistening effect on the top of the hammer when the light strikes it from the proper direction acts as a guide.

In the use of this device the hammer should never be allowed to strike more than once at the same point, and in fact not too near the first point. All pieces under test must be clamped solidly. Most of the testing should be done in a bench vise with the scleroscope used in the swinging arm. Where many pieces of the same kind are to be tested some form of holding jig should be made. In some castings with large crystals, where a variation in the readings is noted at regular intervals across the sample, the actual hardness is to be taken as the average of all the readings.

Several suggestions for jigs to hold parts under test are given in Fig. 4. The diagram to the left illustrates the use of plates in a bench vise for holding balls during the test. The plate to the right is countersunk, while the other is flat. In testing the surface of tubing a scheme like that shown to the right in Fig. 4 may be used. Here two plates are used in the vise for jamming down the tube on the plug placed within the tube. The spot at which the test is to be made is shown by an arrow in each case.

The pressure of the hammer used in the scleroscope, due to the very small area of the point of contact, may be as much as 500,000 lb. per square inch. The height of the hammer fall is 10 in. and the diameter of the hammer somewhat less than $\frac{1}{4}$ in., with a length of $\frac{3}{4}$ in. It weighs about $\frac{1}{72}$ oz., and the diamond striking tip is slightly spherical and blunt with a diameter of about 0.02 in. A value of 100 is chosen as the arbitrary numerical value of the hardness of quenched carbon steel, which makes the hardness of lead on the order of 2

In metal working it is found that soft lead with a hardness of 2 can barely be cut by a lead alloy of a hardness of 4, and the same relation exists between metals with hardness factors of 4 and 8, 8 and 16, and so on, until it is found that to cut steel of a hardness of 50 the cutting tool must have a hardness of close to 100; that is, twice as great. These figures relate moreover to cutting slightly without an instantaneous loss of the cutting edge. To preserve the edge of the cutting tool over a short interval a ratio of $2\frac{1}{2}$ to 1 is required, and in a commercial cutting tool the minimum ratio of hardness must be 3 to 1. Thus, if a cutting tool has a hardness of 100 the material which it can be used to cut cannot have a hardness of more than say 34 unless overheating of the edge of the tool is prevented either by using a lower feed, speed or other means.



FIG. 3. TESTING HARDNESS OF SHELLS

This subject is touched upon here as one of the practical aspects of shop work in its relation to the question

of hardness and to point to the usefulness of the instrument under discussion.

Tests were made on automobile parts that had undergone heavy service, and in the disassembling of the machines that were used as the basis of the tests a study was also made of the following points:

The matter of battering and shearing of the parts because of their being too soft at the core when case-hardened, or when hardened without cementation, or when not heat treated at all. Also for wear due to a

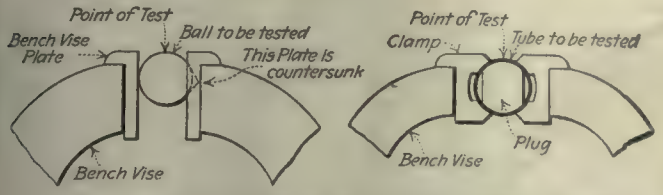
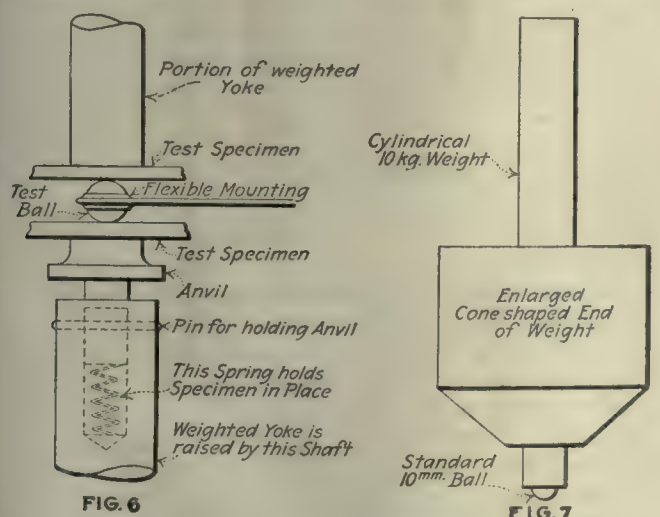


FIG. 4. VISE CLAMPS FOR HOLDING TEST PIECES

lack of hardness; for chipping of corners due to an excess of hardness; for fatigue because of an elastic limit and a hardness which was too low, and for crystallization and fractures due to insufficient toughness where the hardness was sufficiently high. It was found that the hardness standards finally adopted did not apply to all kinds of steel and in particular to plain carbon steel, in which the toughness rapidly decreases as the hardness is increased.

A few of the numerical hardness readings obtained from these tests will show the tendency toward standardization. Thus for automobile frames of chrome-nickel steel the readings of hardness range from 40 to 45; for plain carbon steel, from 35 to 40; for axles of chrome-nickel steel (0.35 carbon), 40 to 45; for springs of very elastic and superior quality made of vanadium steel, from 65 to 80, and of plain carbon steel, 60 to 75. Other readings were found for crankshafts, transmission



FIGS. 6 AND 7. BRINELL HARDNESS TESTS
Fig. 6—Applying Brinell hardness test to two specimens at once.
Fig. 7—Special device for obtaining Brinell hardness

shafts, transmission gears, starting crankshafts, pump shafts, piston pins and for a variety of other automobile parts.

One use of the scleroscope is as a check on the pyrometer in the heat treatment of steel. If not properly calibrated at sufficiently short intervals a pyrometer might vary with length of service enough to impair the value of high-grade steel. In such cases the scleroscope may be employed to test the hardness of the steel and check the reading of the pyrometer.

Another application is in the tests of armor plate, projectiles and gun metals. The resisting power of ar-

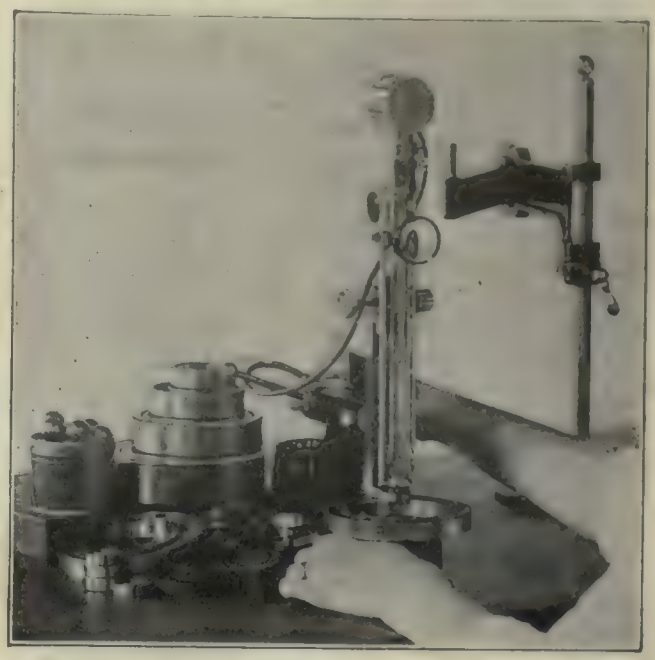


FIG. 5. USING THE SCLEROSCOPE WITHOUT THE STAND

mor plate is investigated after the use of the proper materials and suitable heat treatment on a basis of the hardness test. Similarly projectiles, where all the other conditions are adhered to, may be said to have a penetrating power that is proportional to their hardness, thus offering a channel for tests by this device.

Other applications include the study of the depth of hardening in steels, and the study of shop conditions in regard to the best conditions of cutting tools and the metals worked upon, with the idea of increasing the economy of production.

Modifications of the Brinell Test Machine

Several other modifications of the original Brinell test device may be mentioned, and are referred to in Figs. 6 and 7. The one illustrated in Fig. 6 was devised for use on cartridge brass. The principle on which the first revised form was based was simply a yoke weighted down to 500 kg., and carrying the test ball, an automobile jack being so arranged as to lift the yoke with the test piece between the jack and the test ball.

A description of the improved machine, which followed the first crude device, is essentially as follows: An iron stand that had been cast aside was employed. A vertical shaft operated by a threaded bevel gear was substituted for the jack, and the shaft so fitted to a bearing at the bottom as to move freely. A handwheel (not shown) produces a motion of 0.01 in. per revolution, and calls for approximately four turns to produce the necessary impression in the test piece. By the scheme clearly shown two specimens may be tested at one time. The spiral spring between the anvil and the vertical shaft was introduced to aid the test. By this means the two test pieces are held in place until the

load is applied and are prevented from falling when the load is released.

Another scheme was devised and reported by J. G. Ayers, Jr., where, instead of applying a dead load of standard amount, a standard impact was employed. A cylindrical weight of 10 kg. was employed with the lower end, having a cone shape, in which a standard 10-mm. ball was securely held, Fig. 7. The height from which this weight had to fall to produce an impression in the test specimen of 3-mm. diameter was found to be 70 mm. By the use of this impact as a standard various pieces of different hardnesses were tested, and the diameters of the test impressions were plotted (ordinates) against the numerical values of the standard Brinell machine (abscissas). The use of an impact rather than hydraulic pressure is quicker, hence this modified scheme has rapidity as one of its advantages in making tests on a large scale.

Muzzling the Punch Press

By C. H. Biron

With drawn sheet metal replacing cast or machined parts the punch press is used today more than ever, and as a result the accident curve of the average factory receives a good share of its stimulus from the mutilation of fingers and hands tending these machines. There are a number of devices designed to minimize the danger to operatives, many of which are not without merit, but there still remains room for improvement.

It is no easy matter to inaugurate the use of safety appliances on punch presses, and not least among the difficulties is the opposition of the operator whom the appliance is intended to safeguard. For example, recently a firm received a sample of a safety device the principles of which were promising and in actual use bore out its inventor's claims, but one unlooked-for drawback consigned it to the fate of its predecessors. The first tests were made in the presence of the officials, who were gratified with the results, and for the time being the operator shared the sentiment.

A Good Cause for Complaint

In the course of a day's work, however, a good cause for complaint became manifest. The device consisted primarily of a light wood bar that interposed crosswise and horizontally between the operator and the die, and which was pivoted at either end in such a manner that in placing work in the die the operator's forearms must displace the bar by raising it from its normal position, thus operating the nontrip feature. At its best working position the bar was close to the operator's line of vision, not enough to obstruct his view but still close enough to distract the natural focus of the eyes. The fault was obvious, and to the operator the element of uncertain accident was preferable to certain eyestrain.

The instance cited was on a production rate of 2000 an hour. On the heavier work of the toggle presses that are run at much slower rates and often expose the entire arm to amputation this discouraging characteristic is absent and safety devices become a necessity.

It is on the more rapid work that the appliances fall short and it is apparently little known that many accidents occur in a moment of confusion wherein the operator exposes his hand after the press has been tripped. There is no device, mechanical or otherwise, that meets this condition.

A common fault of devices that minimize danger is their tendency to minimize production as well. Speeds of 1500 to 2500 an hour are common with light forming or piercing operations, and the slightest unnecessary move consuming but a fraction of a second on each piece amounts to a considerable loss in the course of a day's work.

The Piecework System

Where piecework price systems prevail the employee complains that the device hinders his ability to "make out;" the shop foreman must attribute lower production at a higher cost to the use of safety appliances—in fact the antipathy becomes general, and safety devices are consigned to some obscure corner until another accident signals the loss of a valued employee and may develop into a costly lawsuit.

A great deal of danger can be eliminated at the start in the design of the tools themselves. Let the draftsman consider well the position of the operator's hand on the piece while placing it in the die (most accidents occur while the hand still grasps the piece) and endeavor in his design to leave clearance for the hand in case of an accidental tripping of the press. Often he can do away with the necessity of exposing the hand to remove the piece by using knockout strippers.

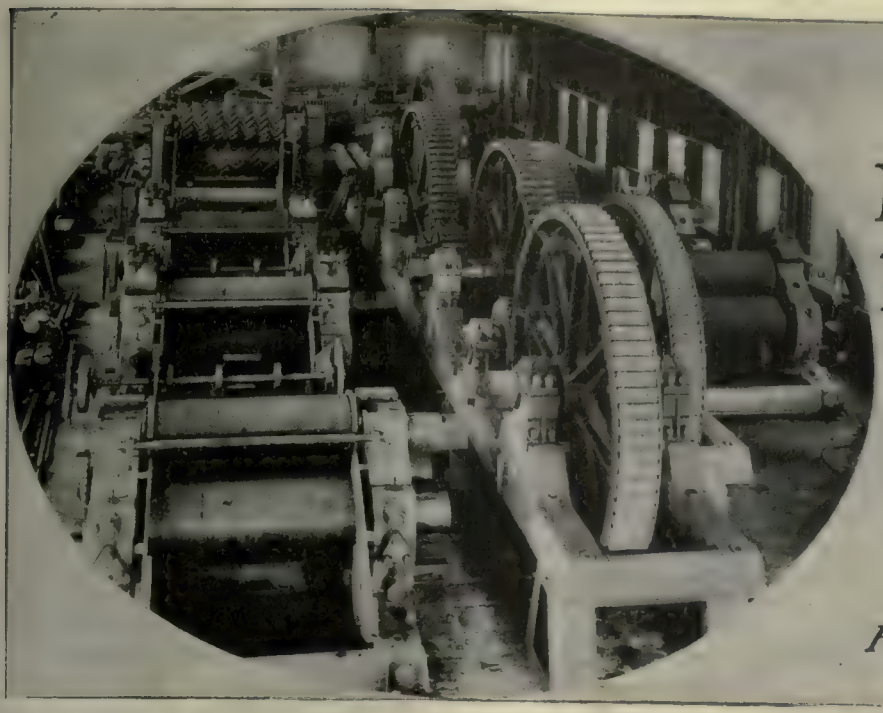
In blanking from strip stock of the wider widths the operator's hands are normally well away from the tools, but the thumbs and forefingers sometimes suffer through coming between the guide-pin bosses, which approach each other more closely with each successive grinding of the die. This is overcome to some degree by tapering the bosses.

Only One Real Successful Method

While safety devices will tend to lessen the number of accidents to some extent there is but one real successful method, and that is to keep the operator's hands out of the tools at all times. This condition was attained in one shop by the use of a loom-fixer's pliers, the long flat tongues of which are admirably suited to certain kinds of press work, and for more than five years these pliers have been in use in its press room. They are inexpensive, always ready, and above all they accomplish the desired result, as with their adoption the percentage of accidents fell to a negligible quantity. Broken and bent pliers were turned in for replacement much less frequently than men were formerly rushed off to the hospital in the works' ambulance.

By actual canvass in a room of 60 pressmen the voluntary use of pliers was unanimous, and no two men were handling the same shapes. With little effort their use becomes instinctive and habitual; one soon becomes accustomed to handling with accuracy and speed pieces of every describable shape.

Cases are few where they cannot be used to advantage, and the operator is no longer accustomed to working with indifference toward danger, and he never places his hand within the die to adjust strippers or clear a fouled piece without a momentary apprehension that prompts him to more caution than he would otherwise exercise.



Heavy Machinery Necessary for Sugar Making

By *Frank A. Stanley*

ONE of the big firms of the South engaged in the construction of sugar-making machinery is Dibert, Bancroft & Ross, whose plant at New Orleans, La., has many features of interest. Many of the parts of sugar machines are very heavy. To those who are not familiar with sugar-mill machinery the crusher and roller mill shown in the headpiece will convey some idea of what one looks like. Some estimate of the size of the members may be had from the fact that the necks of the rolls used in sugar mills are often 18 in. or more in diameter by 22 in. or more in length. It is obvious that heavy housings and jaw boxes must be provided to accommodate these massive rolls and withstand the enormous pressure to which they are subjected when the sugar cane is passed between them.

Few of us who drop our sugar into our cups are aware that before it could be manufactured machinists had to build a gigantic machine weighing over a hundred tons and comparable to a rolling mill for armor plate.

Some of the big bearing shells are seen in Fig. 1, lying on the bedplate of a mill, presenting further evidence of the heavy proportions of the work as a whole. A roll being turned preparatory to grooving is shown in Fig. 2. The end of the roll shaft is formed with a large square by which it is driven when in place in its housings, and this squared end is utilized for rotating it in the lathe, a split dog in the form of a pair of bent straps serving to drive the work. The roll is supported in blocks which provide a bearing under each journal. Some of these are as large as 36 in.; in these the roll itself is cast-iron, forced onto a forged-steel shaft under great pressure. In Fig. 3 is shown a bottom roll and shaft with a roll diameter of 36 in. and length of 7 ft. across the face. The interior is bored a press fit for the shaft for a distance of about 26 in. at each end and the portion between is cored larger for clearance. The bore has two diameters to facilitate the pressing in of the shaft. The smaller end of the bore is 19⅞ in., the larger end 20 in., so that there is a clearance of ⅛ in. for the shaft when slid into place until its smaller end reaches the corresponding portion of the roll bore.

The roll and shaft are put together under 600 tons pressure, which is unusually high, as it runs up to 30 tons per inch of diameter or about three times that used for forcing locomotive drivers onto their axles and for other work of similar character.

The hydraulic press that is used to force the roll shell onto the shaft is a horizontal machine of 1000



FIG. 1. BEARING SHELLS FOR MILL JOURNALS



FIG. 2. FINISH-TURNING A BIG ROLL PRIOR TO GROOVING

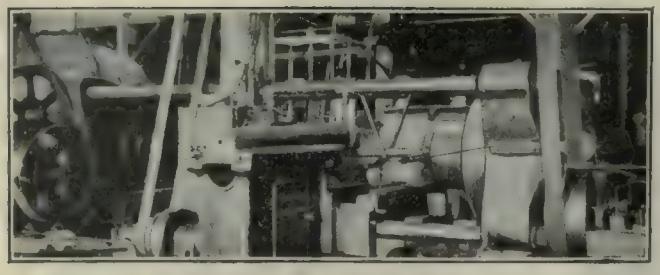


FIG. 4. A HOMEMADE 1000-TON HYDRAULIC PRESS

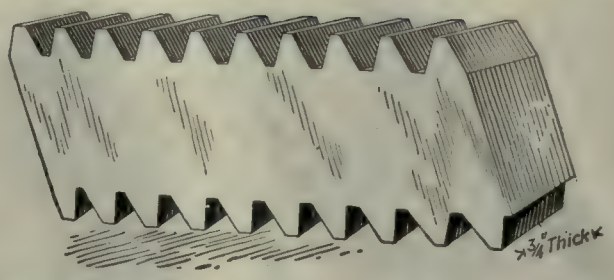


FIG. 5. DETAIL OF DOUBLE-EDGED GROOVING TOOL

tons capacity, is homemade and of ample dimensions between end housings to admit work considerably longer than the roll illustrated by Fig. 3. The press is shown in Fig. 4, where the right- and left-hand housings are seen at either side of the shaping machine that occupies the foreground. The housings stand some 7 ft. from floor to top and they are tied together by four through bolts 6 in. diameter with nuts at the ends.

The roll illustrated in Fig. 3 is finished with a series

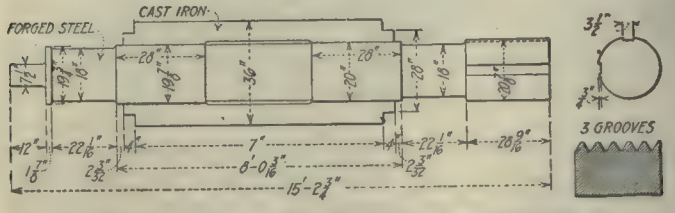


FIG. 3. ROLL AND SECTION OF GROOVES

of grooves around the circumference spaced three to the inch, though frequently the roll faces are grooved six or seven to the inch. The form of tool used in the grooving operation is shown in Fig. 5. It is a flat formed cutter with teeth similar to a flat chasing tool, except that the teeth are uniform instead of being beveled away at the leading end to provide a starting clearance. The tool is fed straight in by the cross-slide until the proper depth of groove is obtained and is double edged with cutting teeth on each side so that an economy in the steel blank is effected and there is always a suitable grooving edge available for the work.

The teeth are formed from the face to the back with uniform section, and as the top surface is ground away in sharpening there is no change in the tooth form. In plan the tool resembles a double-edged rack with teeth similar to a coarse-pitch U. S. Standard thread.

There are various forms of grooves in different classes of rolls. Several types of rolls are shown in Fig. 6, the one at the top being cast with herringbone corrugations for crushing the cane as it first enters the mill. Underneath this is a shaft for a roll of the kind already described, and at the front of the pile is a finely grooved roll, which is one of the finishing set where the fine grooves act to squeeze the cane, and deeper grooves every few inches serve to carry away the juices. This latter roll is also of the construction referred to where the roll proper, or outer shell, is pressed upon a shaft for carrying the whole unit in the housing bearings.

The different types of rolls are very heavy units to handle and machine. The roll in Fig. 3 weighs when in place on its shaft about 14 tons, and the complete outfit of rolls in a nine-roll mill alone will run up to say 120 tons, this without the gearing, housing, etc., which in the total make up a massive piece of apparatus.

The machine shown in the headpiece has a length of approximately 75 ft. for the main bedplates, and some idea is therefore obtained regarding the sizes of the spur gears that operate the sets of rolls. These gears are 10 to 14 ft. in diameter by 12 to 16 in. face and will weigh 5 or 6 tons each. They are fitted on shafts 18 in. or more in diameter and are themselves built up in the form of gear rings mounted on a spider.

In Fig. 7 a cast-steel pinion is illustrated on the table of the keyseating machine. This pinion is one of the driving members in the gear train for the rolls and its proportions are well shown. This pinion weighs about 1½ tons. Its teeth have a circular pitch of 4.5 in. and a length of face of 14 in. Broad keyways are used in this class of work, and referring specifically to the bottom roll in Fig. 3, which is illustrated with two keyways in the end of the shaft, these keyways are 3½ in. wide



FIG. 6. SEVERAL TYPES OF "ROLLS"

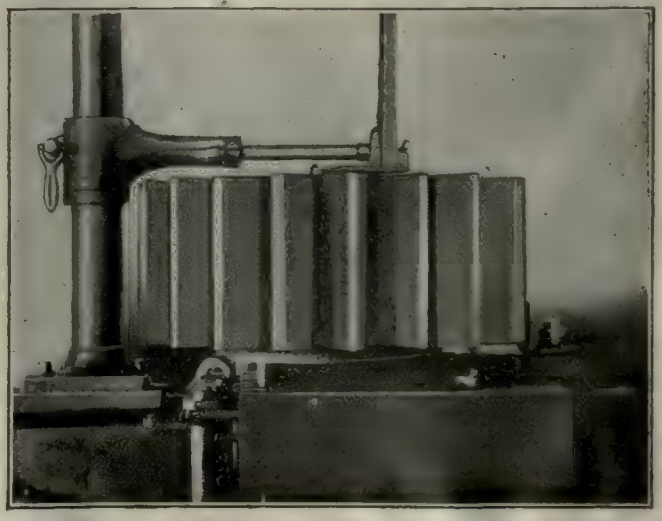


FIG. 7. CUTTING A KEYWAY IN A CAST-STEEL PINION

by $\frac{3}{4}$ in. deep. They are planed into the shaft at 90 deg. to each other and are cut clear across the enlarged end of the shaft, which is $28\frac{9}{16}$ in. long.

The top roll in each set of three is the driver. The shaft in the top roll extends 10 in. beyond the ends of the other shafts and is formed with a square as large as the shaft diameter will permit to receive the driving chuck, or cathead, on the short shaft that extends across from the gear train. The connections for the rolls and gear train are therefore very similar to the drive employed on roll sets in steel mills.

In some instances a herringbone form of gear tooth is used and it has been found to impart smoothness of action.

Manufacture of Tungsten and Molybdenum

By PAUL McJUNKIN

A BRIEF description of the method of manufacturing tungsten and molybdenum wire may be of interest to those who are not acquainted with it. The process is essentially the same for both metals.

The successful manufacture of wire of these materials required extraordinary perseverance in the various steps, but as is often the case in even the most remarkable technical achievements it appears that nothing essentially new was employed. This should not detract from the credit due to those who had the ability and the resources necessary to achieve the remarkable result of obtaining wires of unusual ductility from materials previously considered nonductile.

How Tungsten Wire Is Made

Tungsten wire is made by reducing tungsten trioxide (WO_3), which has been purified, to metallic tungsten powder, which, with a small amount of a binding material, is compressed by a mold in a heavy hydraulic press to a stick of square section, usually about 20 cm. long by 1 cm. square. This stick must be carefully handled until it has been brought to an extremely high temperature in an electric furnace, which temperature can be attained only by using a heating coil of tungsten or molybdenum protected by an atmosphere of hydrogen or nitrogen. After this treatment the stick has sufficient mechanical strength to permit its being mounted vertically between heavy water-cooled copper clamps in a water-cooled vessel in which an atmosphere of pure hydrogen can be maintained. An electric current is then passed through the stick of tungsten, bringing it nearly to the fusing temperature of the metal. At this temperature the pressed stick consolidates into a homogeneous rod, now called an ingot, having contracted considerably both in length and thickness, and, though still very brittle when cold, having very considerable mechanical strength.

The next step is perhaps the most important, since it is here that the extremely brittle mass of tungsten is given a fibrous structure, permitting it eventually to be drawn into wire. The successful introduction of this step was undoubtedly due to the persistence of A. J. Langelier of Providence, R. I., who has had many years of experience in the swaging of metals. The swaging machine contains a pair of dies which when rotated deliver a series of rapid blows from different angles on a rod of metal passed between them, thus reducing the diameter and giving to it the mechanical working which results in the elongation of the crystals of the metal and consequently a fibrous structure. In the case of tungsten and molybdenum this can only be accomplished with the ingot at a very high temperature and in many steps with a very small reduction in diameter at each step. By the time, however, that the ingot has been reduced to a diameter of about 1 mm. it is possible to begin actual wire-drawing operations.

The wire drawing is done on specially constructed drawing machines, using diamond dies, though to a small extent special alloy dies have been successfully used for the larger sizes. During the first passes through the dies both the wire and the dies must be kept quite hot, the temperature being reduced as the diameter of the wire decreases. As a lubricant for drawing aquadag is applied to the rod during the swaging and adheres to the wire throughout the drawing process, giving it a jet-black appearance, hence the term "black wire" applied to the unannealed and uncleaned wire as it comes from the dies.

Coiling the Spiral

For coiling the spiral filaments used in gas-filled lamps and for use with the "form wound" method of filament mounting tungsten wire is generally used unannealed, while for winding the filament on the stem directly from the spool it is generally annealed. Usually the unannealed, or "black," wire is very curly, due to the die not having been exactly symmetrical or the line of drawing not exactly coinciding with the axis of the die. If the annealing be carried far enough the wire will be entirely free from kinks or curls, but the tensile strength, which is very high in the "black" wire, is greatly reduced by annealing so that a partly annealed wire is most suitable for lamp manufacture.

Tungsten and molybdenum are also made in the form of sheets or strips, which are produced by subjecting the ingots to hot rolling. For some purposes the rods resulting from the swaging of the ingots are directly of value. For other purposes shapes molded from the metal powder and intensely heated in an electric furnace are useful.

Larger units of production are being constantly attained and improved methods of manufacture developed, both bringing nearer the more general use of these metals in the world's industries.

Properties

Tungsten, and to a lesser extent molybdenum, is distinguished by several characteristics. Both are extremely resistant to corrosive or other chemical action. The tensile strength of wires is enormous, in the case of fine tungsten wires from two to three times that of the best steel wires. The melting points are

extremely high. They are generally very hard, slight alloying and proper treatment making them excessively so. The following data summarize these and other properties of tungsten which may be of interest:

Density, 19 to 21.4, depending on the method and extent of mechanical working in its preparation.

Tensile strength, 300 to 425 kgm. per square millimeter (425,000 to 600,000 lb. per square inch) for wire which has had considerable mechanical working, hence depending largely upon the size of the original ingot.

Young's modulus of elasticity 42,200 kgms. per square millimeter (60,000,000 lb. per square inch) for wire in which the fiber has been fully developed.

Melting point, 3177 deg. C. (5722 deg. F.).

Thermal conductivity, 0.35.

Coefficient of expansion, 0.0000043.

Specific heat, 0.0357.

Electrical resistance at 25 deg. C. (77 deg. F.): 6.2 microhms per cubic centimeter (37.5 ohms per mil foot) for hard-drawn wire to 5.0 microhms per cubic centimeter (30 ohms per mil foot) for fully annealed wire.

Temperature coefficient of electrical resistance (0 to 170 deg. C.) 0.0051.

Applications

The greatest quantity of both tungsten and molybdenum is used in the manufacture of alloy steels, for which purpose the metals are reduced in the form of ferrotungsten and ferromolybdenum.

By far the leading use of the pure metals is that which first prompted their production, tungsten for the filaments of incandescent electric lamps and molybdenum for the anchors or hooks which support the tungsten filament. Certainly the purest tungsten, if not the first production, was that secured by the colloidal process of Dr. H. Kuzel. That which made the tungsten lamp of today practicable was the production of tungsten in the form of wire, both because of the comparative cheapness of the filament itself and the lower cost of making the lamps because of the greater mechanical strength of the filaments.

Most people who are familiar with tungsten and molybdenum believe that on account of their peculiar properties their use is only in its infancy and is destined to undergo enormous development, and that these metals merit the very serious consideration of men engaged in many diversified lines of industry. Indicative of this diversity a few applications will be mentioned, some of which are already extensive while others are only in the experimental stage and some must await improvement and cheapening of production for extensive use. Tungsten, and to a lesser extent molybdenum, has been used with great advantage over the metals previously employed in the manufacture of incandescent electric lamps, because of the very high melting point and low vapor tension at high temperatures.

The Use of Tungsten Disks in Wireless Apparatus

Tungsten disks are extensively used for spark gaps in wireless apparatus, and the metal has almost entirely replaced platinum for the contact surfaces of vibrators in ignition coils and many other electrical instruments. For some of the more important controls of airplanes, cables made of tungsten wire are largely used instead of steel because of their greater strength and because being entirely unaffected by moisture or corrosive gases there is no possibility of the development of a defect through any slight imperfection or abrasion of the protective coating applied to steel cables.

Electric furnaces operated at very high temperatures are becoming more important in many industrial processes. The use of tungsten and molybdenum wire and ribbon for the heating coils permits of operation at a temperature several hundred degrees higher than is possible even with platinum windings. X-ray tubes have been made much more powerful through the substitution of tungsten for platinum as a facing for the targets because of the higher temperatures permissible.

The Development of the X-Ray

This development of X-ray apparatus has made it practicable to apply these rays to many industrial processes, such as the hastening of chemical reactions usually dependent on sunlight, the inspection of metals for imperfections, the sterilization of boxed cigars against destructive insects, the curing of patent leather, the coloring of glass for optical purposes, etc. On account of its hardness, toughness and of its not being affected by local heating tungsten needles have largely replaced steel needles in phonographs, being serviceable for a hundred reproductions without injury to the record.

Tungsten wire has been used to some extent as strings for musical instruments with much satisfaction. Its weight, about two and a half times that of steel, increases volume of sound and it has been suggested, though not to my knowledge tried, that in consequence pianos may be made of either smaller size for a given volume of sound or having a greater volume of sound from present sizes. Because of its great tensile strength and that it can be readily drawn to diameters as small as 0.0004 in. tungsten wire is used as suspension wires for scientific instruments and as invisible suspension and control wires for advertising novelties and theatrical effects. Certain easily made alloys of tungsten are extremely hard and will doubtless come to be largely used for cutting tools and wire-drawing dies.

It is hoped that these examples may at least suggest many other uses.

Tungsten Wire Data

The following tables are based on average data for the wire generally used for filaments for electric lamps. Necessarily the figures for resistance are only approximate, as these vary with the density and degree of annealing of the wire. They are, however, accurate in that they show the correct relations of wires of different diameters:

TABLE OF RELATION BETWEEN DIFFERENT WIRES

Diameter		Reistance Cold in Microhms		Length	
Mm.	In.	100 M.	1000 Ft.	M. per Kg.	Ft. per Lb.
0.010	0.00039	76,500	233,500	665,000	990,000
0.015	0.00059	34,000	104,000	295,000	440,000
0.020	0.00079	19,200	58,300	166,000	248,000
0.025	0.00091	12,250	37,400	106,000	159,000
0.030	0.00118	8,500	25,800	74,000	110,000
0.035	0.00138	6,250	19,000	54,000	81,000
0.040	0.00157	4,800	14,500	41,500	62,000
0.050	0.00197	3,060	9,400	26,500	39,700
0.060	0.00236	2,130	6,500	18,500	27,500
0.070	0.00276	1,560	4,750	13,600	20.300
0.080	0.00315	1,200	3,650	10,400	15,500
0.090	0.00355	945	2,880	8,200	12,200
0.100	0.00394	765	2,330	6,650	9,900
0.125	0.00492	490	1,500	4,250	6,350
0.150	0.00590	340	1,040	2,950	4,400
0.175	0.00689	250	760	2,170	3,240
0.200	0.00787	192	583	1,660	2,480
0.300	0.01180	85	258	740	1,100
0.400	0.01570	48	146	415	620
0.500	0.01970	31	94	266	397

Building the Kempsmith Milling Machine—I

BY M. E. HOAG

Some of the operations followed in the construction of a well-known milling machine, as well as a few details in regard to handling stock and routeing of work through the factory, are here presented.

THE success of a modern machine-tool plant depends not only on good equipment, competent workmen and financial backing, but the loyalty of the workmen and the system of handling the work both from the viewpoint of the offices and the shops are important factors to be considered. The shops of the Kempsmith Manufacturing Co., Milwaukee, Wis., present an excellent example of the up-to-date machine-tool manufacturing plant, whose ability to meet the present trying conditions should be of interest to others.





FIGS. 1 AND 2. STORAGE OF CASTINGS FOR SEASONING

The shops are single-story buildings with sawtooth roofs. The floors were originally of concrete, but they did not prove satisfactory on account of the accumulation of dust and grit which could not be prevented from getting into the bearings of the machinery. It was also believed that the health and efficiency of the workmen were impaired by standing on the cold concrete floors, so they are now overlaid with wooden paving blocks. The trouble from dust has been eliminated and the men have been found to be more efficient and able to stand for longer periods when occasion demands.

The apprenticeship system is in vogue in these shops, and that it is very successful is evidenced by the fact that the department foremen have with one or two exceptions risen from the ranks of the apprentice.

Two railroad spurs at one side of the shops afford ample transportation facilities, large loading platforms with cranes and storage facilities being provided, partial views of which are shown in Figs. 1 and 2. At the opposite end of the storage platform shown in Fig. 1 is a building which is devoted entirely to the storage of countershaft parts.

The stock enters the shops from the storage platforms and makes a complete circuit of the plant, passing from one machine or group of machines to another and to the assembling, testing, inspecting and painting departments until the completed machines finally reach the shipping department and are ready to leave the shop at practically the same point that the raw material entered.

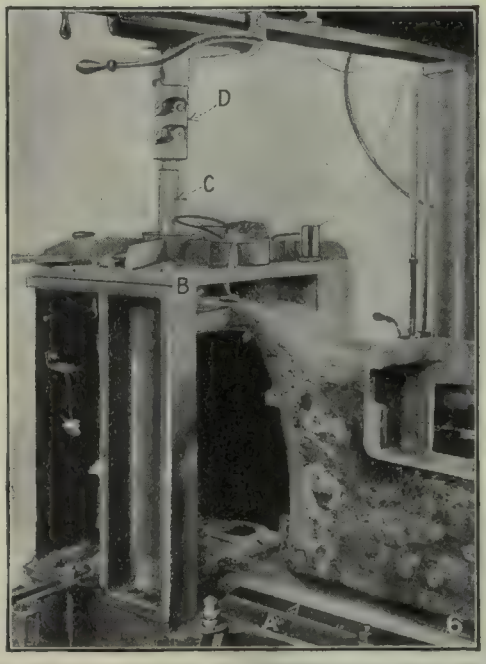
A system of unit assembling is followed, whereby the various parts such as columns, knees, tables, etc., are assembled, the sections passing thence to the final assembling department, where they are brought together to form the complete machine. In the superintendent's shop office there is installed a system of boards by which accurate track is kept of stock in process and storage, so that a glance is sufficient to determine the department in which any lot of parts is located, data of these movements being taken from the operation tags and time cards turned in, as each operation is completed, and transferred to plugs on the boards. The boards are divided into cross-sections, a straight-edge on each board aiding in securing correct location. An idea of the general construction of these boards is shown in Fig. 3.

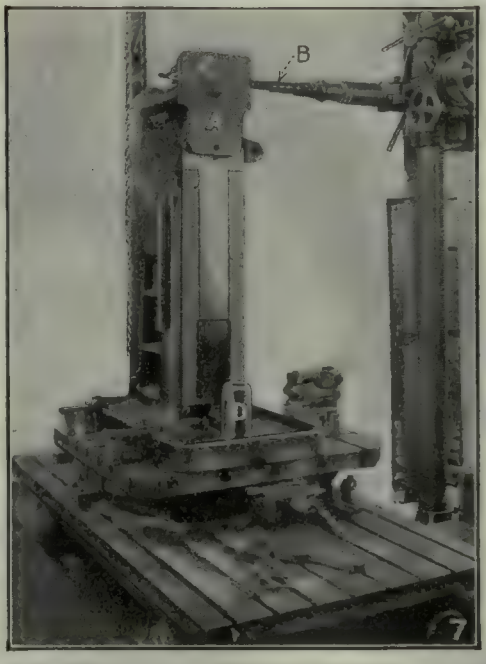
Standard jigs are used for all planing, milling and other machining operations, which insures uniformity of parts and of finished product. A few of these jigs will be described in this article.

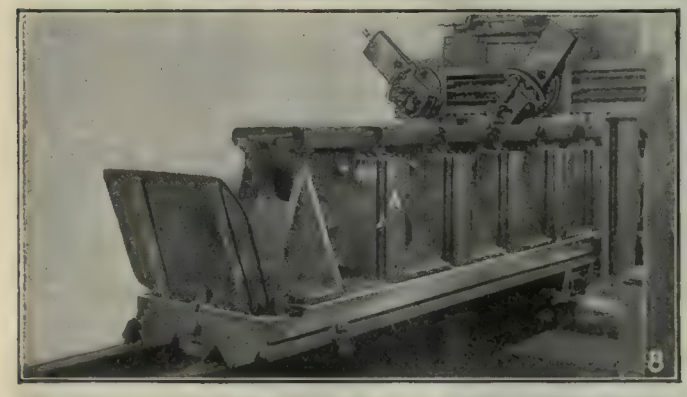
The first operation on the columns is planing the bearing surfaces for the knee, as shown in Fig. 4. For this operation the base of the column is allowed to rest on the planing-machine table, while the upper part, which carries the arm, is held by setscrews and suitable clamping blocks in the jig, the work being indicated and leveled up as in regular practice. All flat surfaces, as well as the Vs, are finish-planed at one setting, this being rendered practicable by long open-air seasoning of the castings. After the planing operation the columns

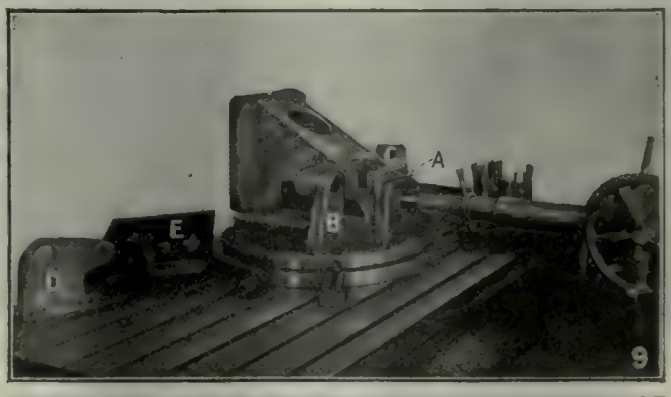


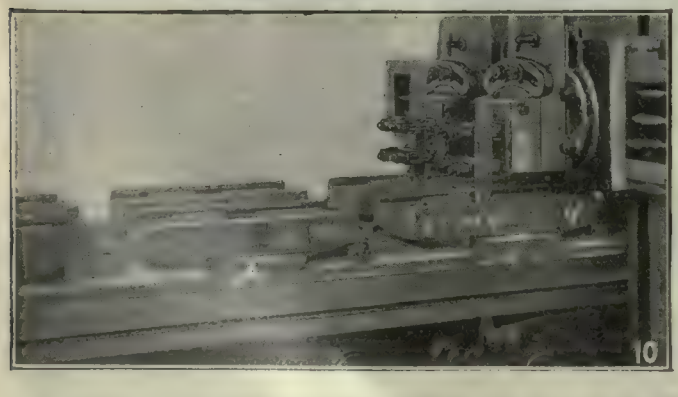














FIGS. 4 TO 11. PLANING, BORING AND SCRAPING OPERATIONS

Fig. 4—Planing the machine column. Fig. 5—Scraping the face of the column. Fig. 6—Boring holes for spindle and overarm. Fig. 7—Boring the arm clamping holes. Fig. 8—Planing the knees in gangs. Fig. 9—A turret jig for boring the knees. Fig. 10—Planing the saddles. Fig. 11—Planing the work tables

are scraped to standards as seen in Fig. 5, which shows a surface plate fitted with trunnions and bail and attached to a chain block so that the workman can handle it easily without a helper. This scraping gives a true bearing surface from which all future locations and gagings are taken and insures the alignment of all parts.

To drill the arm hole, spindle holes and back gear-shaft holes the column is placed face down with the scraped surface resting on and clamped against the ways of the jig as seen at *A*, Fig. 6, the head of the column being located in the bushed portion *B* of the jig

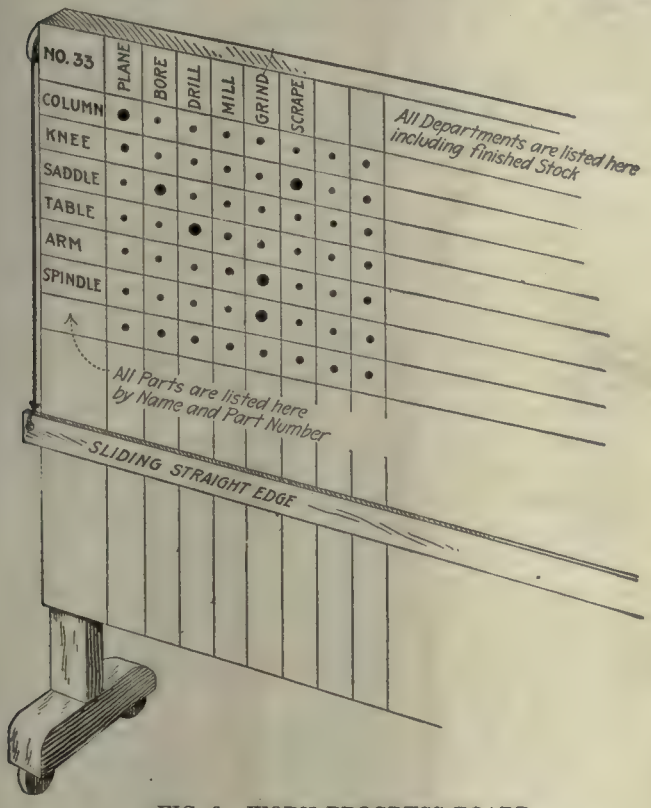


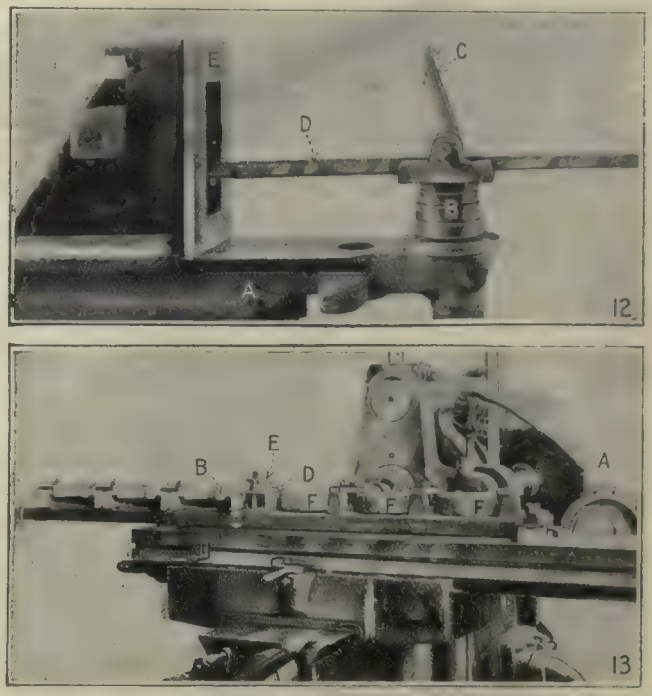
FIG. 3. WORK PROGRESS BOARD

under a radial drilling machine. Movable slip bushings and a boring bar *C* with a universal joint *D* render the boring of these holes a simple operation.

To bore the arm-clamping-screw holes the column is placed on the turntable car of a Pawling & Harnischfeger horizontal boring and drilling machine, as shown in Fig. 7. The jig *A* is clamped to the column, being located by plugs that enter the holes already bored for the spindle and arm, and serves to guide the boring bar *B* by means of two slip bushings, one of which may be seen at *C*. The boring, facing and tapping of the boss *D*, which supports the nut for the elevating screw, is done in a similar manner, the jig being located by and clamped to the ways on the front of the column.

The knees are planed in lots of eight, jigs being used to secure proper location and alignment, as shown in Fig. 8. The column bearing is planed first, the castings being clamped in the jigs by the Vs that receive the saddles. After planing all surfaces in this position the position of the castings is reversed, and they are clamped with the finished surfaces against a second set of Vs in the jigs shown at *A*, thus bringing all of the bearing surfaces square with each other and in perfect alignment. They are then placed on a horizontal drilling machine as shown in Fig. 9, and the various holes bored. The jig used for this work is of the turret type, so that it can be indexed for drilling all the holes at one setting and thus insure their proper relation. As shown in the illustration there are four bushings in the bushing plate *A* and one in plate *B*, all the holes covered by these five bushings being bored with the jig in the first position. The top plate is then indexed through an arc of 40 deg. and another hole bored through a bushing in *C*, after which it is turned 180 deg. from the original position, and by setting the two auxiliary bushing plates *D* and *E* into the back of the jig the remaining holes are bored. It should be noted that for all machining operations the various parts are jigged and clamped by the Vs. After planing, these surfaces are all scraped true before any boring operations are performed, which insures perfect alignment of the bored holes with the bearing surfaces.

The method of setting up the saddles for planing is shown in Fig. 10, each jig *A* being tongued and bolted to the planing-machine table. The work is reversed



FIGS. 12 AND 13. OTHER OPERATIONS
Fig. 12—An aid to scraping. Fig. 13—Milling trunnion rings

upon these same jigs for the second-planing operation. The tables are handled in much the same way, as shown in Fig. 11. Anyone who has done much scraping on heavy work knows that much energy is wasted in working heavy parts together for the purpose of locating the bearing spots. To reduce this labor the device shown in Fig. 12 is in general use in the Kempsmith shops and it greatly facilitates the scraping-in of heavy parts. In the illustration the machine column *A* is laid face up on the floor, and the piece *B*, which carries a shaft and pinion on the handle *C*, is bolted into the arm hole. The rack *D* carries a sort of clevis on one end by which it is loosely attached to the knee *E*. It is not difficult for the workman to slide the knee back and forth on the column by turning the handle *C*.

The bronze trunnion rings, one of which is shown at *A*, Fig. 13, are milled on the ends as shown at *B* and are

handled in lots of three on the jig *C*, which consists of a cast-iron plate with suitable locating and clamping blocks and a collar *D* bored true and central with the bedplate which slips over the stud *E*, this stud being fastened into one of the T-slots in the milling-machine table. The jig plate can thus be turned end for end about the stud *E*, and it is provided with a hinged tongue or locking device at each end fitting into the central slot in the table to locate the jig plate in alignment in either position. When three pieces *F* have been milled, that end of the jig is swung past the cutter and the other end of the jig which has been loaded during the milling of the first three pieces is brought into position. Thus an almost continuous milling operation is maintained with a comparatively simple jig.

The Trouble Man Discovers a New Kind of Chain

By Philip C. Gunion

"Did you hear how Tom White and Bill Grace are good friends now?" asked the Trouble Man as he stopped before my desk one morning.

Tom White was our young mechanical engineer and a college graduate, and he and Bill Grace, our master mechanic, a graduate of the famous school of experience, had never got along very well together, so I was interested in hearing that they were now friends and in hearing the reason.

"No," I replied, "I have not heard about it, so go the limit."

"Well you know how them two never could agree about anything. It was Bill's fault mostly, because he was always sneering at the book learning that Tom had and trying to catch him up on things. Bill didn't like it because such a young man as Tom stood in so well with the super. He was always starting fool arguments.

" 'Perfessor,' Bill would say, knowing that Tom considered himself a practical man and therefore hated to be called that, 'Perfessor, I would like to have you answer me a question and explain to these gentlemen here a few scientific facts.'

" 'Shoot,' Tom would come back pleasantly, 'I can explain some things and others I can guess at. What's troubling you?'

" 'Well, I would like to know whether it is possible to float a battleship on a drop of water,' replied Bill with a wicked wink at the gang.

" 'Of course not,' says Tom, 'that's a foolish question.'

" 'It can be done though,' insisted Bill.

" 'How?'

" 'Well, you build a drydock that fits the ship skin tight so there's no room between the dock and the sides of the ship for any air and then you put in the dock one drop of water and lower the ship into the dock and the water spreads out in a thin skin and floats the ship. It's simple,' explained Bill.

" 'Simple enough,' admitted the gang.

" 'It can't be done,' insisted Tom, saying that some man with an Italian name had a law that a ship had to displace its weight in water to float. He said that Bill's one drop of water would be squeezed out so fast it would never know what hit it.

" 'What's this guy Avygardro know about it?' asked Bill. 'Did he ever try it? My guess is as good as his'n.'

"And that is just a sample of how Bill would try and make out Tom didn't know anything, and Tom would get so excited and mention such a lot of rules and laws that we never heard about that the most of the boys figured Bill was the original wise guy.

"Secretly, though, Bill knew Tom was way ahead of him on the reason for things and fast catching up on practical things. Bill used to take a peep at Tom's books when the lad was not around and pick up lots of things to talk to the boys about.

"You know Bill has to make out specifications for materials he needs, and instead of asking Tom to help him he would look into Tom's notebooks to see whether to judge machine oil by the color or by the taste, and how strong steel is, and the like.

"Tom found it out and played a little trick on him. He heard Bill talking about a new length of chain for the counterweight on the big elevator door, and Bill was asking one of the foremen how you specify how strong a chain ought to be. He didn't know either so Bill said he would look it up.

"Tom beat him to it though and made a page in his notebook called 'Chains' and wrote 'Chain is specified in pounds per foot.'

"Bill read it when he got a chance and says to the foreman: 'Chain is specified in pounds per foot. That counterweight is a 100 lb., so I will need a good strong chain that will carry 100 lb. per foot.'

" 'Right,' says the foreman.

"So that's how the specification went into the super, and he roared to have Bill sent to him at once when he saw it.

" 'Are you trying to kid me, Grace?' he demanded.

" 'No, sir,' trembled Bill.

" 'Just what do you mean by chain 100 lb. to the foot then? I suppose 2 ft. of your chain would hold 200 lb. and 3 ft. 300 lb., and so on?'

"Bill was too surprised to answer, but Tom, whose desk was near by, came to his rescue. 'You only wanted a foot of chain, didn't you Bill?'

" 'Yes sir,' says the bewildered Bill to the super, one foot's enough, sir.'

" 'And that foot of chain must hold 100 lb.,' explained Tom.

" 'That's different,' says the super, cooling down. 'I thought you were trying to get funny. That's all, Grace.'

"Bill came up to where Tom was working in the shop a little later in the day and says curiously. 'Why did you get me out of that mess with the old man, Tom?'

" 'Because I and your own pig-headedness got you into it,' replied Tom, 'and because I like you, Bill.'

" 'Well I'm damned if I know why you do when I have ragged you so much. But that liking goes double and I am with you from now on. It don't bother me any more that I am still going to be just a master mechanic when you're the super,' says Bill humbly.

"And Tom's sure to be the super some day," added the Trouble Man earnestly.

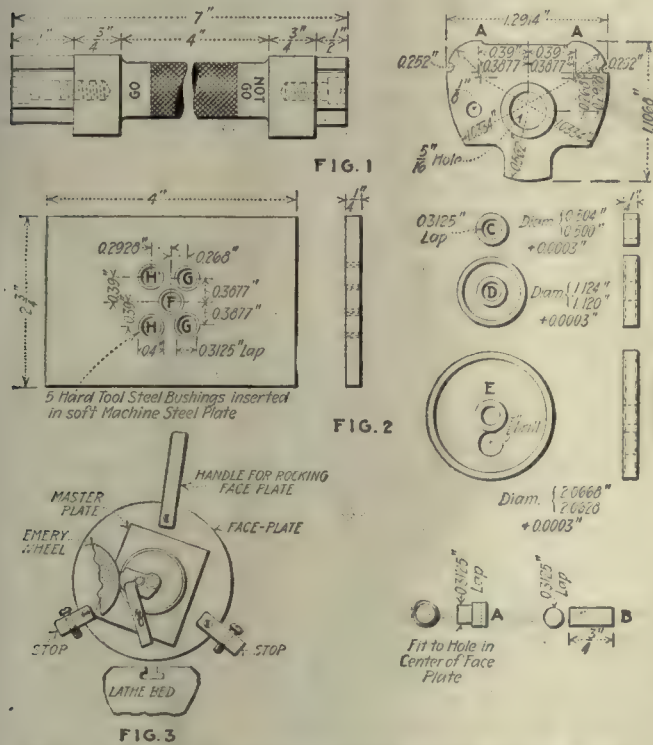
"Nothing can keep a man like that down," I replied, chuckling at the 100 lb. per foot chain as I began to check the payroll.

Grinding Accurate Profile Gages by Means of Master Plates

BY HERBERT M. DARLING

The accurate grinding of irregular-shaped profile gages may be simplified in many cases by the use of suitable master plates. This is especially true when it is to be done in a shop that is only moderately well equipped for doing work of this character.

BY THE use of master plates many gages of irregular profile may be ground in the bench lathe. The gage shown in Fig. 1 is used for the purpose of checking the inside profile of a rifle band, and by reference to the illustration it will be noticed that the



FIGS. 1 TO 3. GRINDING ACCURATE PROFILE GAGES
Fig. 1—The gage to be ground. Fig. 2—The master plate and buttons. Fig. 3—Method of using the master plate

gaging surfaces are made up of five separate radii struck from as many different centers. The essential dimensions must be maintained within a tolerance of 0.0001 inch.

The gages were roughed out of tool steel and hardened, sufficient stock being left for grinding on the outside and for lapping the holes. As the same tools and methods were used in finishing both gages only one will be described.

Let us take, for example, the no-go gage, which is 0.004 in. larger over all than the go gage. First I made as accurately as possible the master plate shown in Fig. 2. The bushings all have the same sized holes, and are spaced to the same center distances as the centers of the radii of the gages to be ground. The faceplate of the bench lathe has a true hole $\frac{3}{8}$ in. in diameter in its center. The larger end of plug *A* is made to fit tightly into this hole while the smaller diameter is lapped to a wringing fit in the bushings in the master plate. The plug *B* is also made to this latter size.

The three buttons *C*, *D*, and *E* are made up from tool steel, are hardened and ground on the diameter, and the sides are ground parallel. The holes in these three buttons are lapped to exactly the same size as the bushings in the master plate. The radius of each button is made to correspond with one of the radii to be produced, plus 0.0003 in. in each case. That is *C* has a radius of 0.2523, *D* of 0.5623 and *E* of 1.0337.

After hardening the gage the holes are lapped out (the $\frac{1}{8}$-in. hole being unimportant as it is only for a dowel pin). The $\frac{5}{16}$-in. hole must be a wringing fit on the plugs *A* and *B*.

A plug is now turned and ground to exactly 0.3125 in. in the bench lathe. Leaving this plug in place in the draw-in chuck the gage is wrung onto it and the face is ground true and square with the hole.

Grinding the Radius

The next step is to grind the 0.562 radius. For this operation the disk *C* is selected, its periphery coppered, and it is wrung onto the 0.3125 plug, which has been left in place in the lathe. The gage is now pushed onto this plug up against the disk. The grinding attachment is then placed in position on the cross-slide, and while rocking the lathe spindle backward and forward by hand the grinding wheel is traversed across the work until it touches the coppered surface of the disk. As the disk is 0.0003 in. large on its diameter the work will now have from 0.0001 to 0.00015 in. to lap on this radius.

The gage is then lined up on the surface grinder and the flat surfaces *A*, Fig. 1, ground to bring the overall dimension to 1.1068 inches.

The Master Plate

We now come to the point where the master plate is used. We start with one of the large radii—1.0334. The master plate, which has several screw holes (not shown) for clamping purposes, is first clamped against an angle iron on a surface plate, and the plug *B*, Fig. 2, pushed into the bushed hole *F*. The plug *A* is pushed through one of the holes *G* from the back of the plate. The disk *E* after being coppered is pushed onto this plug, the $\frac{3}{8}$ drilled hole near its center going loosely over the plug *B*. The gage is now pushed onto *B*, and by means of an indicator the surfaces *A*, Fig. 1, are lined up parallel with the sides of the master plate. The master plate is now located on the faceplate of the lathe by means of the plug *A*, which fits the center hole of the latter.

After making the clamps secure, stops are set to prevent turning the lathe spindle too far and the radius is ground by rocking the faceplate and traversing

the grinding wheel until it touches the coppered disk. The setup is shown in Fig. 3. The work is now relocated and the other large radius ground in the same manner.

The next step is to grind the 0.252-in. radius, for which the two holes *H* are used in place of *G* and the 0.504-in. disk instead of the larger one. When the gage is ground it will have about 0.00025 in. on its over-all dimensions to lap, after which it is ready to assemble on the handle with a fillister-head screw and dowel pin.

The other end, or go gage, is finished in the same way. As the center distances are the same as in the first gage the same master plate is used, and the same disks are made to serve by first grinding down their outside diameters to a size 0.004 in. smaller.

Drawing a Shell From 1-In. Boiler Iron

By G. R. SMITH

In these strenuous times when the efforts of everyone are being strained toward greater production some seemingly impossible feats are being accomplished. Among these the drawing on an ordinary double-action or draw-press of metal as heavy as 1 in. in thickness is worthy of notice.

WE NEVER know until we have tried what may or may not be done in the way of forming heavy sheet metal into peculiar shapes. A few years ago heavy shell drawing with a common double-action draw-press was unknown, and I well remember the expressions of disbelief when steel coffins were first drawn up from ¼-in. stock, soon to be followed by the drawing of 55-gal. steel barrels from $\frac{3}{16}$- and ¼-in. stock. No little wonderment was excited, even in the face of these achievements, when a press was recently built to draw an automobile body; but hitherto no one, so far as I know, has attempted the drawing of 1-in. boiler plate even in the smallest shapes.

Production Doubled

While the operation here described might possibly be called a forging by those not familiar with this class of work from the fact that it is drawn while hot, it is not a forging in any sense of the word, but is a true drawing operation on a toggle-action draw-press. This operation is one of the results of the recent speed-up request in connection with the shipbuilding program, and the production has been doubled several times with material reduction of cost.

The shell, or flange, shown in Fig. 1, was originally designed as a coupling flange to be used in boiler and engine work. But since the cost of their production has been cut they have been in great demand in the shipbuilding industry for oil caps, stanchion and equipment bases, lead collars, etc., and are drawn in various sizes from different thicknesses of metal.

These flanges were first made from steel blanks with the center tapped out and short lengths of pipe screwed in, but this method was unsatisfactory besides being slow and costly. It also required several sizes of pipe for the different sizes at flange.

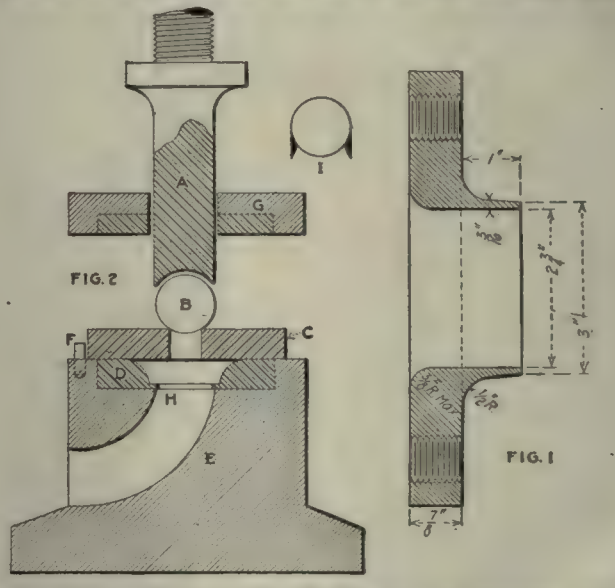
I might dwell at length on the construction of the tools for this operation, the various forms of punches that were tried out, and the many difficulties encountered before success was attained, but I feel that this would be needless, as we are interested only in the tools that were ultimately successful.

In Fig. 2 is shown a cross-section of the tools used with a blank in position to draw. The punch *A* is cupped at the bottom end to fit the steel ball *B*, which is the actual drawing punch, and is ⅛ in. smaller in diameter than the ball. The ball is made of tool steel, and after several attempts with balls of varying hardness it was found to be more satisfactory to leave it unhardened. The diameter of the ball determines the size of the hole in the flange.

The blank is shown at *C*. The die *D* is of tool steel and hardened. It is set into the cast-iron die block *E* and several pins, one of which is shown at *F*, locate the blank in position for drawing.

The blank holder *G* is of cast iron with an inserted ring of hardened steel.

It will be noticed that the die *D* has a shearing edge



FIGS. 1 AND 2. FLANGE DRAWN FROM 1-IN. BOILER IRON AND TOOLS FOR DRAWING HEAVY FLANGE

at *H*. The hole in the die at this point is just large enough to pass the ball, which, as it passes through the die, cuts off any surplus stock, carrying the scrap ahead of it in the form of a ring as shown at *I*. The ball then passes out through the curved opening in the die block, dropping into a pail of water where the sudden chill and contraction of the ring of scrap causes it to loosen so that it is easily knocked off the ball with a light hammer.

The blanks are cut out of the plate with the oxy-acetylene welding torch, and the center hole is cut out in the same manner.

The blanks are brought to a bright cherry-red heat

in an oil furnace located conveniently near the press and are passed to the die while still red hot. After the hot blank is placed in position and the ball placed on the hole a small handful of granulated charcoal is shaken around the edge of the center hole and the ball, this acting as a lubricant allowing the ball to be forced through easily, leaving the hole smooth.

In heating the blanks care should be taken to avoid scale as much as possible, each blank being drawn just as soon as it is hot enough. The longer it is left in the furnace the more scale will form, and while no great trouble is experienced in the dies the result is a poor shell.

Getting a Continuous Run

By placing a cold blank in the furnace for each hot lank taken out a continuous run may be had, and after few blanks are run off the operator can judge the amber of blanks that will be required in the furnace. By throwing the drawn shells in a pile on a sheet of stock or a concrete bed and allowing them to cool slowly they will anneal, and may be machined very easily if required.

The production is at the rate of about one hundred an hour. The press used for the work is a Bliss No. 14-B, but there are a number of toggle-action draw-presses of this size and general style on the market that would meet the requirements.

Locating Knocks in Motors

By B. Z. Reiter

One of the intricate problems a mechanic has to deal with is that of distinguishing between and locating engine or motor knocks. To do this a listening apparatus as shown in the sketch is useful. It is made of a ¾-in. copper tube about 8 in. long with a steel point welded in one end. In the other end a steel rod is inserted making a snug fit in the copper tube. A telephone receiver is then connected by means of wire to the end of the steel rod to complete the listening apparatus.

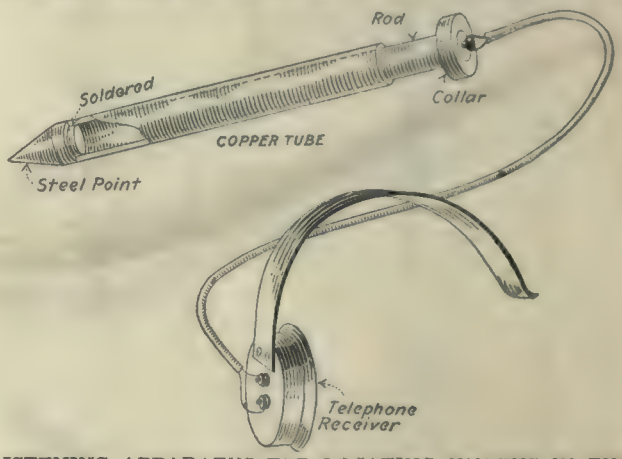
When trying to locate a knock the steel rod is pulled out about 4 in. By touching the motor with the steel point on the places where the trouble is expected and keeping the receiver to the ear the knocks can be heard distinctly while the steel point is showing the location of the trouble. The more experience one has in listening to knocks the more expert will one become in finding them and telling what is loose. Each faulty motor part has a different knock which comes always in regular periods relatively to the speed of the engine.

A loose connecting-rod produces a sharp bump or a very heavy hollow sound. To locate the faulty connecting-rod is easily done by running but one cylinder at a time, in which case two bumps are usually noticeable, due to the relief of the explosion pressure. If the rod is very loose the knocks can be located by turning the engine with the crank. This trouble is caused by a twisted rod, loose bearing, scored bearing, burnt-out bearing or side play. With a seized or burnt-out bearing the motor will groan or stick in starting.

The main-bearing knocks are readily located by running two cylinders at a time, one on each side of the crank bearing. A hard bump will be noticeable throughout the motor, produced regularly with the firing of the two cylinders. Such knocks are caused by end play in the shaft, loose-fitting bearings, or scored or a burnt-out bearing. In the latter two instances the motor will groan upon starting cold.

A loose piston pin is distinguished by a sharp metallic knock. It can be located by using the listening rod for each cylinder and speeding up the motor, then closing the throttle suddenly. By doing so a double knock will be noticeable which is very sharp and better termed a rap. The knocks are caused by a crooked or a broken pin or a tight or badly worn member.

A loose crankshaft is seldom encountered. It gives a rattling slap combined with a thud. In some cases only the thud is audible; in other cases the looseness of the bearings will allow the gears to slap and rattle.



LISTENING APPARATUS FOR LOCATING KNOCKS IN THE MOTOR

Generally this trouble is very hard to discover, due to the pressure of the valve springs. The trouble can be located by sounding gear-case and camshaft bearings with the listening apparatus. The knocks are caused by loose bearings, end play or bad fitting bearings.

A loose flywheel will produce a very heavy knock at low engine speed and appear regularly. The knock will change its nature entirely when the motor is speeded up, and the vibration of the shaft will produce a dull chattering knock. It is located by disengaging the clutch and rocking the flywheel back and forth. The trouble is caused by improper fitting, loose bolts, broken bolts or bad keys and splines.

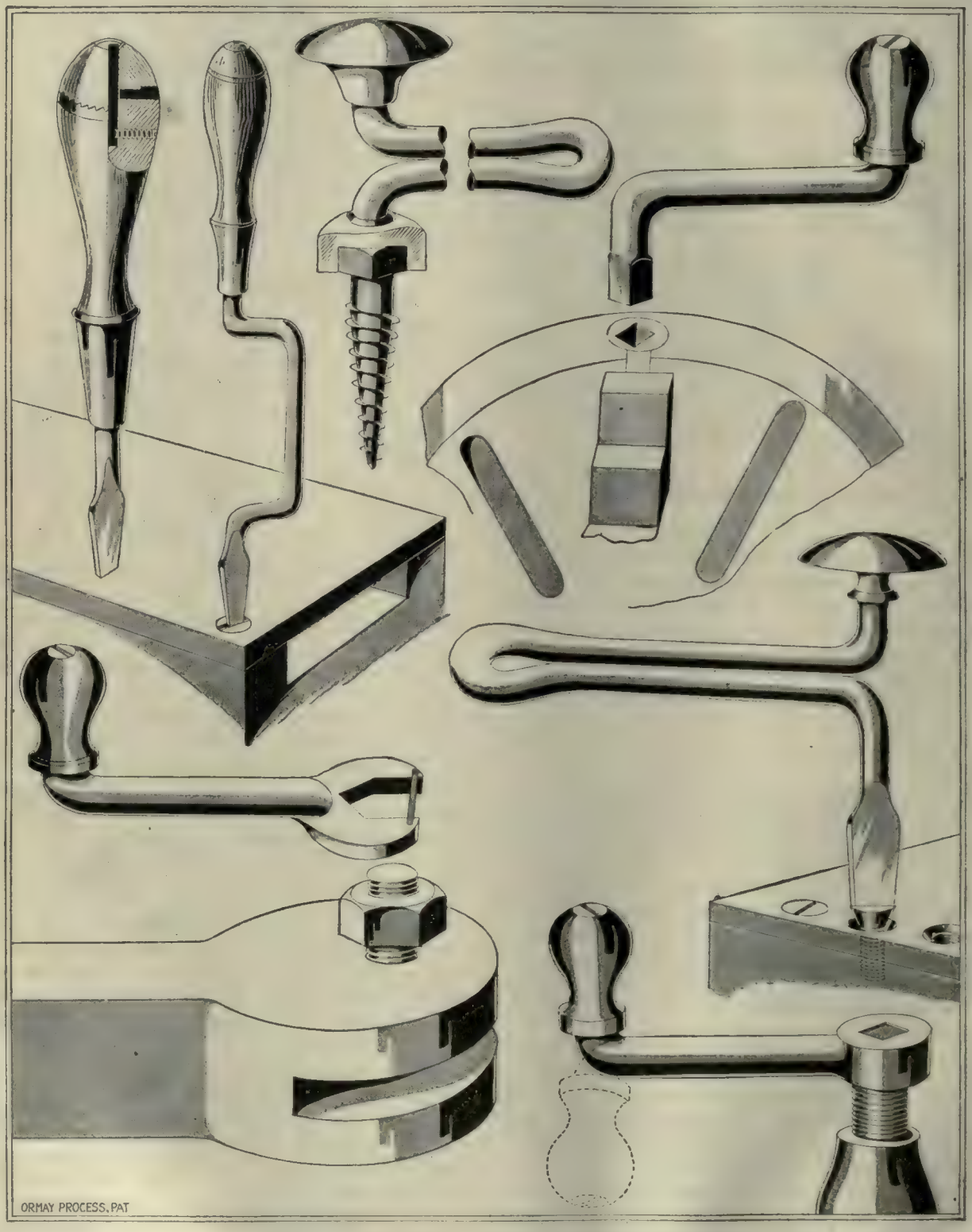
A loose piston gives a very short knock, the clearness of it varying with the size of the cylinder and metal used in the piston. It can be located very easily by the use of the listening apparatus against the cylinder wall. It is caused by a large bore, small piston, or taper piston or bore.

Loose valve tappets will produce a brisk tap or knock very often encountered and difficult to remedy on a high-speed motor. This trouble is caused by excessive clearance, bent or sticking valve stem, flat and out-of-round rollers, bent valve spring or a seat that is not square, or a combination of given causes.

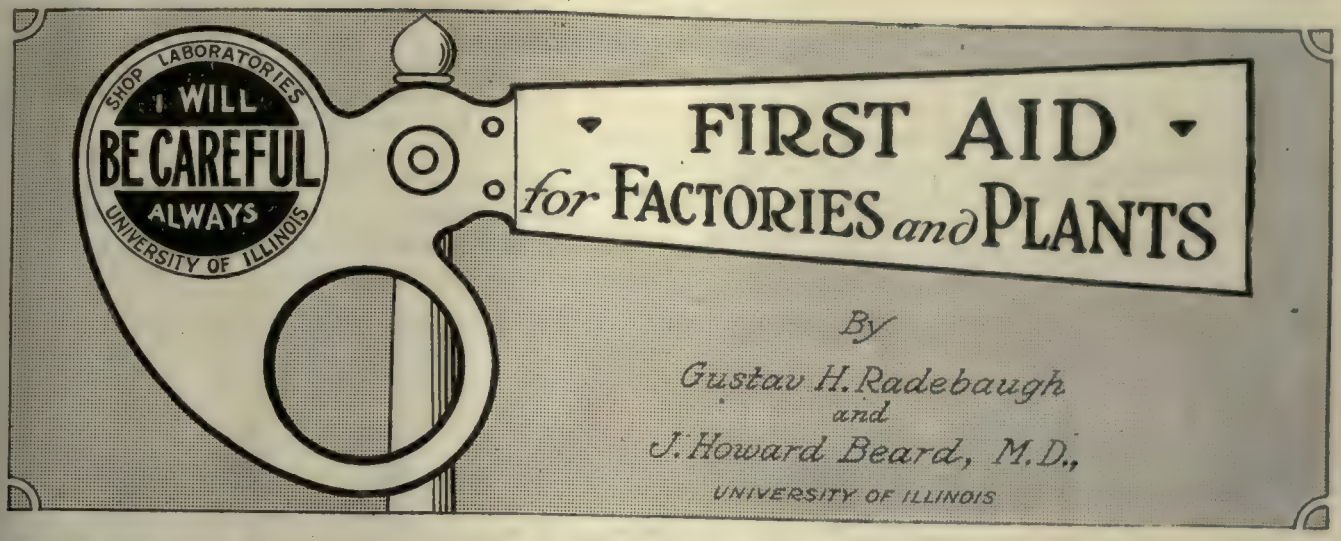
Successful hunting for these troubles requires a great deal of experience that can be obtained only by continued practice which develops the sense so that not only the different knocks are easily distinguished but are also speedily located.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



QUICK-ACTING SCREWDRIVERS AND WRENCHES



FIRST AID for FACTORIES and PLANTS

By
Gustav H. Radebaugh
and
J. Howard Beard, M.D.,
UNIVERSITY OF ILLINOIS

WITH the extensive introduction of women into the various industries and the employment of unskilled workers in occupations requiring technical knowledge we may expect an increase in the number of accidents.

As a means of promoting the efficiency of the worker and providing prompt salvage when injured intelligent first aid is most important. It saves life, gives quick relief, prevents infection and shortens the period of disability. Dr. J. D. Milligan of the Pittsburgh & Lake Erie Railroad Co. noted that in 3000 cases of men using proper first-aid methods infection was reduced to less than 1 per cent. where it had been 10 per cent. before. First aid to be valuable must be based upon the noninterference with and the protection of the wound. A first-aid man after giving treatment should get the injured immediately to the surgeon, to the trained nurse of the plant, to the hospital or to a local physician. The fate of the injured depends largely upon the man into whose hands he first comes. If the wound is treated with a simple aseptic dressing and the patient is sent to a surgeon much will be accomplished. If the first-aid man attempts to do more he is likely to be guilty of doing meddlesome surgery that may prove more dangerous to the injured than the wound.

Two million industrial accidents yearly in the United States, causing 25,000 deaths, 28,000 dismemberments, 2500 permanent, 80,000 partial and 700,000 disabilities of longer than four weeks is a casualty list more to be expected from the soldiers participating in the world war than workers engaged in peaceful pursuits. The loss of time, the decreased efficiency, the expenditure for medical care and the result of such injuries constitute a serious curtailment of the productivity of the nation and impose a heavy economic burden on the people. This burden can be lightened by the observance of the simple rules of safety outlined in this article.

The economic value of properly rendered first aid will be unquestioned if it will shorten the period of disability. A slight wound of the finger followed by infection may prevent a man from working for weeks. If the use of a simple sterile dressing will avoid infection the dressing and the time of a fellow worker in rendering first aid will represent money well spent.

A proper organization is a most important feature of successful first-aid work. Any system to be effective must have the enthusiastic support of the manager, the superintendent, the factory surgeon, the foreman and the workmen. The manager must be interested and convinced of the economic value of such an organization if his hearty coöperation is to be obtained in furnishing equipment, a place for instruction and the use of an hour or two a week of the time of the men. The superintendent must give his assistance by requiring the employees to learn first-aid methods as a part of the routine of the factory. The surgeon must give instructions by lectures and practical demonstrations and he must be judge of the efficiency of the work of the teams. The organization should promote popular interest in the conservation of life, limb, materials and machinery; it should demonstrate the economic value of first aid by the results obtained. It should instill a spirit of fellowship and coöperation in the use of safety methods, pride in the observance of factory rules for the protection of employees and the learning of proper methods for care of the injured. An effective first-aid organization should be a part of a general program of safety and conservation. A safety committee should have control of all activity pertaining to the prevention and care of accidents and to health improvement. Methods should be used that will convince the worker of the value of safety first and first aid to him personally, excite his interest in them and create a spirit of mutual understanding and help between employer and employees in the promotion of an organization for their common good. The best results will be obtained when the relations and the duties of every man are definitely outlined and thoroughly understood and each man knows and is prepared to do his part in an emergency. A diagrammatic outline of an ideal organization is shown in Fig. 1.

Stimulating interest in first aid is the function of the chief surgeon, who must have such personality and ability as will create enthusiasm in the first-aid captains and workers. The average man is very susceptible to the suggestion of his fellows.

The chief surgeon may organize the men into first-aid classes. On completion of a prescribed course and the passing of an examination each man should receive a diploma bearing the signature of the president and the surgeon of the plant. Through coöperation with the safety committee of the State Manufacturers' Association the course and diploma should be standardized and made uniform.

Many accidents will eventually reach the courts for final settlement and the question will be raised as to who gave the first aid and his qualifications. As a corporation frequently has to assume responsibility for the acts of its agents it is essential that the type of instruction and methods used should be widely recognized as correct. Unfortunately a doctor with no reputation but with a license to practice makes a more impressive witness in court than a machinist who may have shown good judgment in rendering first aid.

Plant and public interest in the importance of the prevention and care of accidents may be increased by short talks during the dinner hour in the different departments of the plant, in the neighboring Y. M. C. A., by annual field-day contests, by awarding prizes for exceptional team work and by the forming clubs to study special phases of accident prevention and care.

Schools located near plants, especially those with a manual-arts department, should give courses in safety first and first aid, for from these will come chiefly the future artisans. Such instruction will bear its fruit in the home and in the factory; it will save lives and prevent loss of time from work.

A Life and Limb Club, such as developed by the instructional staff in the mechanical-engineering department of the University of Illinois, has an appropriate name and is a particularly suitable means for the promotion of interest in safety first and first aid among students and workmen. For this reason it is worthy of detailed description.

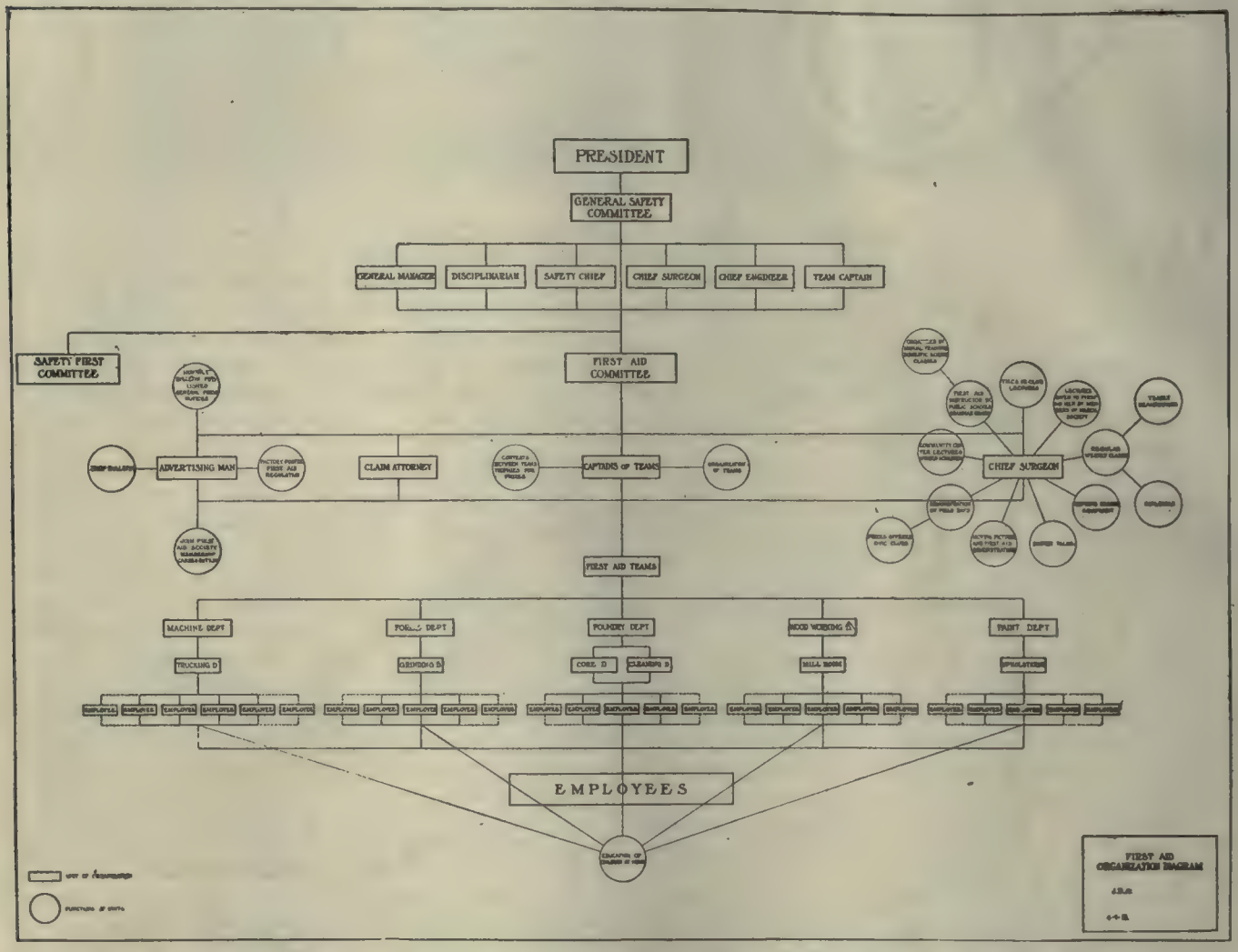


FIG. 1. RELATION, FUNCTION AND COMPOSITION OF THE VARIOUS UNITS OF A FIRST-AID AND SAFETY-FIRST ORGANIZATION

Each man on beginning work in the laboratories of the mechanical-engineering department is asked to sign a pledge, shown in Fig. 2, after which he receives the membership card and button shown in Fig. 3. The button is to be worn in a conspicuous place.

To bring the activities of the club into each department of the plant a bulletin board, Fig. 4, is located where it must be passed by the men going to and from the time clock or checking station. It is filled with club news, interesting posters and notices concerning safety first and first aid. It may also contain the names of the captains of the first-aid teams and the members of the club receiving awards or special mention for efficient first-aid work. This board should be in charge



Life and Limb Club

Mechanical Engineering Dept.
University of Illinois

Pledge

I hereby express my desire to become a member of the Life and Limb Club, which has for its objects the safety and welfare of the students while they are engaged in the use of the equipment in the shop laboratories. As a member of the club I agree to first, to obey standard shop instructions at all times secondly, make the slogan, be careful my rule of conduct, third THINK before acting to avoid injuring myself and others, and fourth, shun the habit of living the life that will dull the sense of caution

_____ 19 _____ SIGNATURE

FIG. 2. PLEDGE OF THE LIFE AND LIMB CLUB

of the advertising man, who is a member of the first-aid committee.

By-laws effectively control the election of officers, the management of the club as well as the award of the buttons.

Where the company issues a weekly or monthly bulletin interest can be further increased by giving a column exclusively to first-aid and safety-first activities, its editing to be under the charge of the surgeon and safety chief.

A system for increasing interest by the award of a button may be worked out in detail by the first-aid committee. For example, a workman may be given a button on the completion of certain standardized work, for the passing of an examination leading to the promotion to captain of a first-aid team or for special skill in rendering first aid.

Medals should be given only for exceptional service in the saving of life, limb, materials or machinery. They should be of bronze, silver and gold and to be presented annually by the president of the State Manufacturers' Association. The medal should be awarded by a committee of the association after investigation of the suitability of the candidate as recommended by the superintendent or the chief surgeon of the plant.

First-aid methods should be of such uniformity as will make them practical in peace or in war, and should be recognized by the courts as proper to be given by a layman in the shop or in the home. Their basis should be a few easily understood principles and simple dressings. Every shop employee should be required to obtain a certificate of proficiency in first aid as a means of protecting himself and his associates, to reduce the cost of casualty insurance, to increase the efficiency of the worker and to be prepared to give relief to those injured in war or in peace.



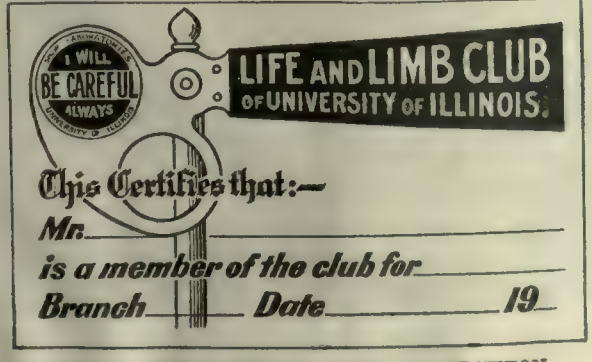


FIG. 3. MEMBERSHIP CARD AND BUTTON



FIG. 4. EXHIBITS ON THE BULLETIN BOARD

The considerations to be emphasized in instruction may be summarized as follows: (1) To apply properly sterile gauze to a wound without contamination of either the gauze or the wound by fingers or unclean objects; (2) to paint iodine on the skin around the wound with a sterile swab or pour alcohol over it and dress it aseptically; (3) to check hemorrhage with a tourniquet only when the blood is spurting from the wound and to stop the spurting without injury to the part; (4) to place the patient on his back in a comfortable position with his head low; if cold to get him warm; if in the hot

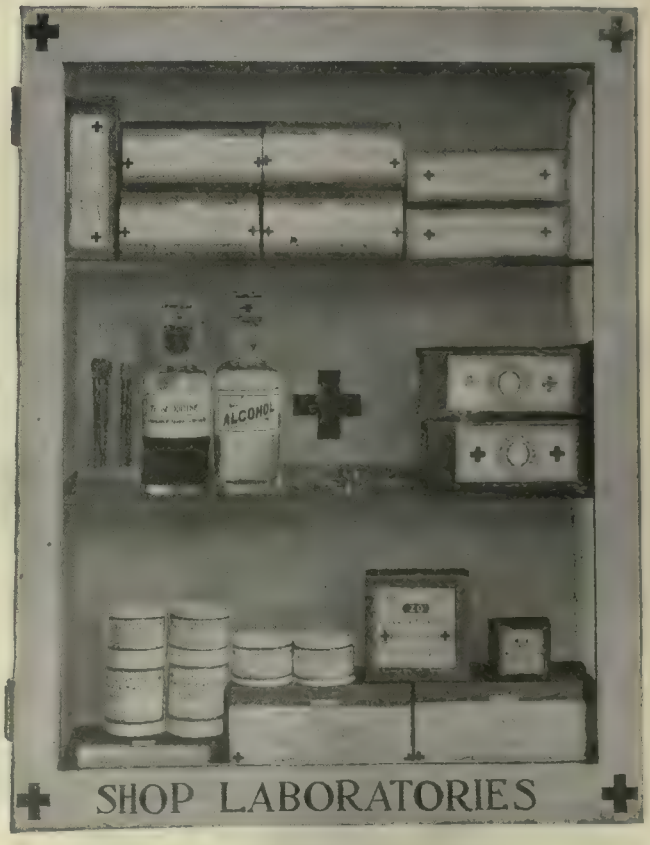


FIG. 5. A FIRST-AID CABINET

FIRST AID CASE RECORD

CASE NO. 4
FORM NO. _____
LOCATION NO. Machine Shop
DATE INSTALLED Aug. 16, 1918
CAPT. IN CHARGE S. Isobe

THIS CASE SHOULD CONTAIN THE FOLLOWING SUPPLIES		WHEN NEW SUPPLIES ARE ISSUED TO THIS CASE MAKE CHARGES BELOW					
STANDARD LIST		RESTOCKING LIST					
Amt.	ARTICLE	Date	ARTICLE	Amt.	Date	ARTICLE	Amt.
4 Boxes	Sterile Gauze						
6	Gauze roller Bandages two 2½" and four 1" wide						
2	Triangular Bandages						
4	Gauze Compresses						
2 Pkgs.	Adhesive Plaster one 1" and one ½" wide						
1	One Pair of Forceps						
1	One Pair of Scissors						
3 oz.	Tincture of Iodine						
4 "	70% Ethyl Alcohol						
6	Sterile Swabs in Test Tubes for appl. Iodine						
1	Tourniquet						
2 Pkgs.	Picric Acid Gauze for Burns						
2	Tubes of Carbolated Vaseline (1% Phenol)						
2	Splints						

FIG. 6. STANDARD 5 x 7-IN. RECORD CARD

sun to put him in the shade; (5) to learn the Schafer method of artificial respiration and to use it immediately in case of drowning, electrical shock and suffocation; (6) to fix a broken arm by a sling and by resting it on the chest; to immobilize a fracture of the leg by a pillow and splint or by a blanket and splint; (7) to send workers with injuries of the eye, ear and nose directly to a physician or specialist for treatment; (3) to get a doctor quickly to the injured, and when this is impractical to transport him without further injury to a doctor or to a hospital; (9) not to give the patient whiskey or anything else, but to make him comfortable and then let him alone; (10) to learn to do nothing rather than too much.

First-Aid Equipment

First-aid equipment should be readily accessible, suitable, economical and standardized. No article of questionable value or likely to prove unsafe in the hands of the trained worker of average intelligence should be included. In each department there should be a first-aid cabinet located in a well-lighted, clean place. The type of case shown in Fig. 5 may be made in the woodworking department of any plant. This one is 17 in. wide, 22 in. high and 8 in. deep. All cabinets should be under the control of the chief surgeon and should be inspected and restocked at least twice a week. They should be tightly closed but not locked. They may be so sealed with a thin wooden pin as to be quickly opened but to leave a record of their use. When the representative of the office of the chief surgeon restocks the case charges are made upon the card shown in Fig. 6. In this way abuses are checked and economy insured.

Each cabinet should contain the following materials: Four boxes of sterile gauze, six gauze roller bandages (two 2½ in. and four 1 in. wide), two triangular bandages, four gauze compresses, two packages of adhesive plaster (one 1 in. and one ½ in. wide), one pair of forceps. one pair of scissors, 3 oz. of tincture of iodine, 4 oz. 70 per cent. ethyl alcohol, six sterile swabs in test tubes for applying iodine, one tourniquet, two packages of picric-acid gauze for burns, two tubes of carbolated vaseline (1 per cent. phenol) and two splints.

Using the Tourniquets

Such articles as tourniquets, splints and iodine may be objected to as being neither simple nor devoid of danger, but trained workers of average intelligence who are not permitted to render first aid until they have received a certificate should be able to use these articles without risk to the life or limb of the patient. In shops where accidents are likely to cause severe bleeding it would seem better to provide a proper tourniquet and instruct the men thoroughly in its application than to have them use a piece of wire or twine in a severe hemorrhage in one of their fellow workmen. If they understand the danger of the tourniquet, how it should be applied and the necessity of immediately calling a physician this objection will be largely removed. The same may be said of splints which when applied too tightly do serious harm. The splints may be so padded as to avoid a great deal of danger from pressure. The bottle containing the iodine should have a red label upon which is inscribed, "Poison if taken internally." When applying iodine a sterile swab should be removed from the test tube and a small amount of iodine poured into the tube and a part of its contents applied to the skin with the swab.

Each shop should have a first-aid station where the patient may lie down and be made comfortable until the doctor arrives. The extent of supplies of the station will depend upon the size of the shop, its proximity to



FIG. 7. FIRST-AID STATION OF THE UNIVERSITY OF ILLINOIS NEAR THE POWER AND MACHINE PLANTS

a hospital and the nearness of a surgeon. It should at least have a stretcher and a pair of blankets.

In large cities a hospital is usually located in factory districts and arrangement for the care of injured employees may be made with the hospital authorities. In such instances first aid may be given and the injured sent to the hospital. This arrangement possesses the advantage that the patient has all the resources of the hospital at his service; an anesthetic may be given with greater safety; he may be promptly put to bed after

ciency was maintained. To establish and maintain such a station would be less expensive and more practical than to permit the employee to waste time by a trip to a local physician for every injury.

The functional organization for the care of the injured outlined in Fig. 8 provides for slight injuries requiring only the application of a simple sterile dressing for those demanding hospital care, and for the rehabilitation of workers injured in their daily occupation so that they may not become objects of charity and an eco-

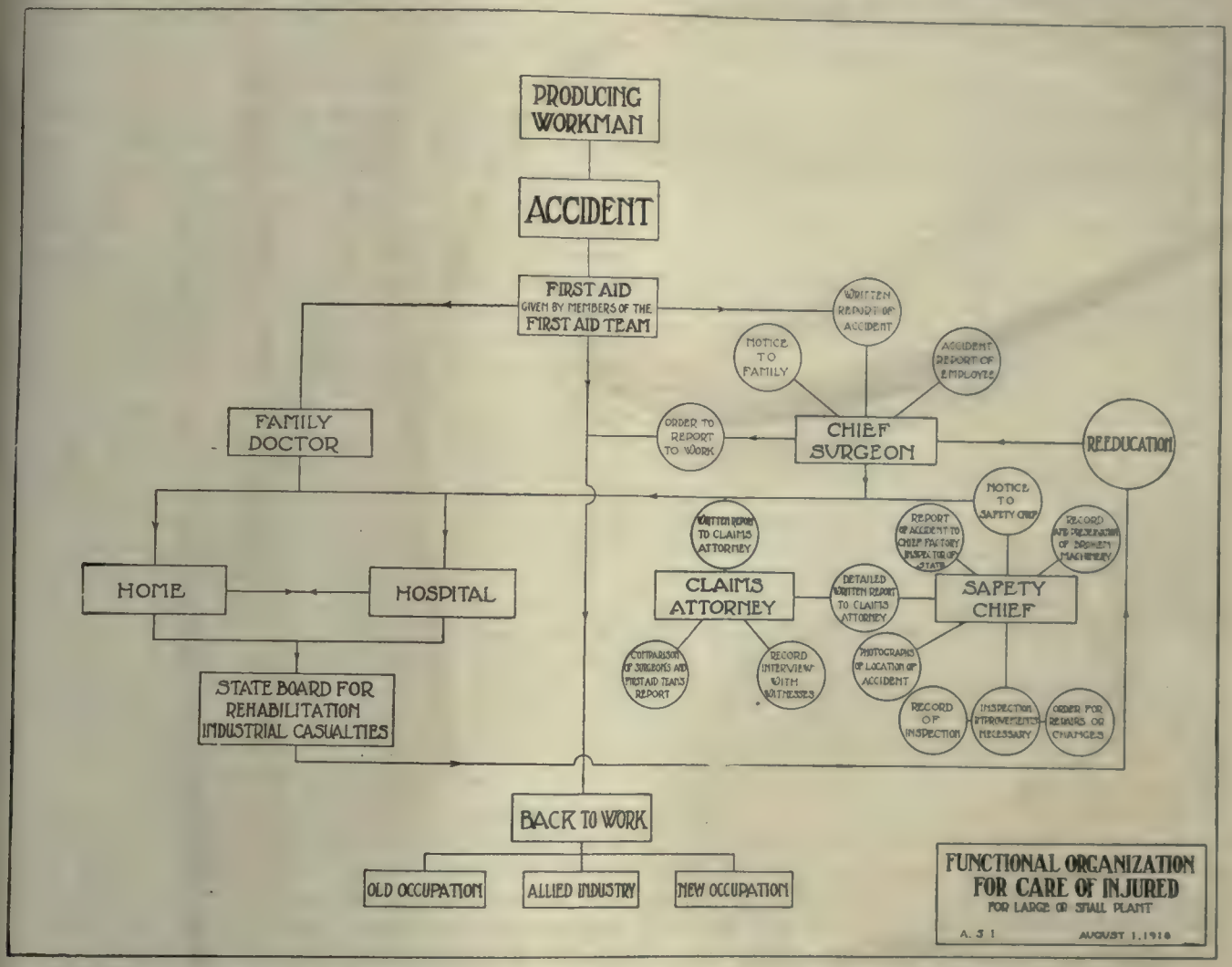


FIG. 8. FUNCTIONAL ORGANIZATION FOR THE CARE OF THE INJURED

an operation, and he is away from the noise of the factory. Minor injuries may be treated at the hospital dispensary. As a cardinal principle of this system neither the best interests of the workman nor those of the employer are served by his remaining unnecessarily in the hospital.

If the hospital is distant and a large number of workmen are employed a thoroughly equipped first-aid station, Fig. 7, should be readily accessible in the plant. It should be supplied with hot and cold sterile water, instrument sterilizer, operating table, facilities for anesthesia and general surgical dressings. As it is to take the place of a hospital dispensary it should be in charge of a graduate nurse. Shops having a station of this kind should also have an arrangement with a surgeon to respond promptly on call and who would see that its efficiency was maintained. To establish and maintain such a station would be less expensive and more practical than to permit the employee to waste time by a trip to a local physician for every injury.

The functional organization for the care of the injured outlined in Fig. 8 provides for slight injuries requiring only the application of a simple sterile dressing for those demanding hospital care, and for the rehabilitation of workers injured in their daily occupation so that they may not become objects of charity and an economic burden. It will meet the needs of the small shop, the factory and the great industrial plant with its own hospital and medical staff.

Graphic methods, Figs. 9 and 10, are striking in their presentation of facts and may be used to show monthly and annually the number of accidents, the total hours lost, the percentage of men injured, the cost of accidents to the plant and the amount of compensation awarded. Such charts should be posted in the office of the manager and the surgeon of the plant and also displayed for the benefit of the workmen. An analysis of the causes of accidents is of great social and economic importance. The records should reveal the cause, the nature of injury, the degree of physical impairment, the hazards of particular occupational groups, the exact place to apply preventive measures, the avoidability of

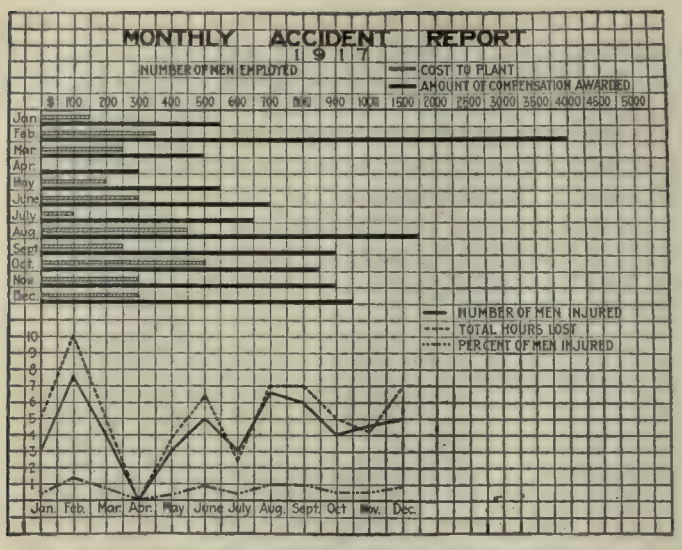


FIG. 9. CHART SHOWING MONTHLY RECORD OF ACCIDENTS

the accident, the responsibility of the worker in its occurrence and the cost. The final report of all accidents should be made on the standard form approved by the Bureau of Labor Statistics.

When industrial accidents are thoroughly considered in their relation to loss in materials, machinery and man

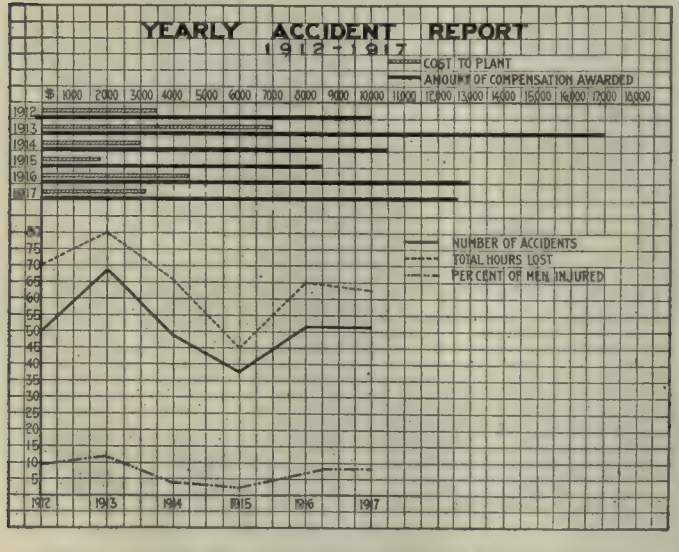


FIG. 10. CHART SHOWING YEARLY RECORD OF ACCIDENTS

power the prevention and prompt treatment of all injuries are amply demonstrated as of great economic and patriotic importance.

"How One Fellow Quit His Job"

By J. D. Cox

President Cleveland Twist Drill Co., Cleveland, Ohio

It was an August day in 1874. Our roll-turning shop was right on the east bank of the river where the afternoon sun, together with its reflection from the oily surface of the water, poured in on us unmercifully. I was working on a set of three high-rail rolls badly needed for the new 90-lb. rails for the Pennsylvania RR. The bottom roll that I had just finished was in the "stands" of the lathe, the middle roll above it in running position to verify and check the dimensions of the finished rail. At the next lathe to mine the boss was loafing along scraping dust off the neck of a pinion for the 18-in. mill that he had finished an hour before.

To change my lathe, remove the two rolls, put the top roll in the "stands" and replace the middle roll over it, was "some job," as the rolls weighed on an average of 3 tons apiece. We had no crane and had to pry the rolls up with heavy planks, block them up and roll them out on the floor and then reverse the operation to get the other ones in.

After about an hour's work, with the help of two laborers, I finished the job, very hot and tired, and my overalls wet with sweat.

I'll Quit First

Just as I stepped down in the lathe pit to adjust my toolrest the boss, a thin little Welshman with a long, red beard, crawled leisurely up on the floor, turned, spit into the pit and said, "Cox, change my lathe, I have to go up town." I knew perfectly well he had been loafing on his job for hours just to spring this on me, and if I was hot before I was hotter now. I swung around, facing him madder than a hatter, and ripped out, "No! I'll be damned if I do! I'll quit first!" Shrugging his shoulders, and in a very mild voice, he replied, "Just as you like," and walked off.

A few minutes later I saw him crossing the railroad bridge bound for a saloon where the mill men had a "hang out," so I put on my coat and went home. Well, I got to thinking the thing over that evening and made up my mind that I was very foolish to allow such a fit of passion to interfere with my plan of mastering the rolling-mill business. So the next morning I went down to see the general manager. I found him out in the mill, and stepping up to him said: "Mr. Ingersoll, I made a fool of myself yesterday and quit my job. If you will permit me to I should be glad to go back to work." "Well, well," he said, "what was the matter?" Whereupon I told him my little story.

The Manager Makes It Right

As I finished my tale I saw a merry twinkle creep in his eye and just the slightest suspicion of a smile playing round the corners of his mouth. He put his hand on my shoulder and said: "Come down in the morning, my boy, ready to go to work, but come to my office first, and I'll see what we can do with you." Well, I was there in his office when he got there. "Where are your tools?" he asked. "Over in the lathe room," I said; "I left them there when I quit." "Go get 'em and come back," he said. So off I went after my little kit of tools.

When I got back to his office he was sitting in his buggy—no autos in those days—and said to me, "Jump in!" and I jumped. We drove about a half mile up the river to the old River Side mill the company had just leased. It had been idle some time and the rolls were in bad condition. He took me into the lathe room and asked me to see if the lathe was all right. I put my hand on the driving cone and turned it over; it ran nice and smooth, so I said, "I think she'll do." "Cox, we are going to start up this mill just as quick as we can, and I want you first to dress up a set of rolls for 8 rounds P. D. Q.," said he, and turned on his heels and off he went.

The Rights to Patents and Inventions

By CHESLA C. SHERLOCK

The proprietorship of patents and the right to inventions and processes developed while the inventor is in the employ of another has been the cause of much controversy not only when the employee was under no special agreement to relinquish any claim that he might have to ideas worked out during his period of employment but also also when such specific contract has been made to that effect. This article quotes some notable decisions in respect to such rights, and in general throws considerable light upon the subject.

ONE of the causes of litigation between employers and employees is that of who has the right to the skill, time or inventive genius of the employee, and this litigation is by no means forestalled by an agreement setting out in minute detail the rights of the parties agreed upon at the time the contract was entered into.

The desire to obtain the fruits of an invention or of a patent is the prime consideration back of this litigation, and it is because the federal Government has always recognized the inventor's claim and his right to protection in the result of his genius that such litigation is encouraged and permitted to occupy the time of the courts.

No doubt this practice of the Government has been instrumental in encouraging inventors to do their utmost in their chosen fields. On the other hand the service that manufacturers, shopmen, mill men and others have performed in hiring persons of inventive skill and setting them to work along their special lines cannot be overlooked. Often important discoveries have been made by persons so employed, and they might never have succeeded in their inventions had they not had the financial aid thus furnished.

The Right to Use a Patent

In a consideration of the law on this subject a distinction should be borne in mind between the right of the employer to the use of the patent or the process and his right of ownership of that patent or process. They may sometimes appear to be the same, but in the legal sense there is a great difference.

Ordinarily one may not have a right to the use of a thing unless one has a proprietary interest in it. The courts are almost agreed that an employer has a "shop right" to the inventions of an employee regardless of whether the title to the patent is in the name of the employer, the employee or is subsequently assigned to a third person. This shop right seems to be absolute. It is not necessary for the employer to have a grant or an assignment. He may use it without consulting the inventor, and the latter has no legal way to prevent such use regardless of whether or not he holds title in the patent.

It is not my purpose to consider the question of "shop right," but to consider the right of the employer to the title and ownership of patents taken out by men in his employ on inventions and processes perfected during the course of the employment.

While the contract of employment may have much to do with the rights of the parties it is a rule that, whether the contract is a general one for employment or for the specific purpose of perfecting inventions, the employer has no right to the title in the patents allowed on such inventions unless there was an express agreement to assign such title to him. It has even been held that such an express agreement given verbally was not sufficient, the employer being unable to secure specific performance of an agreement which he could not absolutely prove.

It is also a rule that even though the employee were hired for the purpose of making inventions and paid a large salary he does not obligate himself to give his employer the title to patents issued unless such agreement was made at the time he entered the employment.

A Court Decision

In an Illinois case a mechanic working for his employer in the construction of a machine invented a valuable improvement. It was held that the invention was the property of the inventor and not of the employer. Said the court: "It may be true that where the employer hires a man of supposed inventive mind to invent for the employer an improvement in a given machine, under a special contract that the employer shall own the invention when made, and under such employment such improvement is invented by the person so employed, such invention may in equity become the property of the employer. But the law inclines so strongly to the rule that the invention shall be the property of its inventor that nothing short of a clear and specific contract to that effect will vest the title to the invention in the employer to the exclusion of the inventor."

In a contract of employment the employee agreed to work in such capacity "pertaining to the manufacture of shellers and powers, and disposing of the same, as the company may consider for their best interest; . . . that he will work for the best interest of the company in every way that he can, and in whatever way such aid can be given it shall belong to the company—that is, improvements . . . that he may make or cause to be made." It was specifically held in this case that this contract of service did not give the employer the right to title in such patents and inventions as the employee had made during his service.

In a federal case an inventor was hired to make improvements in plows for the employing corporation, for which he was paid $3000 a year. He spent the corporation's time making such improvements, which he patented in his own name. In the absence of an express agreement the corporation was held not entitled to an assignment of the title to the letters patent. It was held by the court that the corporation had nothing more than a license to use the plows so improved, which, upon the dissolution of the corporation, was not assignable to a new corporation formed by the old stockholders.

It has been held by a federal court that the mere fact that an inventor was working for another, using his shop and materials, will have no effect upon the right to the title to the invention or patent in the absence of a specific agreement to the contrary.

A Case Decided by Federal Court

In another case decided by the federal courts, a workman agreed to give his skill, attention and inventive ability to the service of a carbon company in improving the process of electroplating and other processes in the manufacture of carbons. The employer claimed that it was entitled and had the right to the perpetual use in its business and for its purposes of the improvements and inventions claimed. The court, however, said that it merely had a license and that there was no plea of title where it was not shown that an express agreement was in existence to the effect that the company should have title to the inventions or to any patent the inventor might obtain for them.

It has been held again and again that employing an inventor to invent a specific machine does not in itself give the employer the right to the title to the invention or patent so produced. Employers cannot understand why they should not have the very article which they employ the inventor to produce for them. If they were to employ the man to copy a machine already in existence they would most certainly be entitled to the machine when completed. Then why are they not entitled to the original machine when they have specifically hired the man for the purpose of producing it? The reason is that the law does not look so much at the question of what the employer was to get, but rather to whether the employee is an inventor. If so, then he shall have the full protection of the law in his invention.

This rule of the law does not apply only to where the employer is a private concern. The federal courts have said that it is also applicable to the Government as an employer, and that the Government has no right to inventions or patents granted its employees in the absence of an express agreement even though it was perfected in the Government's shops during regular hours of work and out of materials furnished by the Government.

A New Jersey Case

In a New Jersey case it was held that the mere fact that a servant makes inventions while in the service and pay of the master and in the line of his employment, in the absence of an agreement to that effect, gives the master no right to the ownership of patents therefor.

In a Massachusetts case a workman agreed to work for an employer for one year at a given monthly compensation and to assign all inventions made by him while in the master's service. When the employment terminated he made certain inventions and the employer sought to obtain them. It was held that as the employment had ended the servant was no longer "in the service of the employer" and that he could not compel an assignment of the patents.

In a New York case an expert was employed by a chemical company to discover new processes for the master's benefit. The expert made several discoveries, which he patented in his own name, and the employer attempted to hold up his salary and in this way compel him to make an assignment of the process and patent to the employer. The court held that this was untenable; that the employer had a license in the use of the process, but that he had no right to the title of it or of any patent issued therefor.

In Wisconsin a company spent several years and many thousands of dollars perfecting an invention of its superintendent with the implied promise that he would assign the patent to the company as soon as it was issued. The court held that the employer had no right to title in the patent, but that it had a perpetual license in the right to manufacture the invention and to sell it free from restriction of any kind or free from any payment of royalty.

Inventing at the Expense of the Employer

Edmunds, a recognized authority, has said that a servant, if really an inventor, may often patent his invention though it be made in the employer's time, with the use of the employer's materials and at the expense of the employer.

In a Massachusetts case, where a servant makes an invention and takes out a patent while in the master's service, but attends regularly to his duties, and uses neither the material nor the means of the master in perfecting his invention or in taking out his patent, it was held there can be no question as to his exclusive right to the fruits of his invention.

There have been cases where the courts have held that where the master's time, money and material were used to perfect the invention, the property in the invention rested in the master, but these cases have really turned upon other considerations of a more technical nature.

A Question of Payment of Royalty

This subject cannot be adequately treated unless thought is given to a statement of fact where it is agreed that the title to the invention rests in the employee and where the employer is using the invention or the process in his business. The question arises, Is the workman entitled to the payment of royalty for the use of his invention? Is there an implication in the mere fact of such use that the employer will pay such a royalty?

So far as it possible to determine there has never been a case decided, in this country at least, which holds that the mere use of a patented article is an implication that a royalty will be paid to the workman owning the title in the patent.

One authority has said: "The fundamental principle determining the question whether there was an implied contract seems generally to have been whether an actual intention to pay for the use of the patent could be inferred from the circumstances. This is especially true in those cases against the Government involving the jurisdiction of the court of claims, which does not have jurisdiction in actions of tort, but only in actions upon contract, express or implied; and the Supreme Court of the United States has said that to give the court of claims jurisdiction the demand sued upon must be founded on 'a convention between the parties—a coming together of the minds,' so there is excluded those con-

tracts or obligations which the law is said to imply from a tort."

It would seem that if a patent is used with the knowledge of the patentee's rights little more should be required to warrant an inference that the user intended to make compensation, since otherwise he would be placed in the position of intentionally committing a tort (personal injury).

A Supreme Court Decision

The Supreme Court of the United States has said: "The alternative of a contract is important to be kept in mind. The officers of the Government knew of the . . . invention and were aware of its great importance, and the purpose to deliberately take the property of another without the intention that he should be compensated—in other words, to do plainfully a wrongful act—cannot be imputed to them without the most convincing proof."

In a Minnesota case it was held that a patentee whose invention is adopted and used by a corporation is not necessarily precluded from recovery of royalty upon an implied contract by reason of the facts that during the period of its use he was an officer and stockholder of the corporation.

It seems to be a general rule that an employee owning the title in a patent which was upon an invention perfected with the employer's time, money and materials is not entitled to the payment of royalty for its use, because the employer has a license in it which the owner of the patent cannot disturb.

It has been held, however, that an implied promise may arise which would entitle the patentee to the payment of a royalty.

In Massachusetts an employee made and patented an invention at his own expense, which was used by his employer, a corporation. It was held that the employee was entitled to a royalty upon an implied promise inferred from the use of the invention.

A mechanic in Indiana perfected several improvements for his employer's machinery and patented them in his own name. The work was done at his own expense and outside his line of duty. His employer directed him, with knowledge of his rights as patentee, to install them on the machinery, and the court held that there was an implied promise to pay royalty.

The Government as an Employer

Where the Government is the employer or the one using the patented article there appear to be many different decisions. One case seems to have outlined the field of the law on the subject when it was held that an implied contract by the Government to pay compensation for the use of a patent hinged upon whether its officers took private property for public use, conceding it to be private property, or claiming that it belonged to the Government.

In another case involving the Government the Supreme Court said: "If the right of the patentee was acknowledged, and without his consent an officer of the Government, acting under legislative authority, made use of the invention in the discharge of his official duties it would seem to be a clear case of the exercise of the right of eminent domain, upon which the law would imply a promise of compensation."

It is well settled that a patentee cannot assert an implied contract to make compensation where the invention is used against the protest of the patentee and without recognition that he has any rights therein, or where it is used in ignorance of his claims and rights.

A discussion of this nature cannot be considered complete without a brief consideration of the principles of law surrounding the employer's right, known as "shop right," to use the invention of a patented article perfected by the workman while in the employer's employment.

While we have seen that the employer ordinarily has no right to the ownership or title in the patent he does not have his rights entirely cut off. He may not be able to own the patent, but he may use it, and in many instances sell it. While the courts have generally recognized the employer's right to a license in the invention they have with one exception refrained from attempting to define the rights which this license confers. In the majority of the cases they have only applied the law to the case at hand and have let it go at that.

A Federal Case

In a federal case the foreman of a brass foundry had patented certain tools which he had produced at the employer's expense. Later he permitted the employer to use them in the business, but when he left the employer's employment he sought an injunction and an accounting. The court was of the opinion that his permission to the employer to use the tools amounted to a license not only for the time he was in the employment but for so long as the tools would last. Said the court: "It can hardly be possible that an employee, himself the owner of a patent, can introduce his patented device into his employer's business without his employer's consent, and without a special agreement to pay him, and afterward turn around and demand royalties or profits and damages from his employers for the use of such device, especially in a case like this, where the invention . . . had been developed and brought to a practical condition at the expense of his employer.

Regarding Color Recipes

In a Pennsylvania case it was held that a carpet manufacturer has the right to use color recipes made by an employee in the course of his employment, even if the employee obtains patents for the formulas to protect himself against the public. The mere fact that it was a custom in the business to give a color mixer exclusive right to his recipes and permit him to carry them off at his pleasure when quitting the master's service will not alter the rule.

This can be said in regard to any business where certain persons may by the nature of their employment come into secret processes and formulas with which they carry on their work. Custom, while recognized by the law so far as practicable, will not be allowed to interfere with substantial justice.

It should not be thought that the employer has a license in any and every patent which any of his employees may happen to take out. In an Indiana case it was held that where none of the employer's material or labor enters into the discovery or perfection of an invention, and nothing of the employer's is devoted to the construction of the appliances patented until after

the invention has been put into definite form and carried to completion, and a patent either issued or applied for, no license for the benefit of the master will be implied.

We have found that (1) where the invention is perfected during working hours the master has a license in its use, but no right to the title or ownership; (2) where completed entirely outside the employment and not from the employer's materials or aid that the employer has no license in it or no right to the title, and (3) the employer has a right to title only where so agreed by an express contract, preferably in writing.

Simple Device for Marking Graduations On Swiveling Heads

By J. V. Hunter
Western Editor *American Machinist*

A simple and successful device for graduating the swiveling base of the grinding head and also for graduating the end of the table for taper settings is in use in the shops of the Dauber-Kratsch Co., Oshkosh, Wis., in the manufacture of its universal grinding machines.

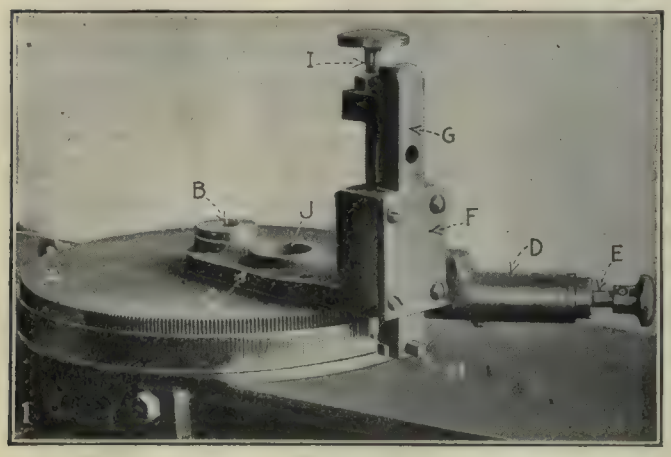


FIG. 1. GRADUATING THE SWIVELING BASE

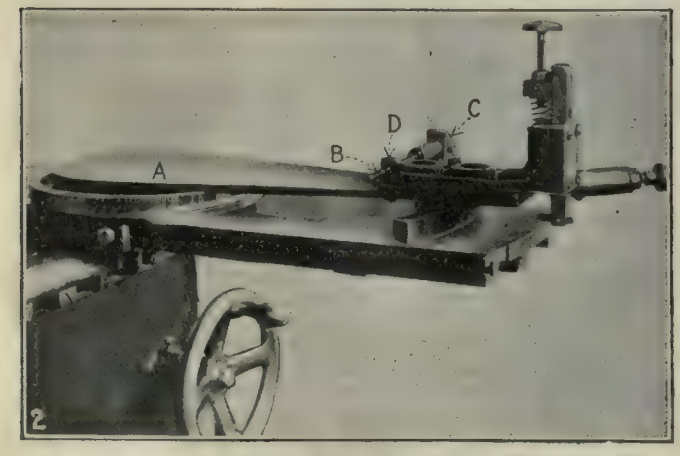


FIG. 2. MARKING THE END OF THE TABLE

Its simplicity will recommend it to those who want a small, accurate device for this purpose. The device is shown in Fig. 1.

When being used for graduating the swiveling base the plate *A*, which has 360 equally spaced notches in its periphery, is placed on the top of the part to be graduated and held in place by the pin *B*. A swinging arm *C* pivots upon the pin *B* and has at one side the lug *D*, which carries the spring-controlled rod *E* that operates the indexing plug. The marking device is carried in the square lug *F*, and consists of a sliding tool bar *G* and cutting tool *H*. The length of the graduation marks is controlled by the screw *I* and for the shorter lines by a stop that can be removed for each fifth line. A spring is used about the screw *I* to raise the cutter bar after each cut.

When graduating the smaller size of machine the arm swings about *J* as a center.

This same device with the addition of the long arm *A*, Fig. 2, is used for graduating the end of the table.

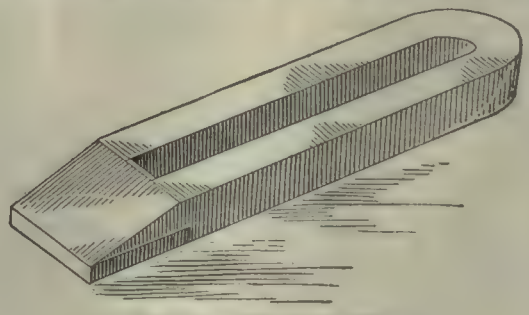
The body of the device as used in Fig. 1 is bolted to the arm and has no function except to carry the tool bar. The arm is adjusted for each successive mark by means of the screw *B*, Fig. 2, supported by the bracket *C* and operating through the swiveling bracket *D*, which is a part of the extension.

A Good Way to Make Straps

By M. L. Lowrey

Most machine shops in which I have worked have been insufficiently supplied with straps for holding work on the planing machine or boring mill, and it frequently became necessary to stop on the setup of a new job long enough to make one or more of these humble but indispensable tools. In such cases it is customary to grab any piece of iron, drill a hole in it with any drill and go ahead with the job, adding the "strap" after its first job is finished to the pile of junk that has been accumulating under the planing machine ever since heaven knows when.

The time lost in this way on a few such jobs would balance the cost of making a set of real straps that, being neatly made and adaptable to many places by reason



IMPROVED FORM OF STRAP

of the long slot, would probably be taken care of and could be found when wanted. The kind of strap to which I refer is shown in the sketch. It is by no means a new thing, but my method of making them is unusual. I take a piece of square machinery steel of suitable size, bend it in the form of a U, turn the ends together and weld them up, making a solid end as the sketch shows. On the under side of the business end of the strap I weld a piece of tool steel—a section of an old file is just about right— grind the ends and edges smooth after welding, and harden.

A set of a dozen or more of varying sizes and lengths will enable one to handle almost any job that comes along, the long slot permitting their adjustment when necessary to get them in close quarters, and the hardened end making them especially valuable when pinch clamping from opposite sides of the work.

Saving Shop Time in the Drawing Room

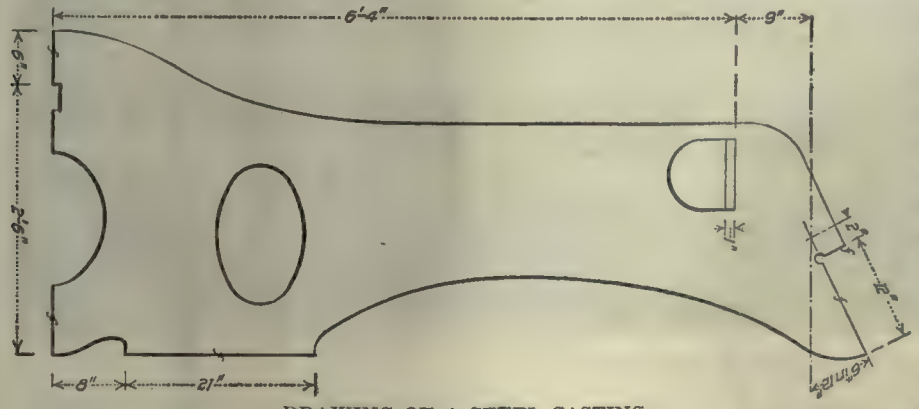
By MILES C. SMITH

The waste of shop time and the added cost of production arising from draftsmen who are inexperienced in shop work have long been noted. This treatise gives two concrete suggestions regarding the use of center lines and dimensions and the need of knowledge of the equipment in order to make practical designs.

ONE barrier to maximum production in many and employees is that of who has the right to the skill, time or inventive genius of the employee, if well conducted.

At the present time, with the machine-tool manufacturers working night and day to complete orders that are weeks and months behind schedule, we have all tried to rebuild our old machines and to equip ourselves as best we could for the new scheme of things. Naturally, this necessitated a certain amount of designing and detailing with a drawing-room force quite below the usual standard of efficiency, and though all have tried to do the best they could I am sure some important factors have been overlooked.

In the first place, in designing a tool or appliance the designer has worked on the same old principle and looked forward to the work to be accomplished with the appliance rather than the methods necessary in manufacturing the appliance itself. As a result the shop receives a set of drawings, skillfully made and well designed as far as the ultimate aim was concerned, that are often the cause of sleepless nights for the shop foreman. How were they to be made when there was left hardly a man in the shop who could decipher the intricate details and when some of the machine operations were next to impossible on the machine tools at hand? This could have all been avoided had the designer taken the shop into his confidence and so altered his design that the machine operations would have been most simple and all within the scope of the tools at hand.



DRAWING OF A STEEL CASTING

Some may say that this complaint is not general and that most reliable designers and engineers try to simplify their designs as much as they can. However, I have had to build equipment from prints gathered here and there from among the foremost engineering offices in the country, the designs of which were not very simple.

There were square holes and square keys where a drilled hole and round pin would have been not only as strong but in many cases they would have answered the purpose better. Machined surfaces not reached on an ordinary lathe, planing machine or shaping machine were called for when the same result could easily have been obtained by a small change in the casting design. Large, intricate forgings were used when the same result might be obtained by making the appliance in several pieces. In each instance the designer seemed to have taken more interest in making a handsome print than in designing an easily constructed machine.

The designer should take a walk in the shop first and acquaint himself with the men and tools at hand, so that when he puts the *"f"* mark on his drawing he may have a mental picture of the operations that are undergone. Minutes now mean dollars, and every time we accomplish a way of saving time, so much more is added to the production of wealth, and to that extent help to replenish what has been destroyed.

Another point that is being daily overlooked is that of making working drawings so that they are perfectly clear to the one who must interpret them. A shop drawing should be so clear that anyone, no matter how far from a mechanic he may be, would be able to see at a glance exactly what is wanted. Many designers persist in the old-time methods of not giving center lines and seem to believe that every machinist thinks in angles and decimals.

Give the machinist center lines through the work. If they cross, cross them at right angles, and when you give him a dimension start from a place on the work he may easily find and not from some point in space which comes handy when making up the drawing. Bear in mind the workman cannot employ drawing-room methods when laying out his work, and particularly in the case of castings there is generally something to hinder drawing lines here and there as is possible on paper.

Give over-all dimensions. Start from one end and give him the over-all so he does not have to figure before he knows whether or not he is able to get the desired results from the forging or casting. Sometimes all these rules cannot be followed while the drawing is in the making. In such cases it is necessary for the designer to fill in the necessary information after his own work has been finished, which is time well spent, because it is a very simple matter to work out points on paper which would take a great many hours to find in the shop.

The illustration, while not identical with the original, is from one of the best-known engineer's offices and

shows the difficulties referred to and will no doubt bring home many similar instances in the reader's experience. The casting is of steel, and all dimensions are given from an inaccessible point, no center lines being given to help the machinist to determine the relative proportions and no over-alls.

Let us all try to correct these time-consuming evils when possible.

Launching a Ship

By E. A. DIXIE

HAVING been asked several times what is done to start a ship on its way just previous to the breaking of the champagne bottle on the prow it seems to me the question may be of general interest.

Some time before the ship is ready to launch the ship carpenters prepare the launching ways or, in other words, the runway on which the ship slides into the water. The ways on which the ship is built have a slant of about ⅝ in. per foot of length. This angle has been found to be satisfactory, if all other conditions are as they should be, for launching vessels endwise.

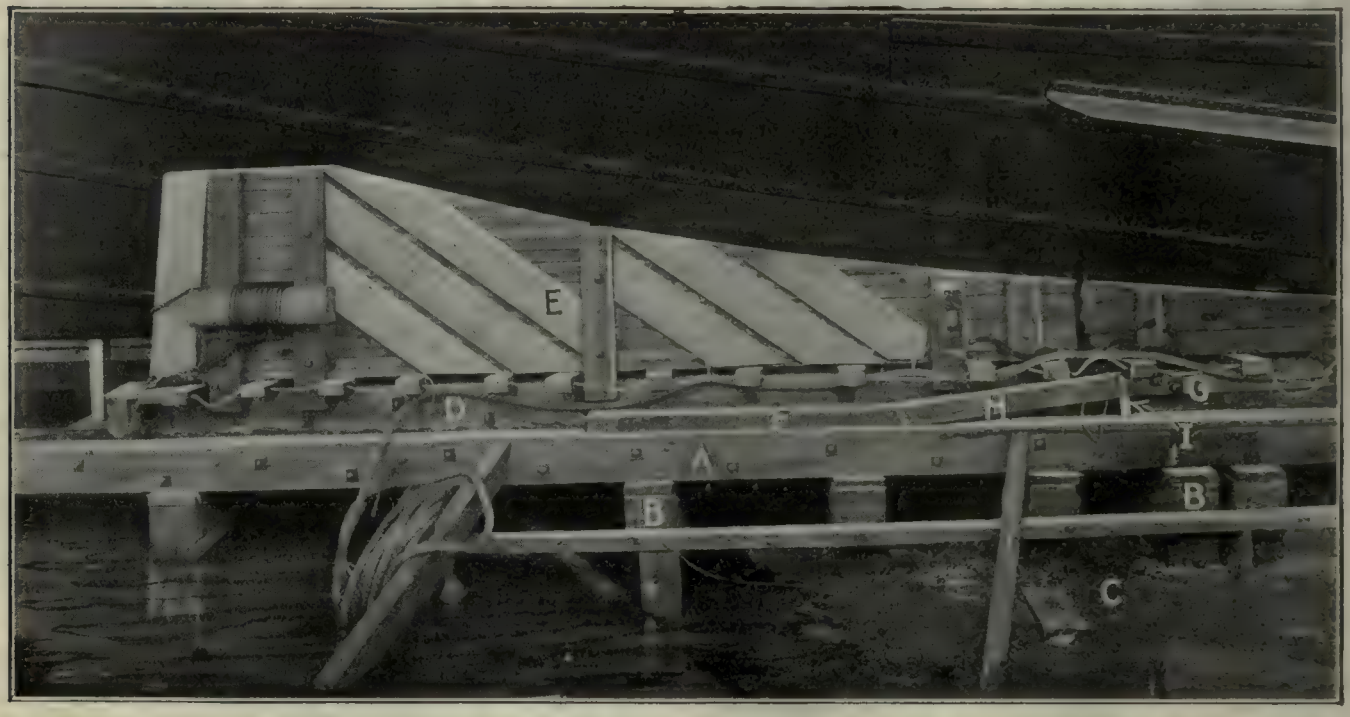


FIG. 1. STERN END OF LAUNCHING WAYS

In Figs. 1 and 2 are shown the stern and bow ends respectively of the launching ways.

The carpenter first lays down and securely fastens the timbers *A*, Figs. 1 and 2. These are laid on the cross-timbers *B*. The opposite side of the ship is also provided with timbers *A*. The two sides *A* are tied together by long bolts which prevent them from spreading and dropping the ship on the concrete ship-way floor *C*. The top of the launching way *A* is now thoroughly greased with tallow. Other greases have been used as a lubricant, but the average ship carpenter pins his faith to tallow, as on more than one occasion these substitutes for tallow have been blamed for causing vessels to stick on the launching ways.

On top of the greased timbers *A* other greased timbers *D* are placed, and on top of these the cradle is built. As its name implies the cradle is that part of the structure on which the ship rests and it reaches practically from end to end of the ship. It is fitted as closely as possible to the ship's hull, but owing to its location and to the fact that it is installed when the ship is nearly completed it is impossible to fit it so that it will take any of the weight of the ship, which of course rests on the keel blocks. The hull is also supported by shores or props, which keep it upright.

Near the stern end of the launching ways is a timber *F* on each side, see Fig. 1. This timber is securely bolted to the stationary way *A*. In a similar manner on each side of the ship a timber *G*, Fig. 1, is bolted to the top or sliding member *D* of the ways.

Tilted at an angle between the forward end of the timber *F* and the after end of the timber *G* is a short timber *H* which is held from falling at the forward end by the small block *I*.

At the forward end of the ways shown in Fig. 2 the forward end of timber *J* is securely bolted to the stationary way *A*. The after end of the same timber is securely bolted to the sliding way *D* under the cradle. A similar timber is employed on the other side of the ship.

In both illustrations a number of wooden pieces will be observed between the cradle and the sliding way *D*. These are long wedges, and a rope is strung through them so that they may be recovered from the water after the ship is launched. Similar wedges are employed on both sides of the ship. When ready for launching they are driven in, thus lifting the ship.

When the keel is clear of the keel blocks the keel blocks are removed. The entire weight of the ship is now carried by the launching ways and all that keeps her from sliding into the water are the dog shores *H* at the stern and the timbers *J* at the bow.

Just before launching the small key piece *I*, Fig. 1, is knocked out and the dog shores *H* driven down and out with a maul. This leaves the two timbers *J*, Fig. 2, one on each side of the hull near the bow, to hold the cradle and ship from sliding.

In Fig. 2, at *K*, is a hand crosscut saw. When everything is ready a signal is given and the two men on each side of the ship saw through the timbers *J*. Sometimes the timbers pull apart before the saws cut entirely through. Occasionally the ship refuses to move even after the timbers are cut through. Hydraulic jacks and other "persuaders" are used in such cases.

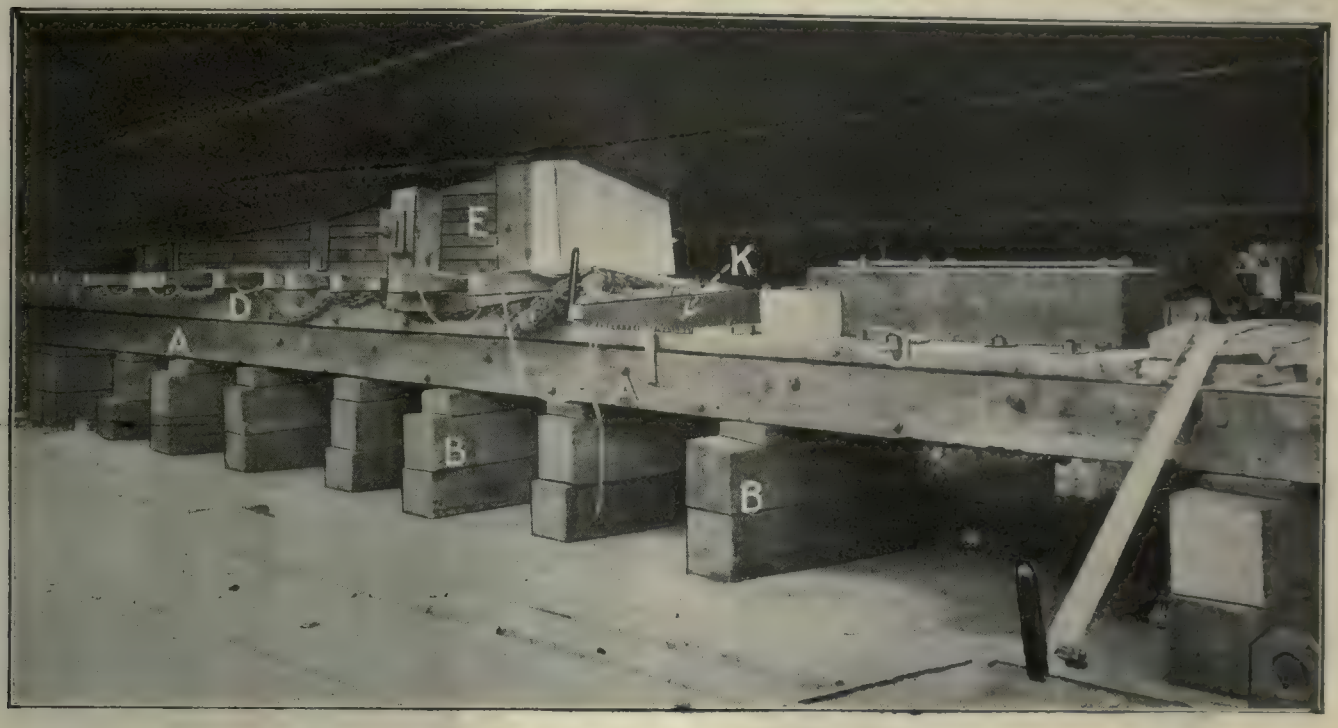


FIG. 2. BOW END OF LAUNCHING WAYS

The Modern Foreman—What Is His Present Job?

By G. CLOCHE

It appears to me that your previous correspondents have failed to appreciate the full significance of the question they ask, and to a certain extent appear to have a queer notion of the foreman and the position he is intended to fill. The point of view, if I understand it correctly, seems to be that in the old days the foreman was a very important personage indeed, brimful of mechanical genius and resource; an autocrat to be looked up to, feared or respected, according to his temperament—mostly to be feared, I should say, in the judgment of some of your correspondents. Even Entropy speaks of "superintendents and foremen carrying on an autocratic rule of the worst kind for the love of it and because they are Huns at heart."

The idea seems to be that the "modern" foreman is losing his power and his job and, under the new order of things, before long, is not going to be required. All the new scientific methods of management are about to usurp his position. This, I think, is very far indeed from the truth, and I beg to postulate the idea that never before was the foreman so important a person as he is today, and he will be increasingly so in the future. There is a new spirit abroad, a larger life looming ahead, and the modern foreman must take it into consideration and assist in the molding of it, and if he is intelligent and broad minded he will be successful.

In the first place an organization, whether it be a large or small one, is compelled today to consult the representatives of the trade unions, etc., on matters of general principles, wages, hours of labor, etc. Obviously these are matters outside the province of the foreman. Then again the nature of the product of a concern has to be determined or modified from time to time. Here the foreman is not necessarily concerned. But once the fundamental rules of the organization have been determined and the nature of the product fixed the foreman must bring his intelligence into operation in the interpretation and administration of these principles and ideas in his particular department. On the face of it this may not seem much, but it is highly important. Through the failure to interpret the idea and the spirit at the back of the rules laid down for the conduct of a shop there may arise misunderstandings leading to friction and strikes involving great monetary loss. A foreman must always remember that in giving judgment on any matter he is speaking in the firm's behalf and in a measure committing his employer

Whatever form of scientific organization be adopted it is plain that there will always have to be heads of departments, or foremen. And in the new democratic age the modern foreman will have to become less a boss and more a leader. He will have to help to promulgate the

fact that to live we must work, and while in our working arrangements we must have order and discipline, yet the worker is doing something more than "working for the boss"—he is working for himself; he is working for his fellow men; he is working so that the wheels of society will run smoothly and produce those things that go to make up many of the comforts and the happiness of life.

When there is a better understanding on these lines between employer and employed, foreman and workman, then the details of a foreman's job will take on a new aspect.

And in the incidental or detail things of a workshop, what scope is there for a good foreman?

The Foreman Must Help the Workman

If the true spirit is to be fostered that will lead to success the foreman must help the workman to feel that he is working with the foreman and not for him. This accomplished, the suggestions and hints on how to do things better and more successfully will not be looked upon as undue interference and swagger and an assumption of an "I am cleverer than you" attitude. Rather it is my belief that they will be accepted as a true foreman will give them, as a sincere effort to help.

Then think of the example a foreman may be to the apprentice boy. We all in youth, unconsciously it may be, emulate someone in certain matters, and often a foreman's actions or ways of performing certain acts are copied by an observant youth unknown to the foreman. So it is that from the highest and best of reasons the modern foreman's job is a most important one. All these things are but the stepping stones to another job of the foreman, and that is the maintenance of the efficient manufacture of the product of the firm that employs him. It is profitable production that counts.

Production a Vital Element

Profits are right and legitimate and are not necessarily the outcome of oppression and the squeezing of the last ounce out of the workman. Production is a vital element. The greater the production the greater the chances of profit, the greater the profits the greater the chances of higher wages, and the greater the amount of goods produced the better for society in general.

The modern foreman must realize that he plays a very large part in the work of production. He it is who is directly up against the work if he is doing his job as a *fore* man. He can eliminate unnecessary movements by a little thought given to motion study; he can keep an eye on the wear and tear of the multitude of details in the way of nuts, bolts, steel plates, bearings, end play in spindles of machines, eccentric motions of jigs, etc., and have them renewed or replaced at the correct moment and thereby save much scrap that would otherwise be accidentally made. All these things and many more are within the scope of the modern foreman. Indeed his position is a great one in many ways if he will rise to it, and it is hoped that he will realize his possibilities and play his part nobly in the new age.

To accomplish all the foregoing will require a nature that is large-hearted, sympathetic and firm. Hence the job of the foreman requires much skill, is an extremely interesting one and intensely human. If he is the right man in the position he will not be slighted or overlooked by the other departments of a successful firm, but will coöperate with them and fill his position cheerfully, realizing that he is a tooth in the gigantic wheel of commerce without which the machine would not do its work so well.

Ford Tractor Trucks for Use in Shops

By E. V. Allen

When shops are large and buildings are a distance apart it is necessary to have some means of transporting material not only from one shop to another but also from one part of a building to another. The officials at the Chicago shop of the Northwestern Railroad have

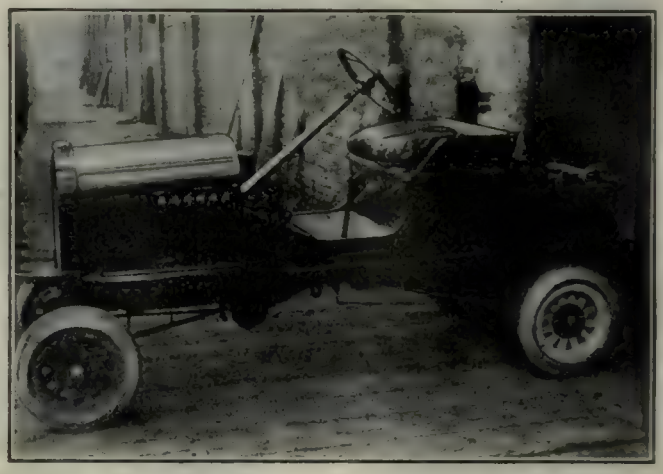


FIG. 1. THE FORD SHOP-TRACTOR TRUCK

solved the problem for their own use by fixing a Ford as shown in Fig. 1. Special built wheels are used which with the solid-rubber tires are 19 in. in diameter with 3 in. width of tread. The broad platforms and

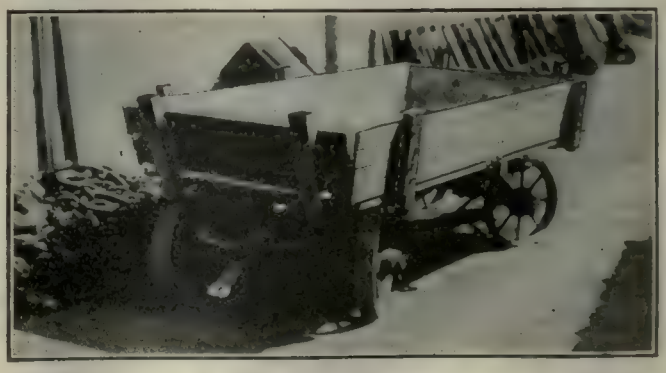


FIG. 2. ONE OF THE TRAILERS USED WITH THE SHOP TRACTOR TRUCK

shop runways of a railroad shop lend themselves well to a tractor of this kind.

One of the trailers used with this type of tractor is shown in Fig. 2. It is large and strong enough to carry the heaviest material used around the average machine shops.

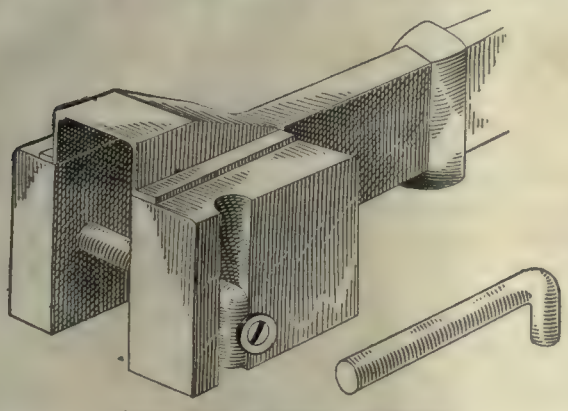


Improvement in Wheel Dressers

By Martin H. Ball

Having experienced trouble from the turning of the pin in the ordinary form of wheel dresser, with consequent wear of the holes, the design shown in the sketch has been adopted.

The end of the pin is bent at a right angle to its body, and this bent portion lies in a vertical groove at the



IMPROVED WHEEL DRESSER

side of the holder. It is held in place by a washer and small button-head screw, and thus effectively prevented from rotating with the cutter as most other kinds are likely to do.

The life of the dressers has not only been materially increased but better service is given as well.

Measuring Gears by the Use of Wires

By John W. Lee

I desire to make a slight criticism on the article "Measuring Gears by the Use of Wires," published on page 291, Vol. 49, of the *American Machinist*. The first part of the article states that the diameter of the pins is such that they touch the teeth on the pitch circle, which is correct; but further on it says, "Let us then make our pin diameter such that the center line of the pin lies on the pitch circle."

It is not possible to have the center of the pin on the pitch circle and still have the pins touch the two adjacent teeth at the pitch circle, as by using such diameter pins they will always drop into the tooth space so far that they are below the outside diameter of the gear and are very hard to measure over. These pins will touch the teeth somewhere between the pitch circle and the base circle, and thus we would not measure the pitch diameter, but an imaginary diameter somewhere between the pitch and base circles.

The pitch diameter is what all gear calculations are based upon, therefore the pitch diameter is what should be measured, and to measure it by this method the pin

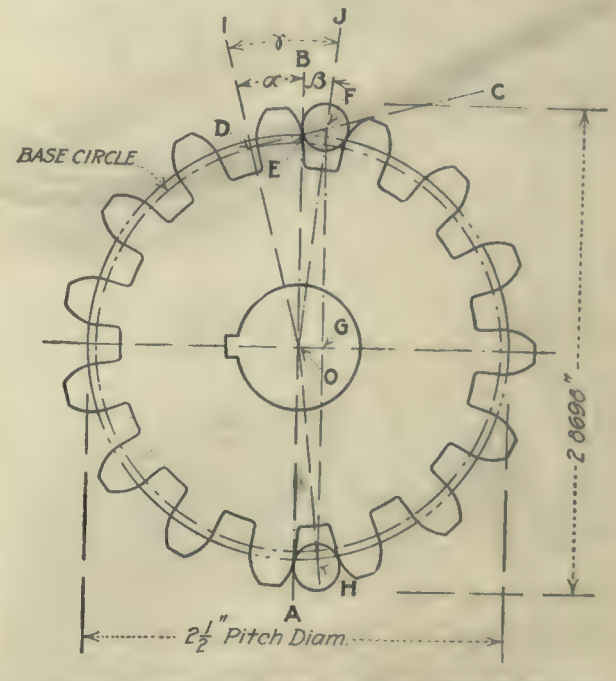


FIG. 1. EXAMPLE OF GEAR TO BE MEASURED

diameter must permit the pins to touch two adjacent teeth at the pitch circle.

To figure the diameter of such pins and the dimension indicated by them is a very simple matter and can be accomplished as easily and accurately in the case of gears as with screw and worm threads, in connection with which the method is widely used.

The procedure is exactly the same in each case, except that for threads it is necessary to use three pins, while for gears only two are required, or the measurement can be taken with one pin in connection with a plug in the center of the gear.

The diameter of the pin must be such that when it is placed in the tooth space it will touch two adjacent teeth at the pitch circle, and it will then always project above the tops of the teeth where the micrometer or vernier can be easily applied.

When the number of teeth in the gear to be measured is even, there are two right-angle triangles to be solved, and when the number of teeth is odd there are three.

Referring to Fig. 1, which represents a 15-tooth, 6-pitch, 14½-deg. involute gear, the two circles, the centers of which are at *F* and *H* respectively, represent the pins.

Let *AB* be the center line drawn in such position that it will intersect the tooth curve at the pitch line.

Let the straight line *CD* represent the unwinding string that generates the involute tooth curve, then *D* is the point of tangency of the string to the base circle.

The line *OI* is perpendicular to *CD*, and *CD* being the pressure line the angle α is equal to the pressure

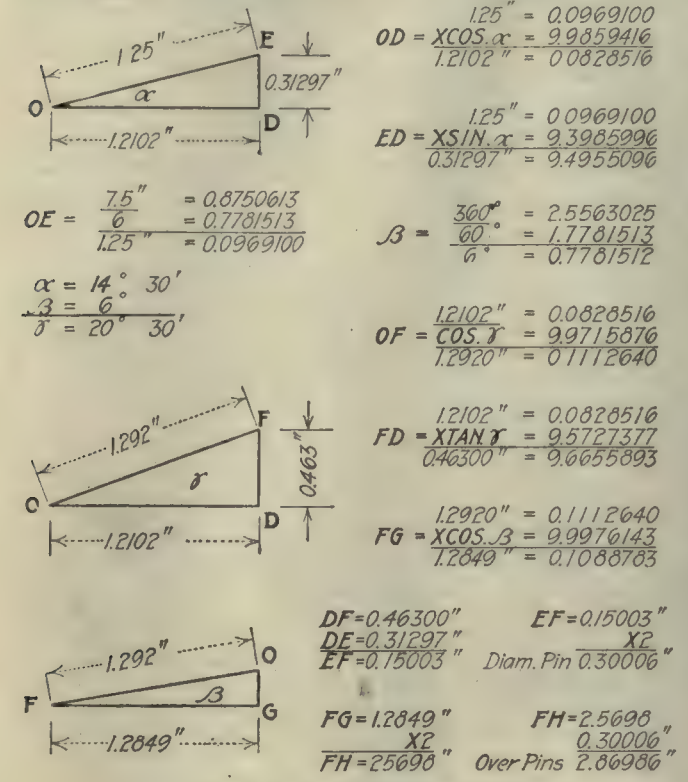


FIG. 2. SOLUTION OF FIG. 1

angle; the radius of the base circle is equal to the radius of the pitch circle times the cosine of the pressure angle α, and the radius of the tooth curve at the pitch circle is equal to the pitch radius times the sine of the same angle. *E* is the point where the center line *AB*, the straight line *CD*, the pitch circle and the tooth curve all intersect, and is also the point of contact between the pin and the tooth of the gear.

The center of the pin must be on the center line *OJ* of the tooth space and must also be on the straight line *CD* to be tangent to the tooth curve at the pitch circle.

Therefore the center of the pin must be at the intersection *F* of the two straight lines *OJ* and *CD*, and the distance from *E* to *F* is equal to one-half the diameter of the correct size of pin to be used.

It is readily seen that the distance *E* to *F* is equal to the difference between the sides opposite of the two right-angle triangles *DOE* and *DOF*.

The angle β is always equal to 360 deg. divided by four times the number of teeth in the gear to be measured.

The angle γ is equal to the sum of the two angles α and β. The distance *D* to *E* is found by multiplying the pitch radius by the sine of α, and the distance *D* to *F* is found by multiplying the base radius by the tangent γ.

The diameter of the pin equals 2 *EF*.

The distance *O* to *F* is found by dividing the base radius by the cosine of γ.

When the number of teeth in the gear is even the dimension over the two pins equals the diameter of the pins plus 2 *OF*.

When the number of teeth in the gear is odd there is still another distance to be figured, which is *FG*.

It is readily seen that the line *FH* is parallel to the center line *AB*, therefore the angle at *F* in the right-angle triangle *OFG* is equal to β, and the distance *F* to *G* is found by multiplying the distance *O* to *F* by the cosine of β and the dimension over the two pins is equal to the diameter of the pins plus 2 *FG*.

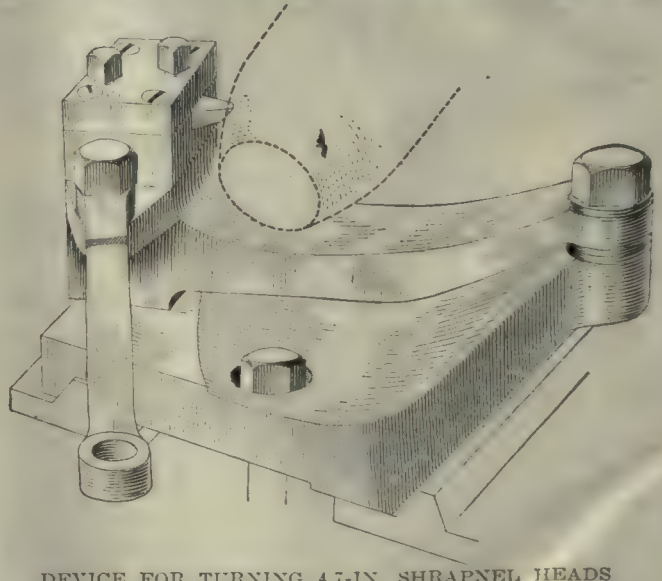
For example, let us take the 15-tooth, 6-pitch, 14½-deg. involute gear shown in Fig. 1. We first find the pitch radius *OE* by dividing one-half the number of teeth by the diametral pitch.

To shorten the calculations we will use logarithms, the operations then standing as in Fig. 2.

Device for Turning the Radius on 4.7-In. Shrapnel Heads

By R. S. Myers

Having experienced some trouble in getting the radius on 4.7-in. shrapnel heads with a wide form tool the following described and illustrated attachment was devised for use in a 14-in. engine lathe in machining them.



DEVICE FOR TURNING 4.7-IN. SHRAPNEL HEADS

A nosepiece having a threaded collar was fitted to the lathe spindle to hold the shrapnel head. This head was screwed into the collar and the collar screwed on the spindle nose until the head came in contact with the end of the spindle.

As shown in the drawing the auxiliary table is bolted to the lathe bed in front of the carriage at the proper distance and the movement is transmitted to a cutting tool held in the movable arm by a connecting link attached to the toolpost.

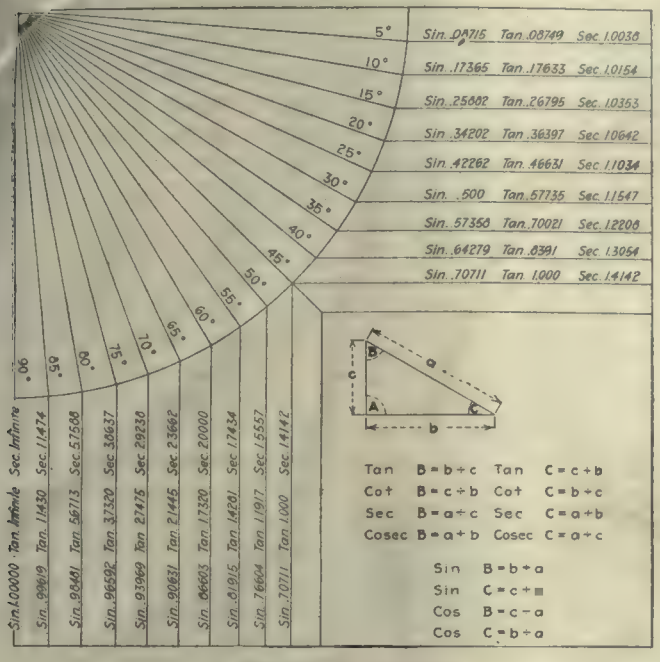
With this arrangement only one cut is necessary, and once the tool is set every piece comes the same.

A Chart of Angles

By Harry Hodgkinson

Some time ago one of our foremen asked me to get up a chart of angles that would present desired information in a form easy to find and thus making it unnecessary to dig it out of a book.

After several efforts I evolved a chart that looked as



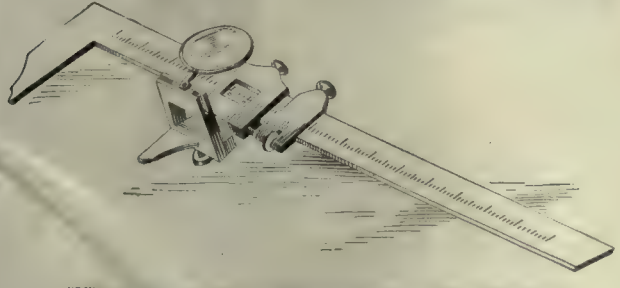
A CHART OF ANGLES

if it might be useful to whose who have to do with angles and a reproduction of which is shown herewith.

Microscope Attachment for a Vernier

By Hamlin Clay

This sketch shows a microscope attachment which I made for my vernier and which saves considerable time when the tool is constantly in use. It is made of aluminum, is very light and not in the way, and it enables



VERNIER WITH MICROSCOPE ATTACHMENT

the operator to use both hands in making a setting while directing his entire attention to the vernier reading.

The attachment is fitted over the movable jaw of the tool and fastened in place with a small knurled-head screw. Its height should be right to bring the glass in sharp focus, and for this reason the glass should first be secured and its focus determined. A glass of about 1¼ in. in diameter is most convenient.

A slot in the upper edge of the attachment is a tight sliding fit for the flat piece which forms a part of the mounting of the glass, allowing the latter to be moved back and forth to bring it central over the desired line on the vernier and thus avoid distortion.

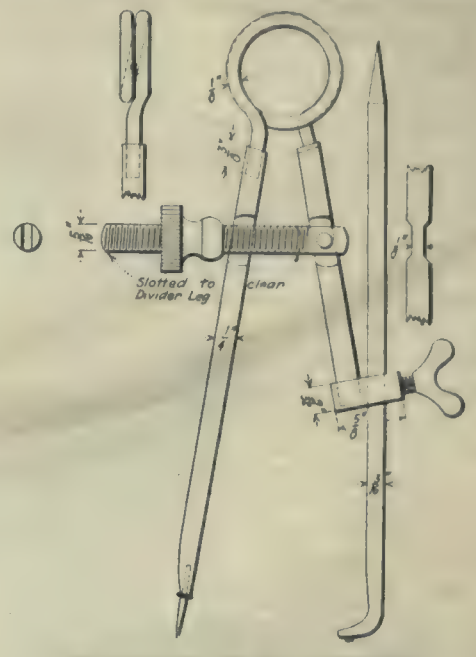
Homemade Spring Dividers

By Lieut. L. H. Morgan-Browne

Somerset, England

The cut shows a very handy small tool that I ran across some time back in a works in this country.

The ⅛-in. steel-wire spring is sweated into holes drilled



HOMEMADE SPRING DIVIDERS

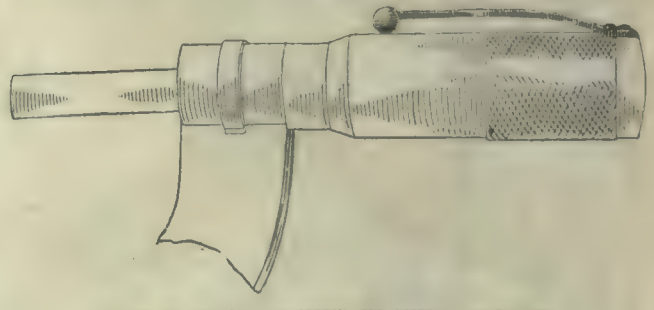
in the top end of the legs and the point of the fixed leg is a gramophone needle similarly secured to the other end.

I have had occasion to use this tool and I find it very handy.

Clip to Hold "Mike" in Vest Pocket

By J. W. Lawson

Many mechanics carry a micrometer in their vest pocket, and it often happens that when they bend over it falls out on the floor and is damaged. The mi-



CLIP TO HOLD "MIKE" IN VEST POCKET

crometer shown in the cut has an old fountain-pen clip cut off and soldered to the barrel, making the tool secure in the pocket.

The Making of a Toolholder

BY ROBERT MAWSON

The toolholder that is the subject of this article requires some interesting shop operations to produce. A brief description of the holder and some of the operations followed in its manufacture are appended.

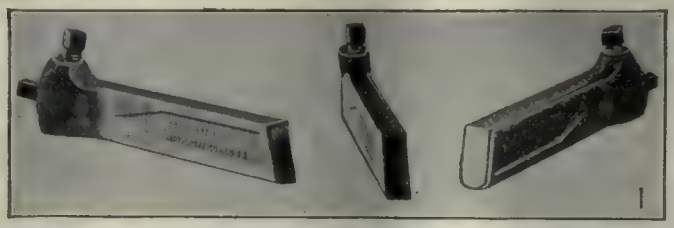
THE toolholder, samples of which are shown in Fig. 1, has a tool-steel insert under the cutting bit to take the pressure off the cut, this insert being forced into place during the process of manufacture and electrically welded to the body of the holder of which it thus becomes an integral part.

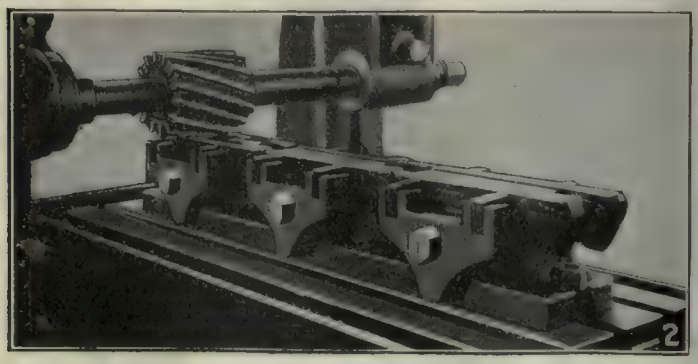
The body of the holder, which is made by the Ready Tool Co., Bridgeport, Conn., is a drop-forging of chrome-nickel steel and it is made in three styles—straight shank, and right- and left-hand offset.

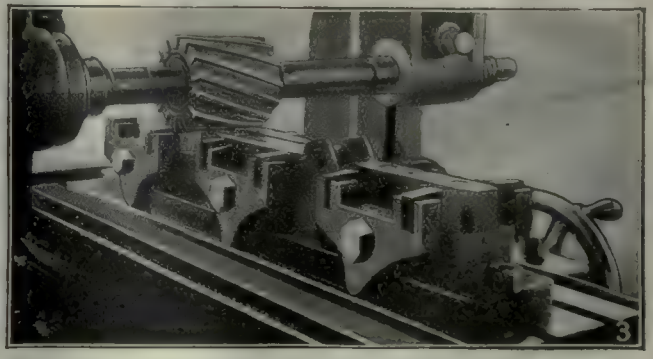
The first machine operation on the forging is the milling of the bottom surface, which provides a locating point for all subsequent operations of manufacture and also insures an even bearing for the holder when it goes into service. The fixture for holding the work for this operation is shown in Fig. 2. It is designed to hold six forgings at once, and the grip is through compensating clamps, which have a bearing at three points, two of which are on the work. Each pair of clamps is tightened by a single bolt passing clear through the fixture.

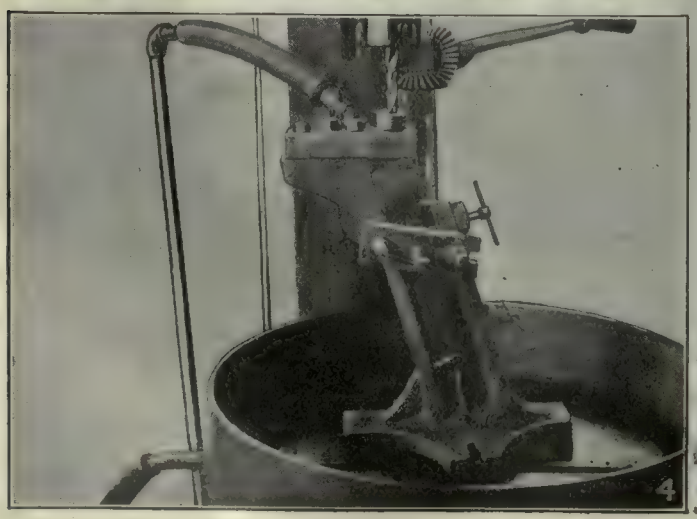
The same fixture is used, as in Fig. 3, to surface the opposite side of the forging, but in this case only two pieces can be handled at once, as it is necessary to stop the cutter before it reaches the raised portion which forms the boss for the setscrew. A plain, spiral, fluted cutter 4 in. in diameter is used for the work.

Following this operation a $\frac{7}{64}$-in. hole is drilled at an angle through the head and a piece of drill rod is forced into the hole. The drilling operation is shown in Fig. 4, and is done under a flood of cutting compound. The tool then goes to the electric-welding machine shown in Fig. 5, where the plug is fused in and becomes practically a part of the surrounding metal. The forgings then go to the heat-treating department for carbonizing. In this department the work, after being subjected for 8 hours to a temperature of 1700 deg. F., is allowed to cool slowly before being removed from the carbonizing material, the effect being to leave the pieces soft and workable. The holders are now drilled in a fixture very similar





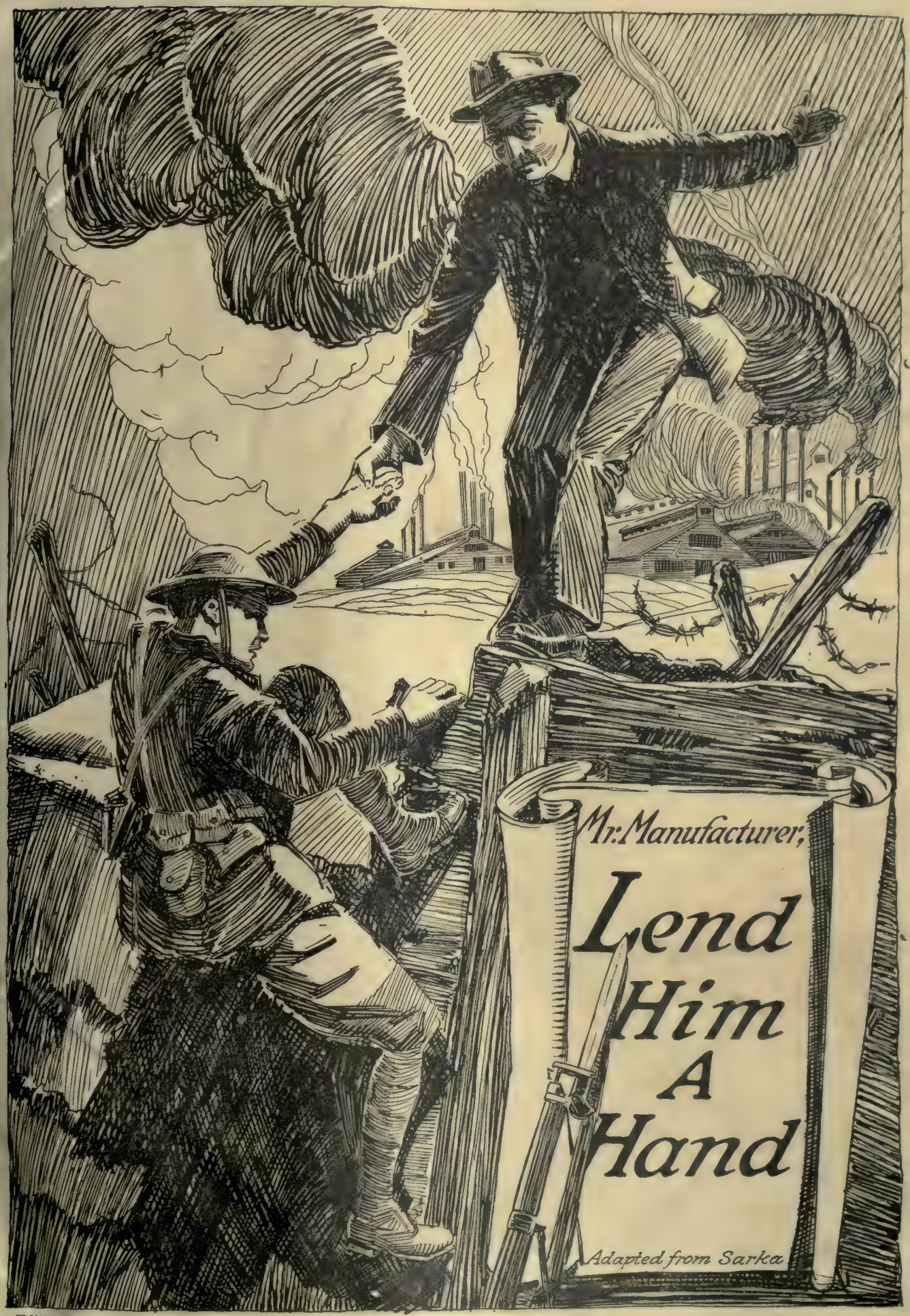






FIGS. 1 TO 5. OPERATIONS IN MANUFACTURE OF TOOLHOLDER

Fig. 1—Three styles of toolholders. Fig. 2—Milling the bottom of the holders. Fig. 3—Milling the top surfaces. Fig. 4—First drilling operations. Fig. 5—The electric-welding machine


Mr. Manufacturer,
Lend Him A Hand
Adapted from Sarka

to that shown in Fig. 4, the same-sized hole being drilled as before, but in this operation the center has been shifted toward the top of the holder a distance equal to one-half the diameter of the hole, so that the new hole is half within and half without the steel insert.

The Broaching Operation

At the point where the hole breaks through on the bottom of the forging the metal has been cut away with an end mill to obviate the difficulty encountered in drilling a half hole, and also to provide against crooked holes and tool breakage in the broaching operation which follows:

Fig. 6 shows the broaching machine with the fixture in place for holding the offset tools. This fixture

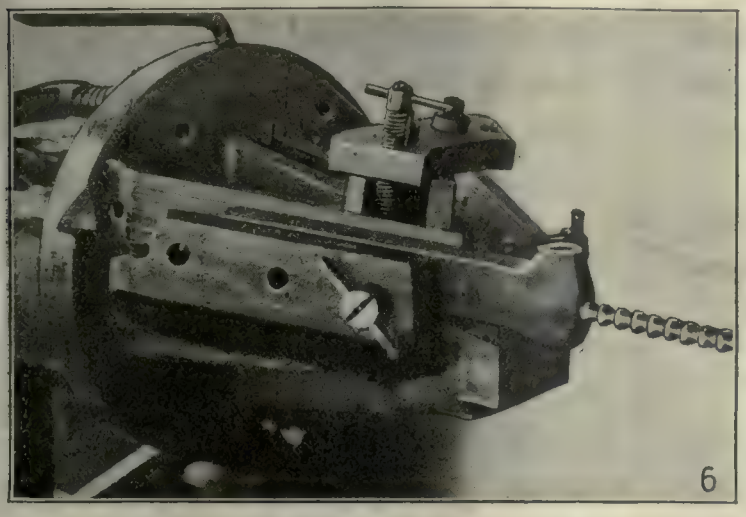


FIG. 6. BROACHING THE SQUARE HOLE

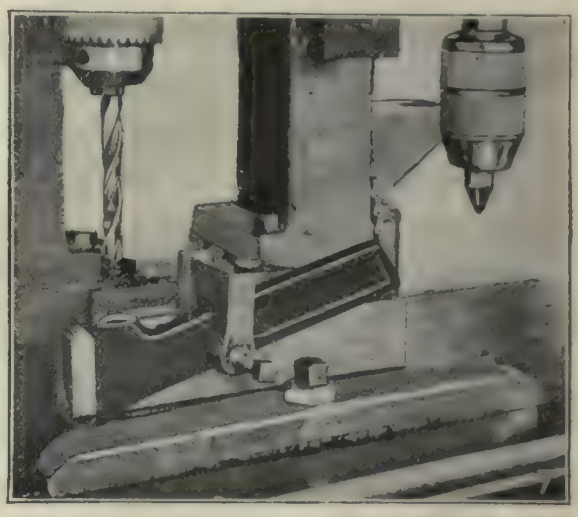


FIG. 7. DRILLING FOR THE SETSCREW

accommodates tools of either hand by merely changing clamping screws from one side of the fixture to the other. The straight-shank tool requires a different fixture.

The hole for the setscrew is then drilled and countersunk in the fixture shown in Fig. 7, the fixture being bolted to the table of the drilling machine, and no guide bushing is needed. The countersink shown in the second spindle removes the corner from the hole providing for the entry of the tap in a later operation and avoiding a ragged edge on top of the tool when the thread is cut. The countersinking is done with the work held in the operator's hand after the drilling is done.

Ready for Packing and Shipment

The tools are given two hardening operations, the makers believing this treatment to make the center of the tool tougher and stronger. The first hardening heat is 1650 deg. F., and oil is used for the quenching bath. They are then ground and polished, after which they are given the second hardening by heating to 1400 deg., dipping in cyanide and quenching first in water and then in oil, this last operation giving the tool that mottled appearance so familiar to the trade. The final treatment is the heating of the tools to 400 deg. to remove hardening strains, after which they are allowed to cool slowly.

The tools are then made ready for packing and shipment.

Cutting a Four-Spline Gear Without Special Tools

By R. C. Thompson

Referring to V. C. Bowser's article on page 1095, Vol. 49, of the *American Machinist*, for cutting four-spline gear without special tools I wish to take exception to the editor's note that "there are two cuts too many in this plug. If the cutter slot and first keyway are accurately spaced to 90 deg. no other keyway is necessary."

My criticism is that if the cutter slot and first keyway are absolutely accurately placed this statement would be correct, but if the plug is made in this manner with the cutter slot and one keyway and there is an error in the placing of the slot and keyway or an error in the first slot due to shake of cutter bar in the slot this error will be multiplied in moving the plug from position to position, thus giving four times the error between the position of the first and last slot that existed in the plug. If the plug is made as shown in Mr. Bowser's sketch this error will not be increased, but the gear will be splined as accurately as the plug.

I raise this point because it is one which is so frequently lost sight of in designing jigs for a sequence of operations on a part, and the tool designer instead of sticking to one locating point changes his locating point with his operations, thus permitting an accumulation of errors. It seems to me that so well known an authority as the editor of the *American Machinist* should not uphold a fallacy of this kind.

[We cheerfully admit the impeccability of Mr. Thompson's criticism from a practical standpoint, but still insist that four times 0 = 0, and were the conditions implied by our "if" in the comment accompanying Mr. Bowser's letter fulfilled there would be no need for the extra keyways in the plug. It is well to avoid the possibility of multiplication of error where it can be done without sacrifice of other desiderata, but we can testify from our own experience that progressive location is by no means impractical. In our shop experience many years ago we made a tool that involved exactly the same principle as Mr. Bowser's plug, but in which the "multiplier" was 42 instead of 4.—Editor.]

A CREED *for* MACHINE

I believe in the dignity of foremanship responsibility of leadership

I Believe in My Firm. Its good name is my good name, and I will actively protect it against slander and strive to elevate it by example. To the men in my charge *I am the firm,* and by my acts they will judge it to be good or bad.

I Believe in Our Product. To keep its quality unquestioned I will make every effort to have good work rewarded, poor work bettered and worthless work eliminated. I will study the uses of our product and tell those who work upon it not only How but Why.

I Believe in Myself. I will swing this job of mine better than any other man could swing it. I will know how long each job takes and how long it should take. I will let each man know that I know not only what he does but what he can do and should do. I will shoulder responsibility, standing back of orders that I transmit and orders that I originate, and in shouldering responsibility I will also shoulder consequences.

I Believe in My Men. Responsible for directing their work, and thus for shaping their lives and the living of their dependents, I pledge myself to the square deal and the helping hand. I will make fit and not misfit. I will see that each man gets a right start and that he continues to get and to give a square deal. I will listen patiently to all suggestions, explain the impossible ones, test the probable ones and give credit and show appreciation for the successful ones. I will let no man quit without my knowing why and, if possible, doing away with the cause.

I Believe in Good Machinery Plus Brains — that their partnership is necessary for production. I will see to it that good machinery gets good treatment and that poor machinery

SHOP FOREMEN

By John H. Van Deventer

in the honor of service and in the —I Believe in My Job.

is either bettered or scrapped. I will tolerate no "deadheads" either of flesh or of iron. I will lead my men and drive my machines, abusing neither. I will strive to make cutting tools cut costs as well as metal.

I Believe in Progress. I will encourage initiative, awaken ambition, foster skill and further the obtainment of knowledge in myself and in my men. I will set a mark and live up to it. I will achieve some definite gain each year in production, some improvement each month in methods, some advance each week in technical knowledge and a step forward each day in leadership.

I Believe in Team Work. I will have it said of me, "There's a man who will always co-operate." Of my department I will have it said, "Those fellows pull together." To these ends I will cultivate in myself the pride of leadership and the joy of accomplishment and will teach my men to know the satisfaction of excelling and the pleasure of being a winning team.

I Believe in the Future of My Industry—that the machine tool does as much for human progress as the surgeon's knife or the judge's library; that foremanship is a profession and not a trade. To advance myself in this profession I will search out new methods as the physician searches out new medicines; study current practice as the lawyer studies current decisions; inspire myself with the essentialness of my work as the clergyman inspires himself with the holiness of his mission.

* * *

So that when my work is finished men will say of me, and my conscience will say to me, "The world is better for your having lived in it and your industry is better for your having worked in it."

Additional copies of the above editorial will be furnished on request.

Details of Liberty Motor Development

By MAJ.-GEN. GEORGE O. SQUIER
Chief Signal Officer U. S. Army

IN APRIL, 1917, when this country entered the war there were being built in the United States only four makes of engines that could be considered of any military value, and even these were useful only for primary training. We had no engines at all suitable for services on the battle front or even for the advanced training of pilots. The largest engine of domestic manufacture developed about 220 hp. and had not proved satisfactory when judged from the standpoint of combat-service requirements. The others ranged from 90 to 135 hp. It therefore was evident that the existing American engines could be used for preliminary instruction purposes only, and that their further manufacture should be limited to training. This was done, with the result that by far the greater portion of the primary training of pilots has been conducted with the Curtiss OX-5 90-hp. engine, the quantity production of which was early obtained. This engine was particularly valuable, owing to the very satisfactory training plane which had been designed around it. The Hall-Scott A7-A 100-hp. engine was also extensively used at first until the production of the Curtiss engine could be brought to a point to meet all the demands of primary training.

Two European engines, the Gnome 100 hp. and the Hispano-Suiza 150 hp., were being put into production in this country early in 1917 by the General Vehicle Co. and the Wright-Martin Aircraft Corporation respectively. These concerns had obtained contracts with Great Britain and France, but were experiencing considerable difficulty in getting production under way. The first Gnome engine was not completed until more than nine months had elapsed, during which time English experts were present in the contractor's plant to aid the manufacture. In the case of the Hispano-Suiza, notwithstanding the assistance of a group of French experts sent over to help get it into production in the minimum time, 13 months were required to get the first production engine on the test block and another month before the first delivery was made. Preparation periods were filled with the most costly experiments and the development of methods and tools for performing the intricate operations required by the design of these engines. All of which expense and delay had cost our Allies dearly.

The Gnome and Hispano-Suiza engines represented the highest product of European design and were in a perfected and standardized state, according to foreign practice and conditions, when their production was undertaken in this country. Nevertheless the changes involved in adapting them to manufacture by American methods, and the development of expert workers for those operations which could not readily be so adapted, required so much time that the advances made in aeronautical engineering rendered such engines largely obsolete for service at the front by the time they could be produced in sufficient numbers to supply any material portion of the requirements.

These two engines were, however, of unquestioned value for advanced-training purposes, the Hispano-Suiza in particular being a dominant factor in this work. Later the LeRhone 80 hp. was put into production by the Union Switch and Signal Co., and by proper utilization of the lessons learned from our allies in the case of the other two foreign engines reasonably satisfactory progress was made in manufacture. This engine too was used for advanced-training work.

One of the serious mistakes the Allies had fallen into at the time the United States entered the war was the development of a multiplicity of types of engines and planes, which made it impossible to have a large number of any one of these types. As a further consequence the trained personnel on the ground to operate and repair the machines had grown to such a proportion that it was estimated that from 30 to 50 men were required on the ground to keep each one of the many types of planes in the air on the fighting line. Manifestly unless this large number of trained men per fighting plane could be reduced by some means it would be hopeless to expect within a reasonable time to put into the air thousands of flying planes, because a single thousand planes on this basis would require from 30,000 to 50,000 men in attendance.

The experience obtained in getting two foreign engines into production in this country and under our manufacturing methods so thoroughly demonstrated the futility of attempting any such solution of our service-engine problem as to at once eliminate its continued consideration. It was realized that copies of foreign designs could not be available in time and in adequate size or numbers to answer the demands of overwhelming air forces at the front. American air performance would have been very small indeed if limited by such a handicap as this.

Moreover, in spite of the fact that a technical commission was at once organized and despatched for the purpose of getting first-hand information on the front and in the aircraft centers of Europe, it was unthinkable that this country should sit idly by and wait perhaps months for the final definite report which should decide the nature and extent of our part in the allied aircraft program. Since the most successful airplanes are designed around specific engines and the engine involves the greatest expenditure of time and effort in development it was apparent to a few of us who were in close contact with the situation that it would in all likelihood be possible to design, develop and practice an entirely new American engine embodying characteristics that would render it particularly adapted to manufacture under American conditions in less time than would be required by the commission to determine the particular European engines that offered the best approximation to the various exacting requirements of service and production plus the time to get it in production in this country. It was decided therefore that our efforts should be directed along both these channels simultaneously and, in addition, to purchase in Europe whatever service equipment might be available to tide over the interval while we were getting into production.

It is apparent that the fundamental unit of engine design or construction is the cylinder and that the evolution of engine power rested mainly with the unit-power capacity of that cylinder which could be taken as representing the largest practicable size governed by the state of the art at that time. Starting with the foundation of this cylinder then it was the most direct reasoning to conclude that all requirements of the service for engines of varying power capacities could be most logically met by combining these unit cylinders into groups of whatever number were required to produce the several sizes of engines desired.

This was done, and the cylinder size of 5-in. bore by 7-in. stroke was selected, after a careful examination of the performance of both American and European engines of the then most modern design, as being the largest that could be relied upon to give satisfactory service. While originally designed to produce approximately 28 hp., this cylinder has been so developed as to yield at present more than 40 hp. as the result of somewhat increasing the speed and altering the functioning characteristics. The standard-unit cylinders were to be used in engines having four or more cylinders each and yielding the following power outputs:

Number of Cylinders	Original Rated Horsepower
4	110
6	165
8	225
12	335

Thus, for the first time in the history of the aeronautic engine for military uses, a truly comprehensive design

*Excerpts from address before the American Institute of Engineers, Jan. 10, 1919.

plan was evolved which in a simple and direct manner provided for the production of a whole line of engines of wide power capacities, but composed of units that were highly standardized and therefore could be really manufactured instead of being merely built. This was and is the only way in which this country could meet the requirements of this most vital part of the program.

It must not be thought, however, that such a revolutionary decision was easy to make or adhere to when made in the face of all kinds of adverse criticism, some of which seemed to be based upon adequate grounds. The development of new types of aircraft engines heretofore had been such a time-consuming matter that it was generally regarded as a thing to be avoided if any ready-developed engine could be found anywhere which would at all answer the requirements. Thus the numerical preponderance of opinion was against the possibility of a standardized American engine being designed, developed and produced in large numbers in anything like the short time required to duplicate some European engine. The nation may well render thanks that its destinies in this particular were guided by such a farseeing and courageous group of men who had the ability to formulate such plans and then to enforce their realization.

You are all familiar to some extent with the history of the design and construction of this engine; how Lieut.-Col. J. G. Vincent of the Packard Co. and E. J. Hall of the Hall-Scott Motor Car Co. laid down the general features and got out the first assembly drawings personally between midday of May 29 and the afternoon of May 31, 1917, working in Col. E. A. Deed's apartment in a Washington hotel in response to a request for a report on the aircraft-engine situation, which came from Howard E. Coffin, chairman of the Aircraft Production Board; the chief signal officer of the Army; Col. Edward A. Deeds, chief of the Equipment Division, Signal Corps, and Col. Sidney D. Waldon, assistant Chief; how the order to build 10 sample 8s and 12s was given as the result of the approval by the joint conference of the Army and Navy Technical Board and the Aircraft Production Board; how the first engine, an eight cylinder, was built in one month as the result of the enthusiastic coöperation of some 10 manufacturers, each of whom produced those parts for which he was best fitted; how the first sample 12 cylinder finished its official 50-hour endurance test 82 days from the time the order for samples was given, and that the total elapsed time during this test was only about 55 hours, a record-breaking performance, and how the success of this endurance test definitely removed the engine from the experimental stage to the realm of proved engines.

Gratifying Endorsement

A very gratifying endorsement of this standardized engine project came from the late Col. R. C. Bolling, whose untimely death in France cost the American Air Service one of its most valuable officers, and Col. V. E. Clark, and Lieut.-Col. Howard C. Marmon, members of the commission sent abroad to ascertain the requirements and which returned about this time, to the effect that a 400-hp. engine was absolutely demanded at the front for the types of airplanes which it had been decided this country should supply and that no engine of this size then existed in Europe.

Those of us who are familiar with the difficulties and disappointments involved in the design, development and perfection of any form of intricate mechanical device can readily appreciate the really remarkable accomplishment represented in the Liberty. Therefore it is not at all surprising that the representatives of the Allies were for some time unable to believe the full truth of this accomplishment. They never had been able to obtain such action and were naturally only fully convinced after many varied and exhaustive tests. So well recognized did the value of the Liberty engine become, however, that the Allies had on order at the time of signing the armistice 16,741 Liberty engines and were constantly endeavoring each to increase their rate of monthly delivery. Airplanes were being designed around this engine in all allied countries and it was fast becoming the predominating aeronautical engine of the allied cause.

It is of interest in this connection to note that this standardized engine already has been tested in the 24-cylinder model and had shown results which prove that the original basic idea will provide for engines of any size which would have been required for any probable increase in airplane size during years of continuation of the war. The 16-cylinder was also proved by the success of the larger engine.

The experimental development of the Liberty has been in charge of a department entirely separate from that dealing with its production, the Airplane Engineering Department under Lieut.-Col. J. G. Vincent and Lieut.-Col. Howard C. Marmon. The work of this department has resulted in a continuous improvement of the power output and performance characteristics of the Liberty 12 cylinder to such an extent that 526 hp. has been obtained with special fuel and detail changes, certainly a remarkable increase from the 335 hp. which the original design was intended to yield. While the weight of the service engine per horsepower has remained at approximately 2 lb., the maximum present development had reduced this figure to 1⅞ pounds.

Liberty Engine Development and Production

The record of production and production development of the Liberty conclusively proves the wisdom of the decision to concentrate all efforts on this one engine for the major part of our program of combat engines. In common with all similar machines many possible improvements and cost reductions become evident as the manufacturing processes and tools are being evolved and as experience is being acquired in the actual production. Also experience in the operating and adjustment of these engines led to alterations being made which resulted in increasing the power output, so that when we were advised that more power was desired than the 335 hp., which the original Liberty was designed to produce, the necessary stops already were known and the delay incidental to putting them into effect was small. The resulting power increase to about 375 hp. answered requirements for several months when advices were again received that more power was needed, and we then again made such alterations as were required to increase the power to around 420 hp. The weight of some of the parts was increased at this time in order that the reliability might not be reduced.

The problem of production was placed in the hands of a separate department in charge of Lieut. H. H. Emmons, U.S.N., and the continuous assistance of such men as Henry M. Leland of the Lincoln Motors Co., C. Harold Wills of the Ford Motor Co., F. F. Beall, O. E. Hunt and Edward Roberts, all of the Packard Motor Co., were obtained by Maj. J. G. Heaslet in charge of the Detroit district. The work of Mr. Wills, which has the greatest value, was the perfection of a new process for the forging of cylinder blanks in sufficient quantities to supply all manufacturers, and which was so very effective that the problem of cylinder-forging supply and cost was reduced to a minor consideration. The wisdom of the action taken is evidenced by the production of 1100 Liberty 12s in one year from the day when Messrs. Vincent and Hall first met and started a preliminary drawing and over 15,000 by the end of another six months.

It is perhaps to be expected that many criticisms would be leveled at an engine evolved under the condtions obtaining at that time and registering the large success which it represents, but all such have proved to be the result of misinformation regarding the conditions to be met, the fundamental ideas of design or of lack of appreciation of the difficulties encountered in creating at a single stroke and without previous experience an aeronautical power plant so much larger than was then in existence.

The Liberty engine stands today as an achievement which for daring, constructive imagination and farsightedness will ever be a cause of pride to the American people.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Terkelsen & Wennberg Lathe Chucks

Terkelsen & Wennberg, 326 A St., Boston, Mass., have recently put out a line of lathe chucks, as shown in the illustrations, which are believed to have several features

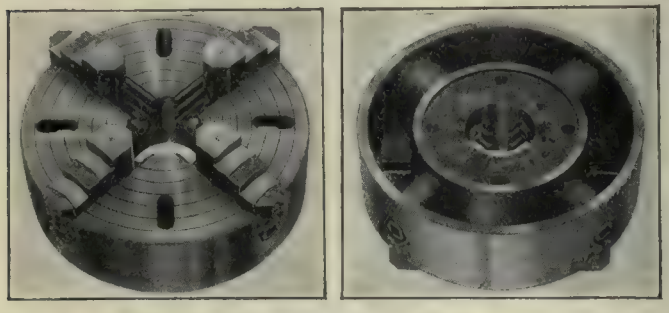


FIG. 1. FRONT AND BACK OF THE T-W LATHE CHUCK

that make them particularly desirable. The body is of heavy single-piece construction and is ground to a finish. The back of the body is not slotted, which is claimed to give it exceptional strength, and thrust bearings are provided at the end of each screw. The jaws are double gibbed, of 30- to 35-point carbon steel, heat-treated and ground all over and are interchangeable. The double-gibbed jaws are claimed to give longer life and greater accuracy than those of the single-gib type. The scrolls are made of 60-point carbon-steel forgings, while the pinions are 50-point carbon steel heat-treated and interchangeable. The threads on the screws are cut from end to end without any necking except at the lower end for the thrust ring, and can be easily removed for reversing the jaws or for cleaning. The thrust ring is made in one piece of solid steel. It is also said that the construction of the chuck brings it closer to the lathe spindle, which tends to make it steadier and to eliminate chatter.

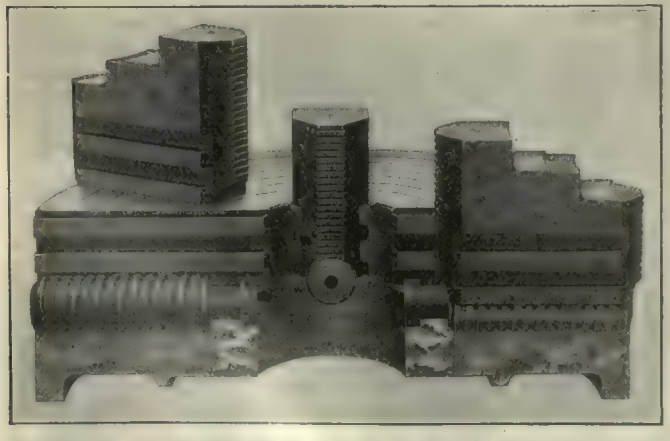
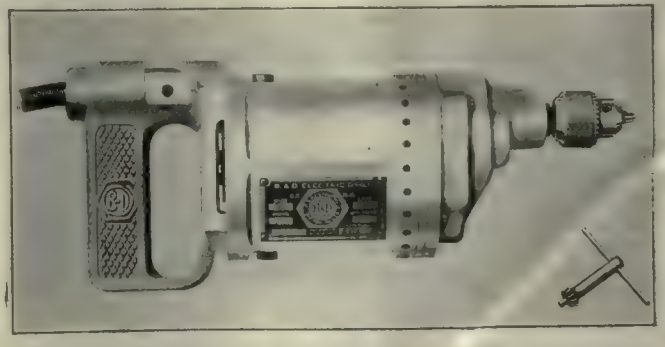


FIG. 2. A CROSS-SECTION OF THE CHUCK SHOWING THE INTERNAL CONSTRUCTION

Black & Decker Electric Drill With Pistol Grip and Trigger

The electric drill shown in the illustration is one of the latest products of the Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md. The



BLACK & DECKER ELECTRIC DRILL

machine is equipped with a pistol grip and trigger switch and is claimed to be the lightest machine of its capacity on the market. Its weight is only 6¾ lb., and its capacity is drills up to $\frac{3}{16}$ in. in diameter. The overall dimensions are 4 in. in diameter by 12 in. long and a series-compensated motor furnishes the power. A no-load speed of 1600 r.p.m. is attained, dropping to 1000 r.p.m. at full load when the energy consumed is 175 watts.

Landau Back-Geared Tapping Attachment

The back-geared tapping attachment shown in the illustration is one of the recent products of the Landau Machine and Drill Press Co., Inc., 19-25 West 44th St., New York. The device is at present made in two sizes, No. 1 taking taps up to $\frac{5}{16}$ in. and No. 2 taps from $\frac{1}{4}$ to 1



LANDAU BACK-GEARED TAPPING ATTACHMENT

in., both being fitted with standard Morse taper shanks. The construction of the device is such that it will work to the full length of the tap. When the tap reaches the bottom of the hole it is automatically released to prevent breakage. The back gears are used to reduce the speed of the tap, the reversing speed being 7 to 1. All parts are hardened and ground and the gears for both tapping and reversing are constantly in mesh. The No. 1 attachment is equipped with a Jacobs chuck.

"Safety Is Patriotism and Carelessness Is Disloyalty"

By Luther D. Burlingame

The slogan "Safety Is Patriotism and Carelessness Is Disloyalty," given out by the National Safety Council in the interest of reducing accidents, so that man power might be conserved for efficiency in war work, applies also to after-war conditions.

In looking at the losses sustained by the American forces in the short time they were in active service we feel that these losses were a heavy toll; but when we compare them with the casualties of industry in times of peace we find that in spite of all efforts toward safety so far made—and there have been great strides in that direction—figures are appalling.

Charles M. McChord of the Interstate Commerce Commission reports that 35,000 workmen are killed by industrial accidents every year, or one every 15 min. every day in the year, and 2,000,000 workmen are injured, or one every 16 sec. Such figures make the casualties of the American Army in the war seem small by comparison, and should bring home to every employer and workman the need of taking further steps to safeguard life and to adopt methods of work which will prevent this drain on our industrial efficiency. This drain, mark you, does not let up with the coming of peace, but continues year after year, and while not spectacular it goes on taking its toll of human life and limb with too little notice on the part of the public and of those responsible for its reduction.

Pan-American Engineering Organization

An ambitious project named the Pan-American Engineering Organization has been proposed by W. H. Woodbury, of Duluth, Minn. It will include such engineering bodies as the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials, the Society of Automotive Industries and other similar organizations. It is intended to use the local sections of the various societies for maintaining local interest, and it is proposed that members of other societies take out membership in the Pan-American Engineering Organization, and that this includes civic and social activities as well as those of the strictly technical societies.

Another object of this organization is to tie the technical man more closely to the affairs of his city or town by interesting him in the engineering and other activities and responsibilities of his own locality.

The Belgian Industrial Committee

The Belgian Consul, 25 Madison Ave., New York, sends us the following:

"I have just received through the courtesy of the Belgian Legation in Washington the following telegram from the Belgian government, which I think may interest you and is transmitted for your guidance, concerning the revival of industry in Belgium:

"In answer to your telegram, No. 599, the best organization to satisfy the demands of American merchants and manufacturers is the Comité Central Industriel de Belgique, Onze, rue du Gentilhomme, Bruxelles. The government is compiling documentation concerning the present condition of the Belgian industry. The Comité Central Industriel is requested to make list of names and addresses of Belgian firms for principal articles. These documents will be transmitted later on."

Omission

In the article "A Modern Can-Making Plant in a Baking Powder Factory," page 1173, Vol. 49, the name of Torris Wold & Co., Chicago, makers of the machinery described, was unintentionally omitted.

Angus Sinclair

Angus Sinclair, well known as the editor and proprietor of *Railway and Locomotive Engineering* and as the author of several books, died at his home in Millburn, N. J., on Jan. 1 at the age of 77.

Born in Scotland, Angus Sinclair first went into the British customs service, and those who knew him well recall some of his quaint stories of those early days. Later he sailed the seas in the engine room of ocean-going vessels and finally came to this country, going into railway work in the Middle West. He was a tireless worker, and soon after his arrival made himself known as a writer on railway topics. In this way he became acquainted with the late George Westinghouse and probably wrote the first railway-man's description of the air brake. Railway literature was scarce in those days, and Sinclair's book on "Locomotive Running and Management" became the guiding star to many a young railroader who was anxious to get to the top; and although he wrote a number of other books, among them a comprehensive history of the locomotive, "Locomotive Running and Management" will remain as his monument in this line. This has gone through 26 editions, the last revision being in 1915, so that this may be said to be his first and at the same time his last book. His book on "Firing Locomotives" has been translated into eight languages, including Chinese.



ANGUS SINCLAIR

In June, 1883, Angus Sinclair became an associate editor of the *American Machinist*, having previously contributed to its columns, as has been the way with all its editors since the beginning. He remained for about two years, leaving in May, 1885, to take up in Chicago the editorial work on the *National Car Builder*, which is now merged into the *Railway Age Gazette*.

In due time he became editor in chief of the *Car Builder*, with headquarters in New York, and when John A. Hill came to New York to edit the *Locomotive Engineer*, which was born in 1888, they soon became fast friends. This friendship grew until in 1892 Sinclair left the *Car Builder* to become senior partner in the firm of Sinclair & Hill, which bought *Locomotive Engineering* from the old publishers of the *American Machinist*.

This was a winning combination, and needless to say they prospered beyond all expectation. Then, by one of the strange turns in the wheel of fate, the firm of Sinclair & Hill, which the old management had given six months to live, bought a controlling interest in the parent paper, the *American Machinist*. It was a bold stroke and required nerve, but they knew the latent possibilities of both papers, and the result is known to all.

After five years of strenuous work in building up both properties to a substantial basis the partners decided that it would be better for each to specialize on one paper, so that in June, 1897, Sinclair took *Locomotive Engineering* and Hill the *American Machinist*. Then the name was broadened into *Railway and Locomotive Engineering* and the paper has made an enviable reputation for itself under the personal guidance of Angus Sinclair, who did not until very recently entirely give up the reins of management. Long years ago, however, in addition to his literary work—and he was a prodigious worker and writer—he was first secretary and later treasurer of the American Master Mechanics' Association, and as such became known to practically every railway official in the country. About ten years ago he received the degree of doctor of engineering from Purdue, and for eight years was a special instructor in the mechanical department of the Erie Railroad.

Mr. Sinclair was one of the early devotees of the automobile, beginning with the old steam car, and also published for a time the *Automobile Magazine*, one of the pioneers papers in the field. He was a member of the American Society of Mechanical Engineers and of nearly all the railway associations, and was a Knight Templar in the Masonic fraternity, a governor in the St. Andrews Society, a former president of the Burns Society and also of the St. Andrews Society of Newark, besides being a member of the American Railway Guild, the Lawyers' Club, the New York Railroad Club and numerous other railway, Scottish and other societies. He is survived by his wife Medora Head Mullin Sinclair.

His friends, and they were many, will miss him from his accustomed place at conventions and other engineering meetings. Few men had a wider acquaintance and few will be more kindly remembered.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



The Government has returned the Milwaukee Ford assembling plant to the company, which will go into operation on Apr. 1, 1918, at a daily production of 200 cars.

The Bureau of Aircraft Production, as a consequence of the stopping of hostilities, has restored the normal commercial position of the use of black walnut by canceling all restrictions placed on it.

The White Co., in addition to the four standard commercial-truck models, offers for 1919 a new "Good Roads" model, which is a 5-ton, chain-driven truck having a six-cylinder engine and steel wheels with wide steel tires instead of those made of rubber.

The present standard mail plane carries 700 lb. of mail. In the months of July and September 33,500 lb. of mail were carried at a total cost of $17,420. Of this $5800 was paid for pilots and mechanics. The De Haviland army planes are to be abandoned in favor of Curtiss R-4 with Liberty motors.

The Post Office Department has increased its requisition with the War Department for motor trucks from 10,500 to 15,700, and as a result it is now expected that the truck orders for commercial trucks placed with the Locomobile, Pierce-Arrow, Packard, Garford and White companies will not be canceled.

Announcement is made that plans are maturing for the exploration of the north polar regions next summer by means of airplanes. The plan calls for the raising of $250,000 by the Aero Club of America, the taking of a ship to Etah, which is located about 600 miles from the pole, and the exploring of the polar regions by land machines or seaplanes.

The 3 per cent. sales taxes collected on automobiles, motorcycles, etc., in the fiscal year ending June 30, 1918, amounts to $23,981,268. In this total amount of taxes Michigan is represented with $14,800,679, Ohio with $3,152,133, New York with $1,890,511 and Wisconsin with $1,236,679. The following states did not pay any part of the automobile sales taxes: Alabama, Alaska, Arizona, Colorado, Delaware, Florida, Hawaii, Idaho, Maine, Montana, New Mexico, North Dakota, South Dakota, Utah, Vermont, West Virginia and Wyoming.

An international aeronautical exposition is to be held in Madison Square Garden, Feb. 27 to Mar. 6 inclusive. This aircraft exposition was approved by President Wilson's first proclamation issued from France. Through the coöperation of the War Department certain war trophies and military features will be the center of interest.

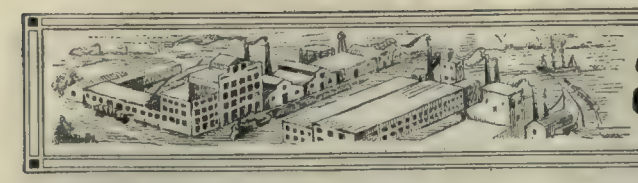
The advantage of the four-wheel drive on a tractor is that all of the weight of the machine and driver is available for traction purposes. The weight of the tractor being equally divided between the four wheels the tractor will not pack the soil as hard as would one having the bulk of the weight on two driving wheels. The four-wheel drive naturally complicates the construction; still this drive has proved successful in motor-truck work during the war and even essential in the work of the Ordance Department.

One of the most interesting developments of the war in the air has been the invention and application of the aerial telephone for directing of air craft. Its successful application as an important airplane equipment is due to the work of Col. C. C. Culver. On June 1, 1918, at Gerstner Field, Louisiana, 39 airplanes equipped with radiophones were paraded in review before Maj.-Gen. W. L. Kenley, who occupied a plane with the flight commander and personally directed some of the formations by using the radio-telephone equipment. With this apparatus aviators can talk 25 miles through the air in excellent atmospheric conditions, while in the worst weather the talking is possible for a 6-mile distance.

The Salvage Branch of the Supply Section of the Department of Military Aeronautics has invited sealed bids for the following material: 1000 Standard J-1 airplanes equipped with Curtiss 0 x 5-90 engines at Houston, Tex.; 200 Standard J-1 airplanes with Hispano-Suiza 150-hp. engines at Houston, Tex.; Standard J-1 airplanes without engines, Houston, Tex.; 10 L. W. F. airplanes with Thomas 135-hp. engines at St. Paul, Minn.; 2000 A-7-4 four-cylinder Hall-Scott engines at Houston, Tex. The bids will be opened at 11 a.m. on Feb. 1, 1919, at the office of the Salvage Branch, Washington, D. C. Each bid must be submitted in duplicate and accompanied by a certified check for 20 per cent. of the amount of the bid. The terms will be cash f.o.b. location given and delivery within 90 days.

Interesting features of the French Breguet biplane are the wing spars and the interplane struts. The spars of both planes are drawn-aluminum tubes of rectangular section $2\frac{1}{2}\frac{3}{2}$ in. x $1\frac{3}{64}$. The wall thickness of these tubes is in the inner section of the upper plane approximately $\frac{7}{64}$ in., and $\frac{1}{16}$ in. elsewhere. The rear spar grows thinner toward the wing tips. On the wing tips auxiliary spars are provided with ash bands of $\frac{1}{8}\frac{7}{4}$-in. thickness and $\frac{1}{8}$-in. three-ply wood glued to both sides. At the points of junction and at the ends of the stampings the spars are strengthened by ash pieces, in some instances of I-shape. The sockets and the wooden linings are held in position by iron-tube rivets. The interplane struts are made of stream-lined aluminum tubes with aluminum sockets in both ends. The inner struts are strengthened by the insertion of riveted U-irons.

The next logical step to be met in the problem of liquid-fuel conservation is the design of an engine especially suited to the burning of kerosene or fuel oils and not the attempt to adopt engines designed for gasoline to the use of kerosene or heavy oils. The present type of gasoline engine does not burn kerosene successfully even at full load, because kerosene and gasoline are widely different substances, having little in common except that they are derived from the same petroleum base. Gasoline mixtures ignite spontaneously at about 680 deg. F., while a kerosene mixture self-ignites about 575 deg. F. Kerosene will not volatilize at ordinary temperatures and pressures, and for the vaporization the assistance of heat is necessary, but even then is not sufficient to produce a homogeneous mixture of oil, vapor and air. Attempts to apply heat frequently fail of their object because the heating of the air decreases its density, reduces the amount of oxygen and thus cuts down the power output. An ordinary electric spark will usually fail to ignite a mixture of heavy oil and air, because the source of heat is too localized and the flame propagation is much slower than in the case of gasoline vapor mixed with air. For these reasons some means other than carburation must first be provided with a heavy fuel engine for an intimate mixing of the fuel and the air, and some means of igniting this mixture other than an electric spark is necessary. The future of a successful kerosene or heavy-oil engine is closely connected with the future developments of the Diesel and semi-Diesel engines.



Sparks from the

Latin-American Market for Tractors

Lack of Transportation Facilities Acutely Felt But Tractors Are Proving Successful in Road Work

The extensive areas of agricultural land in Latin-American countries offer a rich field for the development of trade in farm tractors. Many of the estates, comprising hundreds of thousands of acres, still cultivate their crops of grain, sugar and cotton under the old systems that require large numbers of laborers and horses. Power farming on these great plantations invariably shows economy of time and expense, and the recent increase in shipments of tractors from the United States to Latin America indicates that the more progressive ranch owners are beginning to realize the value of new methods. In the fiscal year 1918 more tractors were shipped from this country to the Latin-American countries than in all the four last years preceding, and in the first quarter of the 1919 fiscal year these exports amounted to more than a third of the total 1918 shipments.

VALUE OF TRACTOR INCREASING

The direct cause of this unprecedented demand for tractors in Latin America is doubtless the awakened interest in agriculture growing out of war-time needs and prices. The value of the tractor in increasing the agricultural production of Latin America is almost equaled by its importance as a road maker. The lack of transportation facilities is acutely felt in some of the richest sections of South America, and the tractor is proving of incalculable advantage in the construction of needed highways.

One of the chief obstacles faced by the manufacturer in the introduction of tractors is the natural aversion of a conservative rural community to new and complicated mechanical appliances. Inexperienced operators, failing to meet with success in the use of an untried machine, condemn and abandon it. The manufacturer must prepare to overcome this difficulty by providing ample instructions and demonstrations, and should moreover take special pains to furnish the proper kind of tractor for the particular class of work desired.

Another obstacle in selling tractors in Latin America is the high cost of gasoline, but it is probable that with the close of the war there will be a reduction in the price of this fuel. In contrast with the scarcity of fuel for tractors the ranch owner has available a large supply of horses and practically unlimited natural pasture, making his outlay for animal power comparatively small. To meet this condition the manufacturer must demonstrate that the land can be much more quickly and evenly worked and to a much greater depth with the use of the tractor than is possible with animal power; he must show that in the planting season not an hour need be lost because of a scarcity of laborers or horses, every moment can be utilized by the tractor, and the fields can be plowed, harrowed and planted at the most favorable period to insure a good harvest.

The Latin-American countries that are foremost in experimenting with tractors are Mexico, Cuba, the French West Indies, Haiti, the Dominican Republic, Guatemala, Nicaragua, Panama, Salvador, Argentina, Brazil, Chile, Colombia, Paraguay, Peru and Uruguay.

* * *

Mr. Manufacturer, Lend Him a Hand

The editorial supplement which accompanies this issue of the "American Machinist" is an appropriate one at this time, as it portrays the much needed assistance that must be given those boys who are returning home from the camps and battlefields and who are seeking positions in the country's industries. Will you, Mr. Manufacturer, lend him a hand?

New Process Gear Corporation Sold to John N. Willys

John N. Willys has purchased outright the New Process Gear Corporation, Syracuse, N. Y., taking over all of the $3,000,000 capital stock of the concern. There is no change contemplated in the nature of the product the company will manufacture, although it is naturally expected that material expansions in the old field will result. It is the intention of the company to solicit gear business of all kinds, and particularly so far as the manufacture of gears relates to differentials and transmissions for the automobile trade.

Thomas W. Meachem and other members of the Meachem family connected with the corporation have retired, having sold their interests to Mr. Willys. On the latter's part this step represents final complete acquisition of a plant in which he previously has been partly interested. No change of active management has been intimated, immediate control of the enterprise being in the hands of J. Allen Smith.

Candles Enough to Last for 5250 Years

The signing of the armistice left the American Expeditionary Forces with a quantity of candles aggregating 7,600,000 pounds, or 46,000,000 individual candles. Each candle made under Army specifications burns 10 hours, and on this basis it has been figured that the quantity of candles on hand is sufficient to burn one candle continuously and without interruption for 5250 years.

The primary use of the candles was to furnish light in the trenches and dugouts, but there is also a very extensive use for them in billets and camps. The supply of candles on hand, while large, is probably no greater than the amount necessary to meet the requirements of the Army for the immediate future.

* * *

Huge Mineral Output in 1917

The value of the minerals produced in the United States in 1917, according to the United States Geological Survey, Department of the Interior, was $5,010,948,000, an increase of $1,496,976,000, or about 43 per cent. over the former record—$3,513,972,000—established in 1916.

The metals established a new record in 1917, being valued at nearly $2,092,000,000 and representing 42 per cent. of the total value of the mineral product. They showed an increase of about $471,316,000, or 29 per cent., over the $1,620,508,000 reported for 1916. The blast-furnace products contributed nearly 90 per cent. of the total increase. Increases were also made in the value of aluminum, copper, lead and silver, but decreases were recorded in the value of gold and zinc.

* * *

Boston Bank Officers Will Go to Australia and the Far East

The First National Bank of Boston is sending two of its senior officers to Australia and the Far East to establish further foreign banking connections.

C. F. Weed, vice president of the bank, and D. A. de Menocal, vice president of the First National Corporation, will leave Boston about Jan. 20, sailing from San Francisco directly to Australia. After a few weeks in Australia, to be spent principally in Sydney and Melbourne, they will go to China and then return by the way of Japan.

Mr. Weed and Mr. Menocal have already had many matters for inquiry submitted to them. They had planned to be absent about four months, but if these inquiries multiply the trip may take longer.

World's Industrial Forge

By E. C. Porter, News Editor

Elevator Manufacturers' Convention

The Elevator Manufacturers of the United States held their semiannual convention at the William Penn Hotel, Pittsburgh, Dec. 4, 5 and 6. Among the subjects discussed were cost systems, coöperative service, elevator regulations, service stations and the prospects of the industry. Among the features of the occasion were a banquet, a theater party and a trip to the works of the Westinghouse Electric and Manufacturing Company.

The following officers were selected for the coming year: President, I. N. Haughton, Haughton Elevator Co., Toledo; vice president, O. P. Cummings, A. B. See Electric Elevator Co., New York; secretary, Frank A. Hecht, Jr., Kerstner & Hecht Co., Chicago; treasurer, J. H. DeVere, Ohio Elevator Co., Columbus.

* * *

Big Extension for Steel Mill

An extension involving an expenditure of $10,000,000 has been made at the Brier Hill Steel Co.'s new plate mill at Youngstown, Ohio. Construction was begun Aug. 17, 1917. The mill is designed to finish sheared plates up to 120 in. wide and any length up to 80 ft. Slabs will come from the blooming mill about three-quarters of a mile distant. When running at full capacity the mill is expected to turn out upward of 30,000 tons of sheared plates a month.

* * *

November Fire Loss

The fire loss during November in the United States and Canada was $12,333,750, and the total loss for the eleven months ended with November was $301,276,635. This exceeded the total for the year 1917, which in turn exceeded the total for 1916, and it was greater than for any entire year on record excepting 1906, when San Francisco was burned and the loss for the year ran up to $459,710,000.

* * *

Demobilization of Army and Navy Students at Stevens Institute

With demobilization of the Army and Navy units of the Students' Army Training Corps at Stevens' Institute of Technology, Hoboken, completed, there are left nearly 500 men who will go on with the regular mechanical-engineering course, only about 70 having withdrawn.

The demobilization of the entire Naval Section of the Students' Army Training Corps occurred on Dec. 21, 1918, with appropriate ceremony, after which the released students presented their commanding officer, Lieut.-Commander Frederick L. Prior with a gold watch.

War-time activity still continues in the United States Government steam-engineering school located at Stevens. This school has thus far graduated 10 classes of 20 to 30 men each, the graduating men being commissioned as ensigns in the engineering line and detailed to the Navy Auxiliary.

Brig.-Gen. C. C. Jameison Resigns from Service

Brig.-Gen. C. C. Jameison, late assistant to Major-General Goethals and in charge of the disposition of mechanical equipment purchased by the Government for the Ordnance Department, has resigned. Details are not obtainable, but it is said that General Jameison's health has been impaired by his strenuous activities. General Jameison, until a few months ago, was connected with the Ordnance Department, first with the Production Division in which connection he was instrumental in the development of much new plant capacity for munition work. Later, and before assuming responsibilities under the Director of Purchases, Storage and Traffic, he was one of the special assistants to the Chief of Ordnance.

* * *

Presidential Boom for Schwab

Seven hundred and fifty men representing the machinery construction and metal-working interests of the Middle West at the banquet on Superintendents' Night, Dec. 21, given by the Machinery Club of Chicago, proclaimed amid high enthusiasm Charles M. Schwab their presidential choice for 1920.

* * *

Found Places for 2,500,000 Workers

The United States Employment Service, under the Department of Labor, has found places for 2,500,000 workers from the time of its organization last January to Nov. 1. The employment service has announced that the number of its officers has been increased from 90 to over 900. It is expected that the service will be used very largely in the placing of discharged soldiers and sailors.

The Lyons Sample Fair of 1919

Affords a Good Opportunity for American Exporters to Demonstrate American Machinery

In view of present conditions and the approaching end of the war American participation in the Fourth International Sample Fair, which is to be held at Lyons, France, from March 1 to 15, 1919, becomes increasingly desirable and important.

Acting on the advice of the Department of Commerce the Department of State has allotted to the American consul at Lyons $1000 for the rental of space at the fair for the display of American goods and catalogs, following a precedent established in recent years. As a result three ways are open to manufacturers and exporters of the United States in which to exhibit at this fair: (1) A stand or several stands may be rented. The area of each stand is about 20 sq.yd., and the rental for the duration of the fair is 600 fr. ($116 at normal exchange). (2) Samples may be exhibited in the official consulate stand on payment of a fee to the fair committee of $25 for the privilege. (3) Catalogs may be shown in the consular stand free of charge. The consul and his staff will endeavor to give the widest publicity to these catalogs.

Each prospective exhibitor is required to fill out and sign an entry form, a copy of which may be obtained from the Bureau of Foreign and Domestic Commerce at Washington. Under no circumstances will any exhibits be shown unless the necessary forms are signed.

Manufacturers and exporters desiring to exhibit under plan 1 should write at once to the Comité de la Foire, Hotel de Ville, Lyons, France, giving complete information as to the character of their exhibit and inclosing the necessary fee for the stand or stands engaged. If on the other hand a manufacturer desires to be represented by catalog or sample in the consular stand under plan 2 or 3 this fact should be immediately communicated to the American consul at Lyons, France, and if samples are to be exhibited the necessary fee sent him.

It is needless to say that samples are a more potent selling force than catalogs, but catalogs are of course better than no exhibit at all.

Regarding the opportunity afforded by the Lyons fair for the promotion of the Franco-American trade, Commercial Attaché Williams reported from Paris under date of Nov. 22 as follows: "I recognize the value of the

Lyons fair in promoting the Franco-American trade. It should be especially useful to exhibit articles which France formerly imported from the Central empires, such as dyestuffs, glassware, etc. In my opinion the Lyons fair would also afford splendid opportunity for the display of American labor-saving devices and specialties for use in the household and on the farm. The sale of goods of this sort would be undoubtedly promoted if American experts could be on hand to demonstrate the American apparatus."

Personals

W. J. FULLER, American representative of Alfred Herbert, Ltd., sailed on Jan. 4 for England and the Continent.

MARCUS A. COOLIDGE, president of the Fitchburg Machine Works, Fitchburg, Mass., sailed on Jan. 1 for Paris to attend the peace conference.

WILLARD A. JOHNSON, who was formerly with the National Acme Co., Cleveland, Ohio, has joined the sales force of A. H. & F. H. Lippincott, Inc., Philadelphia, Penn.

T. T. FAUNTLEROY has been appointed sales engineer for the Lakewood Engineering Co., Cleveland, Ohio, with headquarters at 1034 Widener Building, Philadelphia. He was formerly New York branch manager for the Gurney Ball Bearing Co.

J. EDWARD GRINFIELD-COXWELL, who has been for a number of years Eastern sales manager of the Columbia Steel and Shafting Co., Pittsburgh, Penn., has started in business for himself with offices in the Marshall Building, 40 Central St., Boston, Mass. He will handle special accounts in cold-finished steels.

FREDERICK PEARSON, for the past 15 years associated with Marshall Field & Co. as advisory engineer in the development of its various manufacturing and merchandising enterprises in Chicago and elsewhere, has opened a consulting engineer's office in the Marshall Field Annex Building, Chicago. He will continue as advisory engineer to the above firm, in addition to other interests engaging his service. Mr. Pearson's experience has been diversified, embracing electrical, mechanical and chemical engineering.

Obituary

A. D. GALLMEYER, superintendent of the foundry department of the Valley City Machine Works, Grand Rapids, Mich., died on Saturday, Nov. 23, 1918.

COL. LEROY T. HILLMAN, commandant of Rock Island Arsenal, Rock Island, Ill., died of pneumonia at his quarters on the island Sunday, Dec. 29, 1918. Colonel Hillman was placed in command at the arsenal early in 1918, succeeding Col. George W. Burr.

Business Items

The plant of the Joseph Reid Gas Engine Co., Oil City, Penn., was destroyed by fire on Dec. 28, 1918. The damage is estimated at $300,000.

The Peninsular Machinery Co., dealer in machine tools, has moved from 100 Beaubien St., Detroit, Mich., to larger quarters at 279-281 East Jefferson Avenue.

The McCrosky Reamer Co., Meadville, Penn., on and after Jan. 1 will be known as the McCrosky Tool Corporation. An increase in its field of business made this action necessary.

The Hess Steel Corporation, Baltimore, Md., has established a branch office at 50 Church St., New York. Daniel V. Foster, who is now representing the Hess Steel Corporation in that district, will be in charge.

The Brown Hoisting Machinery Co., Cleveland, Ohio, announces the following changes in its organization: Harry Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice president, general manager and director; Robert G. Clapp, director; John F. Price, director; Ewen C. Pierce, general manager of sales.

Wheelock, Lovejoy & Co., Cambridge, Mass., have dissolved partnership and have been incorporated under the name of Wheelock, Lovejoy & Co., Inc., with H. F. Simpson as president, A. O. Fulton vice president, and F. B. Lovejoy treasurer. They have been appointed general sales agents in the New England states for the Ludlum Steel Co., of Watervliet, N. Y.

The Metal Ball Co., with works at Danbury, Conn., and office at Bridgeport, Conn., has been incorporated under the laws of Connecticut for $50,000 and will make high-grade steel balls for bearing purposes. The officers of the company are George E. Crawford, president; W. Le Roy Ketchem, vice-president and sales manager, and George Smith, secretary and treasurer.

Dick, Kerr & Co., Ltd., held their annual meeting in London on Nov. 14. Important plans for the future were outlined by the chairman, who said that the work of consolidating the organization of the company with those of Williams & Robbinson and the United Electric Co. has been completed. He further announced that it had been decided to establish companies in France and Japan to exploit rights in connection with apparatus for railways and tramways.

The Minneapolis Steel and Machinery Co. has moved its offices and warehouse to S114-116 Monroe St. This firm has taken over the machinery business of the various branches, consisting of farm tractors, hoists and derricks, and all future business with the firm in Oregon, Washington and Idaho will be handled from this office. The Spokane branch will continue to handle the structural-steel business as usual. P. E. Lattner is the contracting engineer.

The East Side Foundry and Machine Co., Belleville, Ill., has been organized and is now in operation in a plant on the Louisville and Nashville Railroad Co. line. The officers of the company are as follows: President, C. P. Tomlinson; vice president, Frank Smiley; secretary-treasurer, Arthur H. Bassler; manager, Eugene Rhodes.

The National Sales Engineering Corporation, Kresge Building, Detroit, Mich., has been appointed exclusive sales representative for the Kelly Reamer Co., the Buhr-Buiwitt Co., the McCrosky Reamer Co. and the Nelson-Blanck Co. The officers are E. E. Minard, president and general manager; C. H. Eckhard, vice president, and T. J. Fraser, treasurer and secretary.

Trade Catalogs

Visible Index Rack. Dumont Visible Index Co., Kansas City, Mo. Circulars, two. Pp. 4; 3⅜ x 6 in. These contain descriptive matter and illustrations showing the installation and use of the Dumont visible index rack.

Sellew 16-In. Crank Shaper. Sellew Machine Tool Co., Pawtucket, R. I. Circular. Pp. 4; 8½ x 11 in. A full description of the Sellew shaper is given with halftone illustrations and a table of dimensions and specifications.

The Kerosene Tractor Repair Price List. Hart-Parr Co., Charles City, Iowa. Booklet. Pp. 45; 6 x 9 in. Here a complete price list with correct name and code word is given of all repair parts of the three-plow kerosene tractor.

Labor Saving Tools. Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill. Circular No. 28. Pp. 49 x 12 in. Illustrates and describes the Thor pneumatic and electric tools and gives a table of specifications.

Spacers for Milling Machine Arbors. Detroit Stamping Co., 951-957 West Fort St., Detroit, Mich. Circular. Pp. 2; 8½ x 11 in. One side of this circular gives illustrations of various-sized spacers. On the other is a general price list.

The Safety Jack. Norlund Novelty Co., Williamsport, Penn. Catalog. Pp. 8; 5⅜ x 7 in. A short description of the construction and uses of this new product is given, together with illustrations showing how it is used under an automobile axle.

Adlight. K. F. M. Lindblad, 65 Sudbury St., Boston, Mass. Booklet. Pp. 4; 3½ x 6 in. A brief description of this shaded individual light is given, together with halftone illustrations showing its use on the lathe, at the press, at the bench and on the desk.

The Prestometer. Coats Machine Tool Co., Inc., 30 Church St., New York. Catalog. Pp. 19; 7½ x 10¾ in. A short description of the Prestometer is given, together with instructions and illustrations showing its use with various tools. The last two pages give a list of the users of the Prestometer.

Air and Light in Foundries and Forge Shops. David Lupton's Sons Co., Welkel and Westmoreland Sts., Philadelphia, Penn. Booklet. Pp. 48; 6 x 9 in. The greater part of the booklet is filled with photographs and descriptions of many interior and exterior views of foundries, machine shops and factories. Three samples of construction are shown by a line drawing insert.

Saw and Knife Fitting Machinery and Tools. Machinery Company of America, general office, Big Rapids, Mich. Catalog No. 30. Pp. 224; 6¾ x 9¾. Covering the output of three factories for which this company acts as distributor—the Covel Manufacturing Co., Benton Harbor, Mich.; Baldwin, Tuthill & Bolton, Grand Rapids, Mich., and the Hanchett Swage Works, Grand Rapids, Mich. It describes and illustrates various types of saw and knife

fitting machinery made by these factories. It will be forwarded to interested parties free on request.

Zelnicker's Bulletin. Walter A. Zelnicker Supply Co., 325 Locust St., St. Louis, Mo. Catalog. Pp. 84; 3½ x 8⅝ in. This is a complete list of all kinds of steam and motor railway supplies and equipment, also pumps, tanks, woodworking and contractors' machinery sold by this company. In each case a description and specifications are fully given.

How to Save Handling Expense in Factory, Warehouse and Stockroom. Barrett-Cravens Co., 711 Transportation Building, Chicago, Ill. Catalog. Pp. 32. This book described in detail the modern development of the Barrett lift truck as a means of handling material in factories, warehouses and stockrooms. Three pages are filled with illustrations showing special racks and platforms.

Philadelphia Gears. Philadelphia Gear Works, 1120-1128 Vine St., Philadelphia, Penn. Catalog. Pp. 84; 5½ x 8½ in. This contains illustrations and specifications of generated spur, bevel and spiral gears, rawhide and micarta pinions, worms and worm gears, racks and lead screws, sprockets and diamond chains. It also contains a page of useful information and a general price list.

Elevating and Conveying Machinery and Labor Saving Equipment. Gifford-Wood Co., Hudson, N. Y. General catalog No. 18. Pp. 480; 6 x 9 in. This is a reference book for engineers, manufacturers and plant managers and shows the application of labor-saving ideas for various industries. All types of elevators and conveyors are fully illustrated; tables of dimensions and prices are given.

Karnetic Holding Device. The Kar-Engineering Co., Inc., 79 East 130th St., New York. Catalog. Pp. 12; 6 x 9 in. Several illustrations are given of the Karnetic parallel V block and protractor-holding device for grinding at angles and for working on irregularly shaped pieces. Other illustrations give a few examples of work performed with Karnetics. Every page contains descriptive information.

Instructions for the Operation and Care of Tractors. Hart-Parr Co., Charles City, Iowa. Booklet. Pp. 32; 6 x 9 in. This is a complete handbook giving the care of the tractor in cold weather; how to start and stop the motor, lubrication instructions, care of the carburetor and its adjustments, the valve and ignition systems and other hints concerning the care and use of both kerosene or gasoline tractors.

Small Tools. The Cleveland Punch and Shear Works Co., Cleveland, Ohio. Handbook No. 6, pp. 40; 4½ x 7½ in. Illustrating and describing the Cleveland line of standard small tools, such as chisel blanks for pneumatic chippers, cold cutters, coupling nuts, cutting edges, dies, markers, punches, wrenches and numerous other small tools. The company also manufactures special tools, and the catalog contains specification sheets for use in ordering.

Ball Bearings. Hess-Bright Manufacturing Co., Philadelphia, Penn. Catalog. Pp. 108; 6¼ x 9¼ in.; cloth bound. This little brochure gives a history of the development of ball bearings, shows their use in the automobile, airplane, machine tools, flour and feed milling machinery, wood-working and electrical machinery, mining locomotives, street railways and in other miscellaneous ways. It is plentifully illustrated and contains several tables and a price list.

Tool Steels. Carnegie Steel Co., Pittsburgh, Penn. Catalog. Pp. 24; 5 x 7⅞ in. A new line of carbon electric tool steels recently placed on the market by this company is described, together with instructions for hardening and tempering each of the five grades. The pamphlet is intended for the actual user of tool steels and contains practical information without an extended discussion of theories. A chart of heat colors with their corresponding Centigrade and Fahrenheit temperatures is included as well as a chart of temper color. Lists are also presented showing the proper carbon content for various lines of tools.

Gisholt Turret Lathes. Gisholt Machine Co., Madison, Wis. Catalog TLC-1. Pp. 102; 7½ x 9½ in. The first part of this book gives a number of halftone illustrations showing Gisholt lathes at work. Following this section are 18 pages carrying examples of parts that have been finished on Gisholt lathes. Then follow several pages of illustrations showing the installations of these machines in various shops and a general description of standard Gisholt turret lathes. The last part of the book is devoted to standard tools for lathes, toolholders and chucks, also the turret on carriage and gap lathes as well as the motor-driven lathes are illustrated and described.

New Publications

The Flying Book—The Aviation World's Who's Who and Industrial Directory.—Edited by W. L. Wade. Two hundred and eighty-two 5½ x 8½-in. pages; profusely illustrated. For sale by Longmans, Green & Co., New York. Price, $1.75.

This book is crammed full of pertinent information about airplanes, airplane motors, manufacturers and men prominent in the airplane field. Details of the main dimensions and power of all the well-known machines are given. These details are so arranged as to be easily found. The illustrations in outline are a valuable feature. Records of various flying achievements are given, and altogether this is a good reference book for those interested in airplanes and motors of the different types.

Oxwelding and Cutting—A Manual of Instruction.—By the Oxweld Acetylene Co. One hundred twenty-six 5 x 8-in. pages; 71 illustrations, 4 tables; paper covers. Issued to those interested through Murray Howe & Co., 30 East 42d St., New York.

To those interested in the practical application of oxyacetylene welding and cutting, this book will prove to be exceedingly informative. Beginning with a brief historical sketch of the development of autogenous welding and cutting, the reader is rapidly taken through the fundamentals of the process. After showing how to handle the blowpipe and other apparatus in a general way definite examples of almost every conceivable form are shown and minute instructions given. These examples apply to both welding and cutting. The clearness of the text and the pertinent illustrations make the subject easily understood by any student or practical operator.

Steel and Its Treatment—By the Metallurgical Staff of E. F. Houghton & Co., Philadelphia. Third edition; 165 5 x 7½-in. pages; 45 illustrations and numerous tables and specification lists. Bound in cloth boards.

This is a very comprehensive little book for the steel and iron worker. The first part covers the steel field in general, and the last is devoted to the S. A. E. specifications for steel, which places it in a form for ready reference that will be appreciated by the practical man. The chapter headings are: Composition of Steel, Thermal Critical Points of Steel, Classification of Steel, Effect of the Elements in Steel, Annealing, Physical Properties, Pyrometers, The Thermal or Heat Treatment of Steel, Carburizing, Casehardening, Carburizing Material, Heat Treatment After Carburizing, The Hardening of Steel, Drawing or Tempering, Furnaces for Casehardening, Heating, Fuels, Quenching and Miscellaneous Hardening Methods.

Standardized Leather Belting — Thirty-eight 5 x 7½ in. pages; illustrations and tables. Published by the Graton & Knight Manufacturing Co., Worcester, Mass. Free to those interested in belting.

This is a convenient little booklet for belt users in general, although primarily put out as an advertisement for G. & K. belting. The subjects treated are: History and Advantages of Standardization, pages 3 to 6; Standardized Series Leather Belting, pages 8 to 22; Tables of Belting Standards for Various Industries, pages 23 to 30, and Rules and Tables, pages 31 to 38. The rules and tables are naturally of interest to all belt users, as they contain articles on such subjects as How to Order Belting, Mechanical Rules Regarding Belting, Horsepower of Belts, Rules for Finding the LeLngth of a Belt When It Is Inconvenient to Use Tape, and Conservative Estimate of Horsepower for Both Double and Single Belts.

Hendricks' Commercial Register of the United States for Buyers and Sellers.—Two thousand three hundred and eighty-four 7⅞ x 9¾-in. pages. Twenty-seventh annual edition, 1918-1919. Published by the S. E. Hendricks Co., Inc., 2 West 13th St., New York. Price, $10.

The new edition of this valuable reference book for buyers or sellers has been thoroughly revised and brought up to date. For those not familiar with this book, reference is made to a complete alphabetical list of trade names of over 200 pages two columns each. This list is printed on pink paper to easily identify it, and is placed in the body of the book between the main classified pages and the alphabetical list of firms containing close to 1000 columns of names and addresses. The group arrangement used in the classified-trade section saves much valuable time for those seeking reliable information. To the modern business office this book is almost as indispensable as a typewriter.

Brass Founding.—By Joseph G. Horner. One hundred and eighty-two 5½ x 8½-in. pages; 247 illustrations; bound in green cloth boards. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 5s. ($2).

Beginning with a short historical sketch of the origin and nature of brass the author writes generally of the different mixtures used. The descriptions are those of a compiler and not of the practical metallurgist or founder. The few definitely proportioned mixtures given are hidden in the text, and not put in the form of tables which could be easily referred to. The descriptions of furnaces are well illustrated by sectional views, and the names of various makers of the apparatus is a feature that will be appreciated by practical men. The examples are nearly all taken from English practice, which differs considerably from American, especially in cases where large quantities are to be melted. The subject matter dealing with appliances, patterns and molds is of an elementary character. The various chapter headings are Introduction; Origin of Brass; Furnaces, Crucibles, Sands; Appliances; Joints; Joint Boards, Odd Sides and Plates; Patterns, and Examples of Molds.

The Safety Movement in the Iron and Steel Industry, 1907 to 1917.—By Lucian W. Chaney and Hugh S. Hanna. Three hundred 5½ x 9-in. pages; 35 illustrations, 36 charts and 116 tables; paper covers. Published by the United States Department of Labor, Bureau of Labor Statistics, Washington, D. C.

This is a valuable book to those interested in safety statistics and safety appliances. It is divided into two parts, the first consisting of a review of the safety movement, with special reference to the war, and the second dealing with the causes and prevention of accidents. The chapter headings of the Part II are Industrial Accident Rates, Physical Causes of Accidents, Causes of Accidents in Blast Furnaces, Causes of Accidents in Steel Works and Foundries, Causes of Accidents in the Mechanical, Fabricating and Yard Departments, The Human Factor in Accident Occurrence, What Are the Limits of Accident Prevention? Nature of Injury, Progress of the Safety Movement in the Iron and Steel Industry, Accident Experience by Department and Occupations, The Methods of the Safety Man. The tables and charts put the material in a form for ready reference.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.27	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	4.17	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	4.17	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.77					
Plates, ¼ to 1 in. thick	4.27	4.52	4.45	4.42	4.39	4.27	4.20

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.52	6.445	6.00	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.42	6.405	5.90	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.37	6.295	5.85	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.32	6.245	5.80	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.72	5.645	5.20	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.62	5.545	5.12	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.52	5.445	5.05	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.77	7.695	7.25	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.47	7.395	6.95	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.32	7.245	6.80	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
3, 11/32, 5/16, 1, 7/32, 5/16 No. 8, 9/32 and No. 10	25.50 to 33.00	5/16 by 12 in. long	14.00
		¼ by 19 in. long	12.00
¼		⅜ by 19 in. long	10.00
No. 12		½ by 21 in. long	10.00
5/32, No. 14 and 1/16		* Special Welding Wire	
No. 18		⅛	33.00
No. 20		5/32	30.00
		1/16	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	47%	20½%	¼ to 1¼	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	¼ to 1¼	36%	21%
½	48%	35½%			
¾ to 1¼	52%	39½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¼ to 3 in. steel butt welded	40%	28%	43%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	36%	25%	39%	23%	37.1%	23.1%

Malleable fittings. Class B and C, from New York stock sell at list + 15%. Cast iron, standard sizes, 5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	21.00*	26.00	23.50
Tin in 5-ton lots	72.00	72.00	85.00
Lead	5.75	7.05	6.50
Spelter	7.85	8.60	8.00
ST. LOUIS			
Lead	5.45	6.75	6.35
Spelter	7.50	8.25	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	35.00	38.00	31.00	35.00	32.50	36.00	35.00
Copper wire (carload lots)	32.00	35.00	32.00	32.00	28.50	33.00	34.00
Brass sheets	36.75	39.75	30.75	35.00	33.00	33.50	35.00
Brass pipe	40.00	46.00	36.50	38.00	40.00	44.00	41.00
Solder (half and half) (case lots)	55.00	55.00	48.00	47.00	43.25	56.00	43.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$36.00	$25.00
New York	38–40	30.00
Cleveland	34.00	34.00
Chicago	29.50	37.00

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THE 14-IN NAVAL RAILWAY BATTERIES



By C. L. McCrea

With the close of the war more complete details are available regarding the design and construction of the Navy's expedition of 14-in. guns on railway mounts that were sent to France to assist our Army on the Western Front, and the full story of how the Navy Bureau of Ordnance succeeded in designing, constructing in the United States, shipping and reerecting abroad and placing in action on the fighting front this battery of finest guns in the war may now be told.

JUST a little over a year ago, Rear Admiral Ralph Earle, Chief of the Navy Bureau of Ordnance, decided that a number of 14-in. 50-caliber guns that were originally intended for installation on ships could in an emergency be diverted to other uses. This size of gun at that time had but a single rival for size and range—that was the German gun which for some time past had been bombarding Dunkirk and which had wrought a great deal of destruction there. It was early seen therefore that if these guns could be mounted and placed in the hands of the armies in France they would be of great value to the Allies.

The immediate question for Admiral Earle and his assistants to answer was how to use the guns. A conference of department heads was called and two main points were decided. First of all it was felt that the greatest and most advantageous service from these guns could be obtained only by making them completely mobile, and this mobility could be obtained only by placing them on railroad carriages. In the second place it was decided that the element of time was a most vital factor, and that unless the guns were ready for firing in the summer of 1918—a date less than nine months distant—the fullest use could not be got from them.

Acting immediately on the decision of the conference the designers went to work on Dec. 26, 1917, on blanket instructions to prepare general plans for a railroad mounting capable of carrying the 14-in. 50-caliber naval gun, to be complete with all operating equipment. This is shown in its entirety in the headpiece.

The first step in designing the naval railway mount was to obtain data on the French railways, their track gage, clearances, etc., and study them. Although the

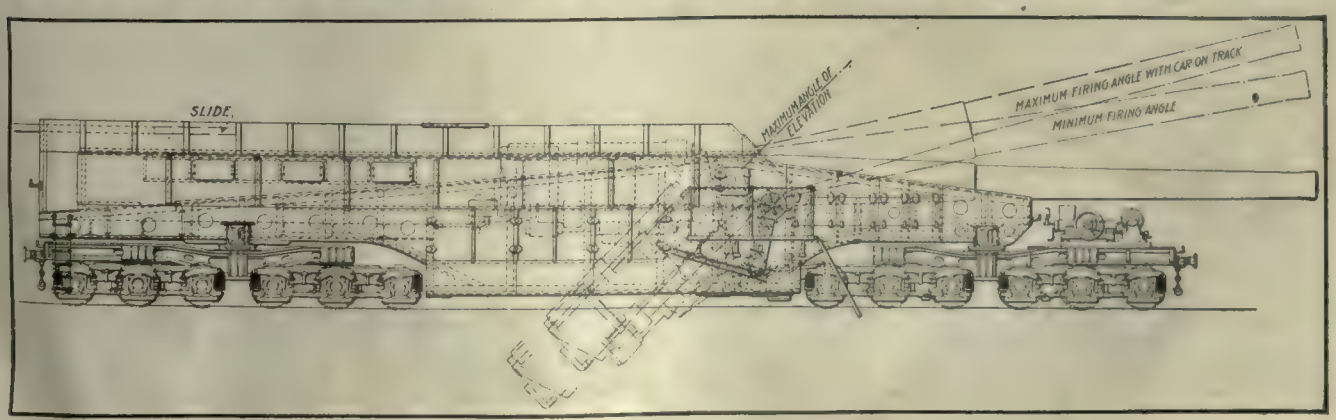


FIG. 1. 14-IN. NAVAL-GUN CAR

French clearances differ considerably from American practice it was found possible to work within them and still use American standards. Time was the vital factor everywhere. The designers were asked to do in weeks what would normally take months, and so the first question the designers asked themselves was, "How can we adapt, as far as possible, the mounts in which these guns are carried on board ship so as to use them on shore?"

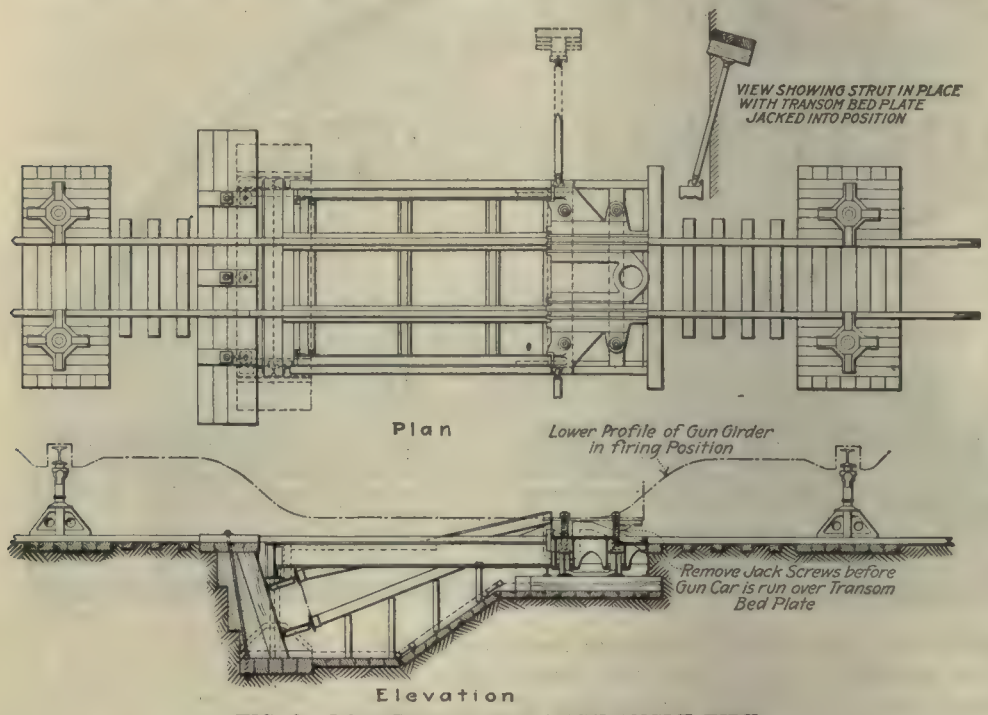


FIG. 2. FOUNDATION FOR HIGH-ANGLE FIRE

On board our battleships these heavy guns are of course mounted in the turrets. The gun itself is finished smooth on the outside; that is, there are no trunnions attached directly to it. At the breech end a heavy yoke casting is attached and the gun is placed within a heavy cylindrical casting known as the gun slide. This slide is machined to a bearing surface on the inside and fitted with bronze liners on which the gun bears. The outside of the gun slide carries the trunnions. The trunnions in turn rest on two heavy steel castings, which are bolted directly to the ship's structure, called the deck lugs. The recoil of the gun on firing is taken up by a hydraulic-brake cylinder attached underneath the slide and connected to the yoke of the gun. After the gun has recoiled it is brought back into battery, or firing, position by means of heavy helical springs placed in four cylinders attached to the gun slide and operating on pistons attached to the gun yoke.

Conditions on board ship had forced the designers of this material to carefully calculate factors of safety and to keep their designs as compact as possible, and careful consideration of the design of battleship turret mounts showed that it should be possible to use a great deal of standard Navy material in a railway mount. The first principle the designers laid down therefore was that as much standard material as possible should be used, both for reasons of proved reliability and of saving in time of construction. A study of the few available general designs of railway mounts previously developed by the French and some rapid calculations showed that it would be possible to mount the gun with its slide and lugs between a pair of heavy bridge girders, these girders in turn being supported on railway trucks. The question of elevating the gun and taking care of its recoil then came up.

The 14-in. 50-caliber gun is 50 x 14 in. = 700 in. or 58⅓ ft. long. To properly balance the gun and slide when in firing position the axis of the trunnions is placed 16 ft. 10½ in. from the face of the breech. When the gun fires it recoils in its slide a distance of 44 in., making a total clear space necessary from the axis of the trunnions of somewhat over 20 ft. As the maximum height above the rail heads permitted by French tunnel clearances is 13 ft. 1⅞ in. it is readily seen that the



FIG. 3. THE CRANE CAR



FIG. 4. GUN READY TO FIRE



FIG. 5. THE LOCOMOTIVE

designers were called upon to provide some method of taking care of the recoil of the guns when firing if the guns were to fire at all angles of elevation up to about 45 deg., at which the greatest range is obtained.

Three methods of caring for the recoil of the gun were available. The first was to move the trunnions nearer to the breech end of the gun and to add either a counterweight to the breach, or a spring cylinder, air buffer, etc., to overcome the muzzle preponderance which would then be given to the gun. This would have necessitated an entirely new design of gun slide, recoil mechanism, etc., and it was promptly ruled from consideration. The second method evident was to provide a means for elevating the entire gun with its slides, lugs, etc., preparatory to firing, while the third method was to dig a pit and provide a structural steel and timber foundation on which the gun might rest when firing at high angles of elevation.

Each of the last two methods offered a practical solution of the problem, with certain advantages inherent in each method. The method of elevating the trunnions would be the only practical solution if the guns were to operate in a country where a great deal of rock is encountered two or three feet beneath the surface, as excavation would then be too difficult to permit digging a pit. The pit, however, could be easily dug in the soil of France, as such conditions do not prevail there.

The decision was made by considering the probable use of the guns. It was felt that these naval railway guns would find their greatest use in firing on fixed targets that were of more than ordinary importance to the enemy; for instance, large ammunition dumps, railway centers, yards, etc., far behind the enemy lines. The destruction of these strategic points calls for extremely accurate firing, for although a single well-placed shot from this gun will create havoc in the enemy communications, etc., the gun must be very carefully aimed and placed in position to accomplish this. When the gun fires directly from the rails the entire gun moves backward a distance of some 25 ft. and must be placed into position and reaimed, etc., after each shot. When the gun fires from a pit a fixed foundation is obtained, and the railway mount for all purposes then becomes the equal of a fixed land mount and permits of extremely accurate and rapid firing. All these considerations were taken into account, and it was decided to provide for a pit with a structural-steel foundation to support the gun when firing at angles of elevation at which the breech of the gun would interfere with the railway tracks.

In order that the naval railway battery might successfully operate independently along the fighting front wherever needed it was decided that complete equipment of every description should be carried with the

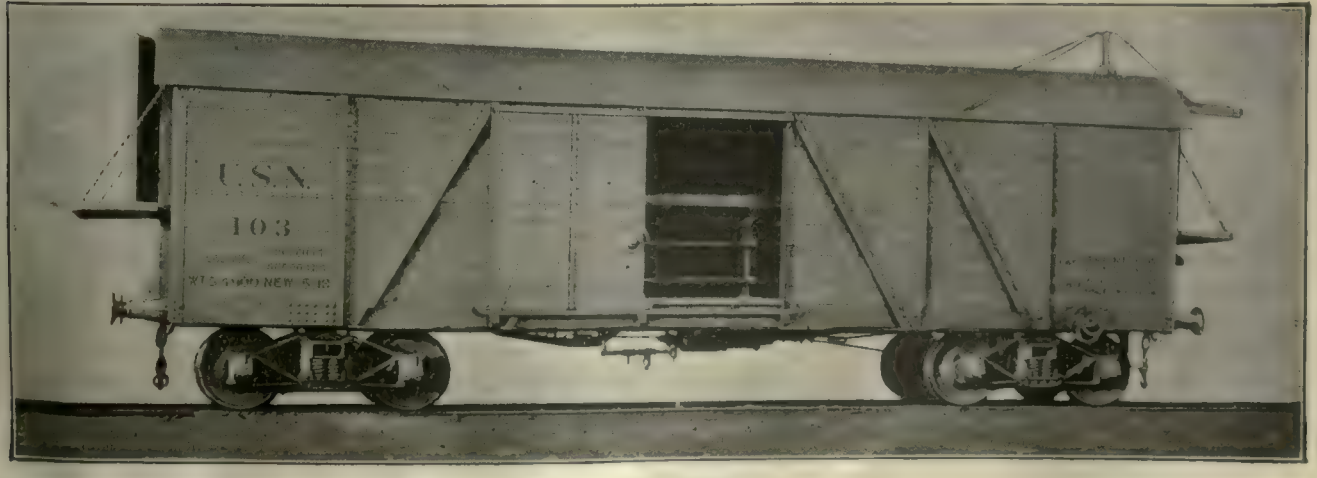


FIG. 6. AMMUNITION CAR

guns. This called for ammunition cars to carry shell and powder for the gun, construction cars to carry foundation material, with means for installing it, berthing and kitchen cars for housing the operating personnel, workshop, fuel and headquarters cars, etc.

Here again, for considerations of time, a second principle of design was laid down, which was that standard United States railway material should be used to the fullest possible extent and only such modifications as were necessary to permit its operation on French railroads should be introduced.

Sundays and holidays were sacrificed and the general designs for the naval railway batteries were out within a few days. They called for an initial construction of

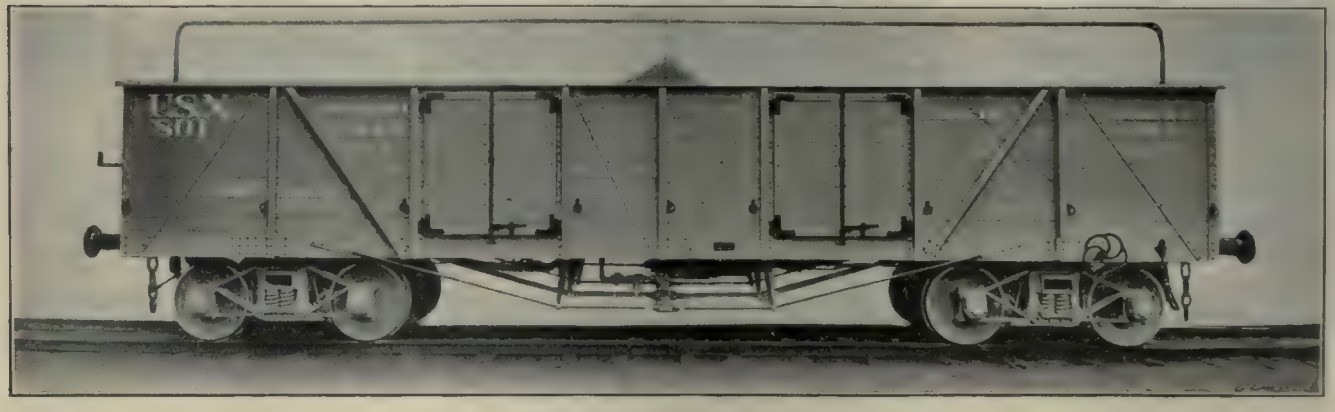


FIG. 7. CONSTRUCTION CAR, GONDOLA TYPE

five battery units, each battery unit composed as follows:

One gun car consisting of two large main girders, each 72 ft. long, braced and tied together to form a single girder unit with a large center well in which the 14-in., 50-caliber gun with its slide, deck lugs, elevating gear, etc., was mounted; the gun was arranged to fire from the rails at angles of elevation up to 15 deg.; for firing at elevations from 15 deg. to 43 deg. a foundation composed principally of ordinary structural steel girders and timbers was provided. One locomotive. Two ammunition cars. One construction (gondola) car. One construction (flat) car with crane. One sand and log (box) car (the latter three for carrying foundation material and installing it). One workshop car. One fuel car. Three berthing cars, and one kitchen car for housing operating personnel. Two battery-headquarters cars for operating the trains, housing officers, etc.

In addition provision was made for a staff train of:

One locomotive, one staff-quarters car, one traveling machine shop, one spare-parts car, one staff-kitchen and dispensary car, one staff-commissary car and one staff-berthing car.

In all the initial plans for five units called for:

Five gun cars, six locomotive cars, ten ammunition cars, five crane cars, eleven construction cars, ten fuel and workshop cars, sixteen berthing cars, six kitchen cars, one traveling machine shop and thirteen headquarters, commissary dispensary, etc., cars.

The practical basis on which the designs had been drawn and their evident feasibility brought forth immediate and complete approval and the designers went back to work on the details.

The heavy weights to be handled and the limitations of French tunnel clearances, track and bridge weights made the design a difficult problem and called for close and careful calculations. Some of the weights to be handled were, for example: The 14-in. gun, 85 tons (170,000 lb.); breech mechanism and yoke, 11¼ tons (22,500 lb.), and gun slide, complete with recoil and counterrecoil mechanism, 25¼ tons (50,700 lb.).

The gun was to be capable of firing at angles of elevation from 0 deg. to approximately 43 deg. The ensuing reactions due to firing are: at 0 deg., gun horizontal, trunnion pressure and resulting horizontal reaction, 814,000 lb.; at 43 deg., trunnion pressure, 966,000 lb.; resulting horizontal and vertical reactions, approximately 700,000 lb. each.

The detailed design and arrangement of the gun car is shown in Fig. 1.

Each of the two longitudinal main girders is 72 ft. long, with a maximum depth of approximately 8 ft. The firing load is very concentrated, and to properly care for it and insure its distribution through the girder section the web of the girder where the deck lugs are applied is made especially heavy. Special plates were necessary for this section. The two main girders are tied together and cross-braced at each end to form a single girder unit which weighs 135,800 lb. A special U-shaped housing is built in at either end of the girder, in which cast steel H-beams, each carrying a center-pin socket, are placed. The center-pin sockets of the H-beams respectively receive the center pins on two 12-wheel car trucks placed at each end of the girder on which it rests.

The construction of the trucks to carry the gun car is of course extremely and exceptionally heavy. Structural-steel girder beams form the frames of the trucks and carry the load to the axles. The axles of the trucks turn in 9 x 12-in. boxes arranged with coil and equalizing springs to insure an even distribution of the load.

The gun is placed in the well formed between the two girders. To accomplish this the deck lugs are fastened directly to the web at its heaviest section by means of steel bolts ground to size to insure a correct fit and an even transmission of the firing stresses. The slide, with the gun and its yoke, is then installed between the lugs, the elevating gear, which consists of a worm in an oscillating bearing operated by hand through a train of gears, as shown, being placed beneath and fastened to the girder flanges and cross-pieces.

Sufficient clear space is left behind the face of the breech of the gun, so that when the gun fires at angles of elevation not greater than 15 deg. (at 15-deg. elevation the range of the gun is 23,000 yd.) all that is

necessary is to set the hand brakes on the gun car after the gun has been properly aimed and fired. The recoil of the gun is absorbed by the hydraulic brake, and the resultant reaction on the gun car is taken up in moving the entire car backward along the tracks. At 15 deg. the gun car moves backward a distance of about 25 ft. The trunnions of the gun are placed so that the load on the axles of front and rear trucks is equalized on firing.

To enable the gun to fire at angles of elevation greater than 15 deg., arrangements for a pit and foundation, as mentioned above, have been provided. Immediately below the elevating gear and securely fastened to the girder webs and flanges is a heavy steel casting called the transom bedplate casting. A similar casting is provided in the foundation. The entire foundation, Fig. 2, is prepared in advance, it usually taking the best part of a day to get it ready. It is of course prepared in advance of the arrival of the gun car at any point at which the gun is to operate. The pit is dug, and by means of the crane car, Fig. 3, the timber-work backing and the structural-steel girders are put in place. The foundation bedplate casting is then put into position, and the girder designed to carry the rails and the weight of the gun car when it is rolled into position over the foundation is placed.



FIG. 8. CONSTRUCTION CAR, FLAT TYPE

To prepare the gun for firing from the pit foundation is then a matter of but a few minutes. The car is run over the foundation until the transom bedplate casting of the gun car is directly over the bedplate casting of the foundation. One-hundred-ton ball-bearing jacks are then placed under the corners of the H-beams at each end of the gun girder, and the entire gun car is lifted from the trucks a distance of about 4 in. By means of screw jacks provided in the bedplate casting of the foundation it is brought up until it engages with the transom bedplate casting of the gun car and the load of the car rests upon it. The girders carrying the railroad track are then moved to either side of the center line of the track, leaving a clear space in which the gun may recoil. Screw jacks are then placed under the heels of the girder to prevent side sway, and the 100-ton jacks are removed from the jacking beams, allowing the entire weight of the gun car to rest on the foundation. The gun is now ready to fire, as shown in Fig. 4.

Accurate aim when firing from the rails is obtained by firing from a curved track, a change in position of the gun car along the track causing a corresponding change in the azimuth of the gun. When firing from the pit, however, this is not possible. Accurate aim of the gun on the foundation is obtained through a traversing gear, which permits the entire gun girder to be swung about the forward H-beam center pin through a horizontal angle of 5 deg., 2½ deg. on each side of the center line of the tracks. As this angle of traverse represents a deflection on either side of the center line of 500 yd. at a range of 23,000 yd., corresponding to an elevation of 15 deg. and correspondingly greater deflections at greater elevations, it is evident that this angle of traverse is ample for all purposes.

The traversing gear is simply a wormshaft turning in a bearing cast integral with the rear H-jacking beam and operating against the girder. It is operated by ratchet wrenches and it has worked satisfactorily.

The loading of the gun is done with an ingenious device consisting of a roller-bearing trolley car mounted in an inclined I-beam, the lower end of which is placed level with the breech of the gun when the gun is in loading position. The 1400-lb. projectile is brought from the ammunition car on a monorail hoist and placed on this trolley. The loading crew then grasps the handles at the sides of the trolley and run the length of the car with it. The car is brought to rest against hydraulic buffers at the end of the I-beam, while the momentum of the shell is sufficient to carry it the length of the powder chamber and into the bore of the gun, where it is brought to rest by the forcing of the copper rotating band into the rifling of the gun.

The entire gun car is sheathed in ¼-in. armor plate. A small combination gas-engine-driven air compressor and winch is placed on the forward truck of the gun car.

The problem of the design of the locomotives and the auxiliary cars of the battery was much simpler than that of the gun car.

The locomotives decided upon as necessary for the work of handling the entire train of cars, including the gun car, are standard consolidation-type locomotives, equipped for operation on French railways, as shown in Fig. 5.

As mentioned previously, one of the first points realized was that standard United States railway material should be used as far as possible, and only absolutely necessary modifications introduced. Only in this way could material be produced in time or, in fact, could it be obtained at any time during the war. Manufacturers had no time for extensive changes of design. Consequently all the cars of the expedition are

built fundamentally to American design, but with French operating devices, track gage, etc.

The ammunition cars are standard steel-frame box cars of 60,000 lb. capacity, as shown in Fig. 6. The roof is covered on the outside, and the sides are lined on the inside with armor plate similar to that which covers the gun car. Doors are placed in the ends of the cars, and a monorail trolley hoist is provided for handling the 1400-lb. shell and the powder tanks so that ammunition may be delivered directly to the loading device in the gun car. Each car has racks built to hold a total of 25 shells and 25 full charges of powder (fifty 280-lb. tanks). The ammunition cars, as well as the other auxiliary cars, are equipped with air brakes.

The construction cars, with the exception of the crane car, which mounts a 10-ton pillar crane provided with a counterbalance and has a boom radius of 21 ft., are standard flat and gondola cars, as shown in Figs. 7 and 8.

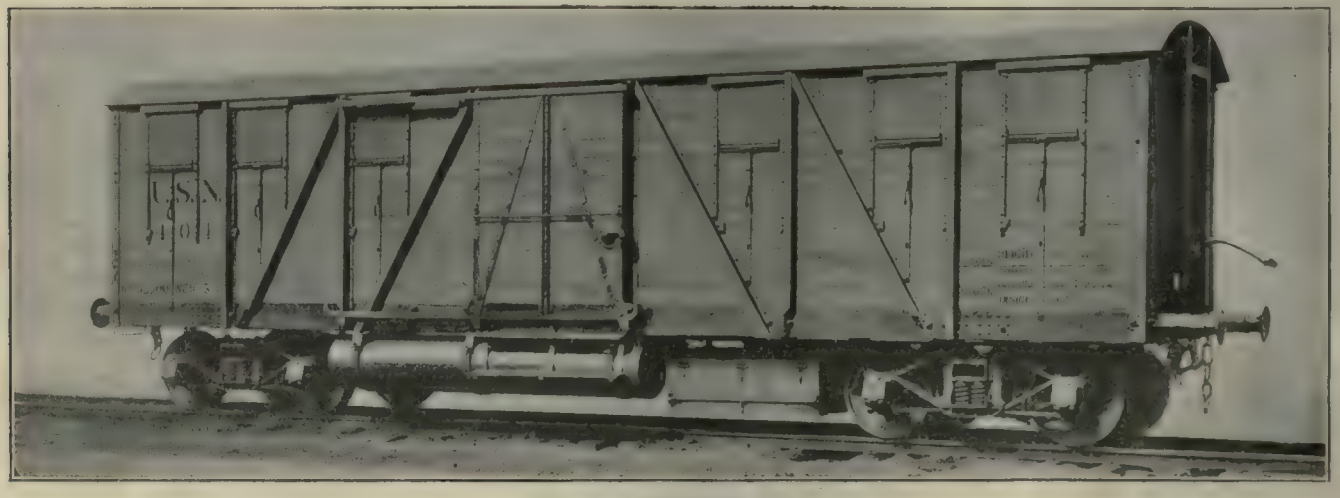


FIG. 9. BERTHING CAR

The berthing cars, one of which is shown in Fig. 9, are box cars provided with folding berths. These berths are placed in tiers of 3 each and supported by the side of the car.

The traveling machine shop is of special interest. It is equipped with a gasoline-engine-driven generator which supplies current to operate individual motor-driven machine tools placed in the car. This car contains a good-sized lathe, a drilling machine, a grinding machine, a forge and a work bench, so that ample facilities are provided for the repair of practically any breakage.

Every available man had been called to work on the project. Designs were being made, checked and traced simultaneously. Finally, in less than one month, they were finished and approved. On Jan. 25, 1918, they were pronounced complete and 136 standard drawings and 11 sketches were ready for submission to the bidders.

In the light of the extraordinary speed made in the drafting-room work on this project it would seem very probable that there would be a sacrifice in accuracy of detail, making changes necessary during the construction of the mounts. Not so with this work. Not a change was made that caused one minute's delay in the work of construction or assembling. The mounts were built exactly as designed—and they worked.

The story of the construction of the 14-in. railway mounts is a tale of marvelous speed. From the first it had been determined that the construction of these mounts would not be allowed to interfere with any work under contract for the United States Army or other important Navy projects. This of course greatly curtailed the possible sources of supply for naval railway battery material, as most of the leading locomotive builders, large machine shops and car-construction companies in the country were working to full capacity. Proposals, however, were sent out by telegraph calling for an opening of bids on Feb. 6, 1918. When the bids were opened on this date the results were not satisfactory, principally because the bidders had not realized the full importance of the project and the dates of deliveries set in their estimates were far too distant.

At the first opening of bids, however, representatives of leading railway-equipment manufacturers of the country were present in person and over the conference table the plans were explained to them. They asked for time to go back to their plants to consult with their directors and accordingly a second opening of bids was scheduled for Feb. 13.

The coöperation of manufacturers in making the project possible was more than pleasing, and at the second opening of bids a number of favorable proposals were received. Among them was the offer of the Baldwin Locomotive Works to undertake the construction of the gun cars and locomotives on a promise to deliver them about June 15. Similarly the Standard Steel Car Co. offered to undertake the entire work of constructing the 72 cars that were called for. By distributing the order among its various plants it was able to promise delivery in from 100 to 120 days. After consideration of all the bids these two were found to be the most favorable and the contracts were awarded on the same afternoon. On the same evening work was commenced on the preparation of the material.

Every war seems to have its one outstanding achievement in speed. During the Spanish-American War all records were broken by the U. S. S. "Oregon" in steaming from the Pacific Coast to Cuba. In the Boer War the famous gun, "Long Cecil," was built at Kimberley in 23 days. In this war the first 14-in. railway mount was completed in 72 days following award of the contract, and 120 days following the commencement of the first preliminary designs.

From the moment that bids were accepted and the contracts awarded the fabrication of material moved rapidly forward. Of course a delivery schedule was laid down. The most optimistic man at the Baldwin Locomotive Works, S. M. Vauclain, vice president, made it out himself—only to have it broken. The first mount was scheduled for delivery on May 15, 1918. The first mount rolled out of the Baldwin shops complete and ready for firing on Apr. 25, 1918. The last mount was scheduled for June 15. The last mount was finished May 25.

There were no changes in design to delay construction. Plates for the girders were rolled at Pittsburgh and rushed to the American Bridge Co.'s fabricating plant at Pencoyd in special cars with navy men perched on top of them to see that they got through on time.

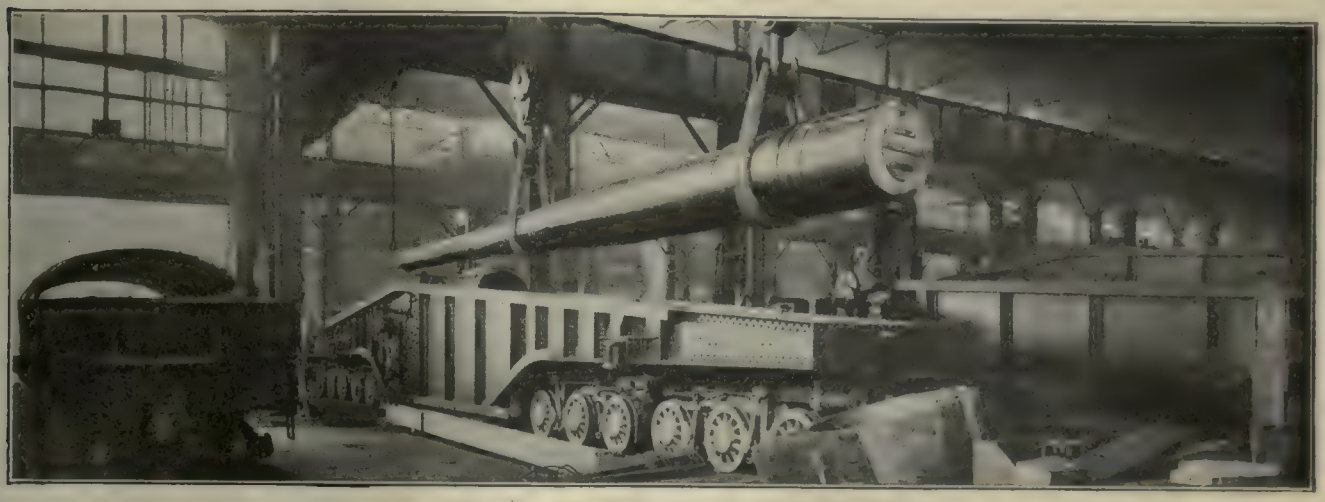


FIG. 10. GUN CAR IN BALDWIN SHOPS

At Pencoyd every available man went to work enthusiastically and the girders were fabricated in record time. The first girder unit was received at the Baldwin shops within one month after the order was placed. Meanwhile the work of constructing the trucks for the gun cars at the Baldwin plant at Philadelphia was progressing rapidly and at the Simonds Manufacturing Co.'s plant in Fitchburg, rolling of the armor plate was started. As fast as armor plate was completed and tested it was loaded on the Federal Express at Boston and brought through to Philadelphia without change of cars. The gun slide, deck lugs and elevating gear were machined by the Washington Navy Yard in record time, and where freight cars were not available to carry parts from the yard to Philadelphia auto trucks made the trip. In fact every conceivable method of transportation was used in seeing that material from contractors reached the Baldwin shops on time. Express cars, baggage cars, freight cars, auto trucks, special messengers and even suit cases were pressed into service.

While one end of the Baldwin shops was engaged in erecting the gun cars, as shown in Fig. 10, the other end was erecting the locomotives for the expedition. At the plants of the Standard Steel Car Co., located at various places throughout the country fabrication of the cars was pushed so that they too were finished in advance of their delivery schedule. In spite of a severe fire and a wind storm which destroyed a considerable portion of one of its large Western plants the contract was completed and the cars delivered by June 1. The start of a complete train of material from the Hammond, Ind., plant of the Standard Steel Car Co. destined for oversea shipment as part of the expedition made an interesting picture.

The naval bluejackets who were to comprise the operating personnel for the battery were selected from the men at the Great Lakes Training Station in February. Those who were to do the work of erecting the gun abroad and operating the train in France were trained in the use of the material by employment as inspectors at the various fabricating plants at work on the battery material. The crew which was to load, fire and actually operate the gun itself was trained by sending it to the Naval Proving Ground at Indian Head, Md., where it received a number of weeks' practical instruction along those lines.

On the morning of Apr. 25, 1918, the first gun car was completed and rolled from the erecting shop of the Baldwin Locomotives Works at Eddystone. After a few preliminary track tests the gun started on its way to Sandy Hook Proving Ground. It was necessary to use the Army Proving Ground at Sandy Hook, N. J., for the proof of this gun, as it was impossible to prove it at the Naval Proving Ground at Indian Head, Md. On the morning of Apr. 30, 1918, in the presence of a small party of Army and Navy representatives and foreign envoys the gun was fired from its railway mount. The test of the gun and its mount was eminently satisfactory in every respect.

Shipment of the Railway Mounts

General Pershing named St. Nazaire as the port of debarkation in his acceptance of the Navy's offer to furnish these guns for use with the American Army in France, and preparations to ship the guns to that port were immediately commenced. The shipment was not accomplished without difficulties. The first ship assigned for the work of transportation was badly battered by storms on her Western trip and forced into drydock for repairs. The second ship assigned was the "Texel," which was one of the first ships sunk by the German submarine U-151 operating off our coast. Finally, however, the steamship "Newport News," deeply loaded with material, sailed from Philadelphia on June 29, and other ships followed shortly thereafter.

The personnel for the naval railway batteries were

ordered abroad as soon as the port of debarkation was fixed and sailed immediately on a troop transport and arrived at St. Nazaire on June 9, 1918.

St. Nazaire has two great advantages for the erection of these batteries, namely, a 150-ton crane at one of the docks and French locomotive shops only a quarter of a mile away equipped with two 125-ton cranes. Outside of the locomotive shops there were a number of tracks available for the erection of the cars, etc., of the expedition and for the finishing touches on the gun cars after the heavy lifts had been accomplished in the locomotive shops. Two or three miles away were located the Montoir storehouses in which space was available for the storage of tools, material, etc., for the batteries. The 19th U. S. Engineers were located at St. Nazaire erecting locomotives for the American Expeditionary Forces. During the first week following their arrival the men of the battery were busy erecting barracks for their use, a site for which was obtained close to the erecting tracks. The barracks were made entirely by the bluejackets from scrap lumber from locomotive packing cases. The tracks on which erection was to take place were then rebuilt. A stationary boiler was borrowed, a leaky air-pipe line overhauled and compressed air for car erection made available.

After this work there was no navy work to do pending the arrival of the first shipload of material. But the men turned to with a vim that surprised everyone. Groups of mechanics were sent to the roundhouse to assist the force there; others went to help the 19th Engineers; still others went to work repairing the tracks in the yards, while switching crews were organized to clear up a congestion of work which had piled up and was delaying erection. The willing coöperation of the navy men and the spirit of "do what you can to lick the Kaiser" made them friends everywhere. It was more as a reward for the help they had given than anything else that the 19th Engineers cheerfully consented to lend one of their 35-ton steam-locomotive cranes for use during the erection of the navy material. But four of these cranes were available at St. Nazaire and all were in use. Without a crane rapid erection work would not have been possible.

The "Newport News" arrived at St. Nazaire on July 8. As the material was brought from the hold of the vessel it was taken to the erection tracks or storehouse and carefully placed in spaces previously laid out for it. A discouraging feature was that on the first shipload of material there were practically no complete units on which work might be started, and experience had shown that it was suicidal to attempt work on units for which all material had not arrived. The material had piled up at the Philadelphia Navy Yard until it was impossible to separate the ship units, and there was nothing to do but wait for the arrival of the second ship. The second and third shiploads of material both arrived on July 21, and erection work was on in earnest. One feature is worthy of special comment. The blueprints showing the assembly of all the cars of the expedition were sent by special mail from the United States so they would arrive at St. Nazaire amply in advance of the receipt of material that they might be studied. Whether they were on a ship sunk by submarine or how they were lost will probably never be known. The fact is they never arrived. New ones were ordered by cable from the United States, but by the time they were received the project was within a week of completion. The locomotives were assembled entirely without blueprints.



FIG. 11. LIFTING A GUN AT ST. NAZAIRE, FRANCE

The heaviest single lift for the crane was the gun girder. This was transported to the shops by placing it directly on the trucks, which had previously been erected, and hauling it on its own wheels. Only the heavy lifts were handled in the shops, as the cranes were in almost constant use by the engineers. As soon as the deck lugs and gun slide had been placed in a girder the gun was inserted in the slide, and the gun car was taken to the outside erecting tracks for completion.

The handling of the heavy 14-in. gun presented a problem. It was far too heavy for the light French flat cars, and as there was no heavy wrecking crane available a breakdown could not be risked. The difficulty was overcome by using the gun girder as a car on which to transport the gun, the gun being laid between the side girders. This operation is shown in progress in Fig. 11.

The car erection went ahead steadily on the outside tracks. Material had been placed so that a progressive movement of the cars was possible. The trucks were first assembled and the frames were then placed on them. The sides and roof of the cars then followed, and last of all the interior work. The task of erecting the gun cars was not nearly as difficult as the erection of the 70-odd cars for the expedition. On no car were there less than 500 rivets to be driven, and on one car there were over 1200. In this connection there was a handicap similar to the loss of the blueprints. Through some mishap the packages marked "rivets," on being opened, were found to contain stove bolts, and it was necessary to borrow rivets from all over France. As the only rivets available were in metric sizes, the cars

were put together with them. On some of the sizes for which no metric-sized rivets were available it was necessary to draw large rivets down to the proper size by hand. In spite of these difficulties, however, the erection of the cars was not delayed.

High-Pressure Work

All of the work was done under high pressure. There were insistent calls day after day from the front for the guns. They were needed, and needed at once. The response of the men to the call is worthy of the highest praise. The working hours were from 7:30 a.m. to noon and from 1:00 p.m. to 5:15 p.m., but when 5:15 p.m. came around the men would refuse to quit. In the long summer evenings in France it was possible to see up until almost 10 o'clock, and the men insisted on sticking to their jobs working steadily until it was too dark to see. It is principally to the wholehearted willing coöperation of the men that the remarkable record in the assembly of the batteries was made.

The first gun girder was unloaded from the ship and put in the shop on July 30. On Aug. 11 the completed gun car was ready to leave for the front in response to orders received from the French high command. With it there was a complete train of cars. The orders to leave were countermanded before the train started, however, and it was not until the 17th that the first train moved off. It was followed by train No. 2 on the 18th. The last gun car and its train left for the front on Sept. 13; the staff train was completed and moved on the 14th, on which day the barracks at St. Nazaire were evacuated and the storage house entirely cleaned out and turned over to the Engineers. The entire group of naval railway batteries was ready for action on the western front two days later.

Final Erection and Assembly

Designs started Dec. 26, 1917, and completed Jan. 25, 1918; contracts let Feb. 13, 1918; shipment commenced in June, 1918; final erection and assembly completed in France on Sept. 14, 1918, a total of 262 days from the date of the inception of the idea to its successful achievement, the naval railway batteries will stand for years as a record of a monumental task accomplished and will reflect undying credit on the officers and men who conceived, developed and forced the idea into existence. The Navy not only put into action the hardest hitting, the most accurate and the longest range guns in the war (merely excepting the German freak gun firing a 300-lb. shell in the general direction of Paris, sometimes hitting that city, sometimes not) but, as far as is known, provided the only high-powered heavy artillery used by the American Army in France up to the signing of the armistice.

The story of the operation of the naval railway batteries is a long one, and it will be told in due time. It need only be said here that the devastation wrought by their enormous shells of steel and high explosive hurled through the air at a velocity of 2800 ft. a second and falling at ranges up to 52,000 yd. (29.5 miles) exactly on the calculated target has brought forth the highest praise from all who observed their work, and from no less authorities than General Mangin and even General Foch.

Graphical Study of Screw Threads

By Capt. H. M. Brayton

Screw threads were among the early methods employed for holding machine parts together. Much science has been brought to bear upon this branch of engineering, and the result has been that a large number of threads have been designed for special purposes. It soon became apparent that some sort of standardization was necessary so that screws made in one shop would interchange with those made in another. As a result of the demand for standardization many civilized

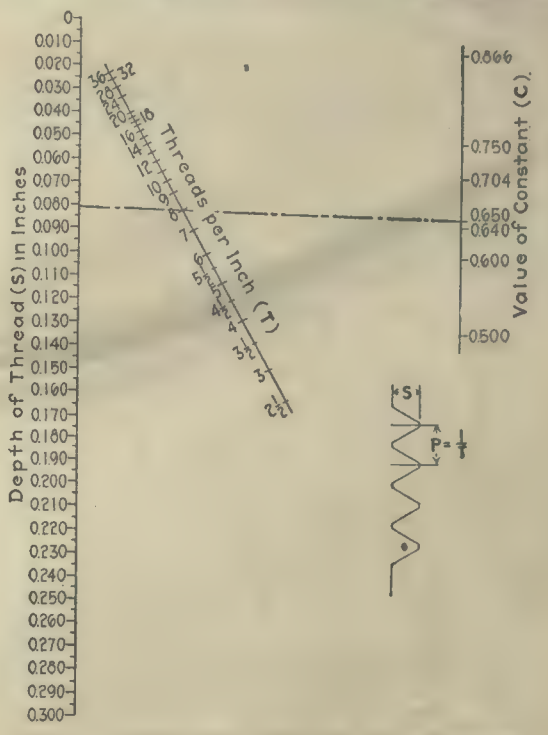


FIG. 1. CHART FOR DEPTHS OF THREADS

countries have adopted some form of screw thread, each standard differing in the various countries to a marked degree. The United States adopted the United States Standard; England the Whitworth thread, while countries on the continent of Europe selected the metric thread.

In the design of screw threads two important factors must be borne in mind—the strength of the thread and the ease of manufacture. A screw thread should be equally strong in shear, bending and tearing of the shank along the root diameter. Rules have been formulated giving the proper relation between the outside diameter of the bolt and the pitch of the thread to give the maximum of strength to the bolt.

It often happens however that a finer or coarser thread is desired for a special purpose, and in order to get the depth of the thread or the root diameter it is necessary to go through a rather tedious calculation. This depth of thread is often desired in the shop and in the drawing room. An example is when it is desired to tap a hole with a certain thread of a given diameter. The machinist desires to know the size of the drill he must use to give him a hole slightly larger than the root diameter of the thread on the tap. The designer needs to know again and again in the routine of his work what the depth of the thread is to be which he desires to

specify. If this happens to be an odd thread it will take much of his time to figure it out or look it up in a table, if he happens to have one at hand.

Fig. 1 shows a chart built up to solve at once the depth of any of the ordinary threads of domestic or foreign design. The depth of the thread is always a function of the pitch or the number of threads per inch. This function will vary only by a constant in all of the different designs. We may therefore write

$$S = \frac{C}{T} = C \times P$$

where S = depth of thread in inches;
C = a constant which depends on the design of the thread;
T = the number of threads per inch;
P = pitch of thread in inches.

The constants for the different threads listed are as follows:

	Value of constant
V-thread	0.866
Buttress or breech and German Lowenherz thread.	0.750
International Standard thread	0.704
United States Standard and French metric threads.	0.650
Whitworth thread	0.640
British Association Standard thread	0.600
Round, square and Acme threads	0.500

The sketch of the thread in Fig. 1 is self-explanatory.

is in knowing the depth of the thread. The chart shown in Fig. 2 enables one to read off at once this root diameter for any of the thread designs listed above. We have here to consider the outside diameter, the root diameter, the threads per inch and the constant which was used for finding the thread depth. This relation is:

$$D - d = \frac{2C}{T} = 2\,C \times P$$

where D = the outside diameter of thread in inches;
d = root diameter of thread in inches;
C = the constant;
T = the threads per inch;
P = pitch of threads in inches.

This chart is read by two lines perpendicular to each other as shown by the two dash-dot lines on the chart. The key shows how these variables are to be connected. In the illustration the constant has been taken at 0.704 and the threads per inch at 20. When these two factors are connected and a second line drawn perpendicular to this first line through the outside diameter of 0.25 in. it will cut 0.180 in. on the bottom scale, which is the root diameter. It is not necessary to draw these lines, but simply draw two perpendicular lines on transparent pa-

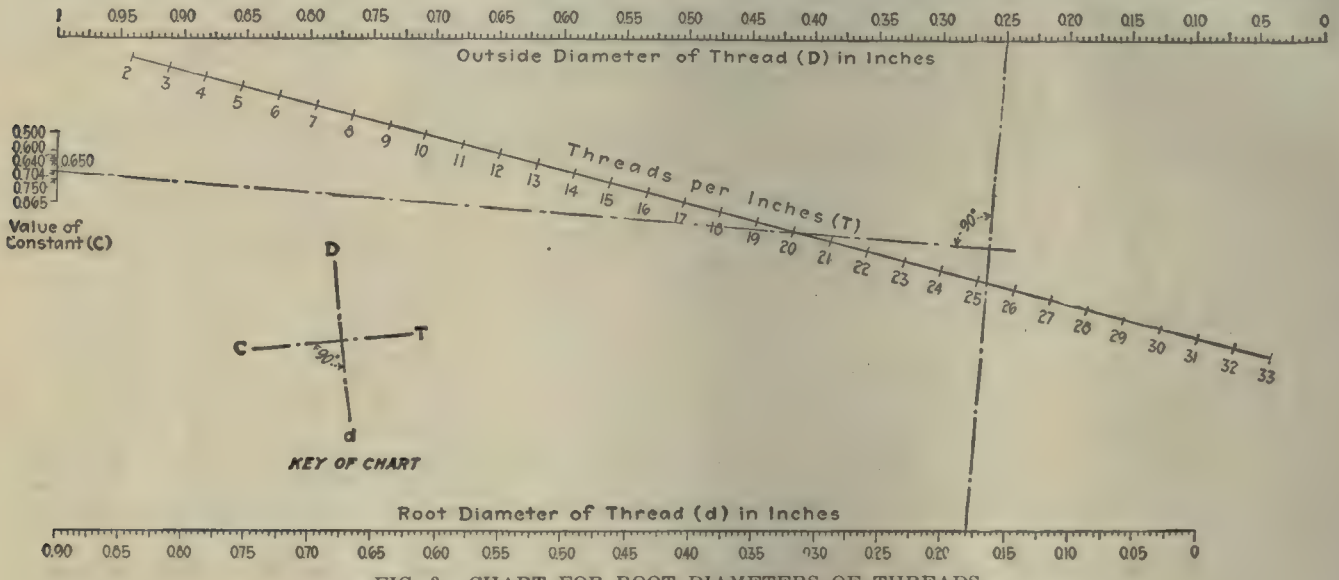


FIG. 2. CHART FOR ROOT DIAMETERS OF THREADS

To use this chart for obtaining the depth of any of these threads draw a straight line across the chart connecting the constant which applies to the thread under consideration with the number of threads per inch. This line continued will cut, on the left-hand scale, the depth of the thread (S). It is not necessary to draw this line, but simply lay on a straightedge.

An example has been taken on the chart as shown by the dash line in which the constant has been selected as 0.650, or that corresponding to the United States Standard and metric threads, and the threads per inch taken at 8. It will be noticed that this dash line continued cuts 0.081 in. on the outside scale. This is the depth of this thread. A feature of this chart is that the scale can be read within very close measurements. A designer can use this chart to good advantage and the practical shopman will find it an aid in explaining his screw-thread problems.

The shopman however is usually more concerned in knowing the actual root diameter of the thread than he

per and read the chart with this paper. Great accuracy is possible on this chart.

No consideration is here taken of the clearance that it is always necessary to allow in selecting a drill from the tap size. The amount of clearance varies for different classes of work and on different diameters, and this must be added to the root diameter read from the chart in order to give the proper drill size.

Repairing Celluloid Triangles

By P. P. Fenaux

In these days of the "high cost of drafting instruments" the following kink may be useful to those who drop their celluloid or composition triangles on the floor with disastrous results.

Clean both sides of the break with ether or alcohol, then coat with acetone, press together and clamp until thoroughly dry (one hour or so). Clean and smooth the break and the tool will be as good as new.

Extracts from Chordal's Letters

In this letter Chordal tells something about inventions and refers to a previous letter in which he wrote of two inventions that came to naught. The inventions told about in this letter are ones that have been outclassed or have lost out. Neither of them was accidental. They were the result of close application, study, hard work and perseverance. One received almost instant and world-wide recognition while recognition for the other was delayed years.

MR. EDITOR:

IN A late letter I told you something about Jimmerson and his two inventions, one of which became outclassed by something better before it got fairly going and the other of which lost its reason for existence because its product went out of fashion. Jimmerson was able to very promptly put his two inventions on the shelf and forget about them.

* * * But there are inventions which do not get promptly outclassed and which do not go out of fashion, and some of these inventions receive prompt recognition and others require years for recognition.

* * * For instance, Wilbur Wright and Orville Wright, two young inventors of Dayton, Ohio, received a prompt recognition. They invented the flying machine. It was no mere piece of luck which fell their way, for they were hard students. When they got the flying-machine bee in their bonnets they proceeded to master the literature of the art, an art which had been dallied with without success for centuries. They read all of the books and mastered all of the formulas and they tried experiments, and even went down to Kitty Hawk, N. C., where the winds blew favorably, and they tried their experiments there and found that they were misled by the books and they had to make over again many of their formulas.

* * * They left Kitty Hawk in disappointment, and went home doubting if they would ever resume their experiments. This was at the end of 1901, but the fall of the year 1902 saw them back in Kitty Hawk with a new machine, and in that year they flew, and today there are many thousands of flying machines in existence and there is a whole army of trained aviators who are flying these machines.

* * * Even at the beginning of 1911 Mr. Maxim and Mr. Hammer, writing in the World Almanac, said: "There are at least one thousand men flying today in heavier-than-air machines, whereas until the latter part of 1906 there were but two men who could fly, Messrs. Wilbur and Orville Wright, of Dayton, Ohio." But the point to be noted is that these two inventors received recognition with reasonable promptness.

* * * In 1907 the two inventors were tendered dinners and receptions by the Aero Club of the United Kingdom; by the Aero Club of America; by the Ohio Society of New York; by the Cosmos Club of Washington; by the Aero Club of Washington; by the Aeronautical Engineers' Society of Berlin; by the Aero Club of France; by the Aero Club of Rome; by the Aero Club of Sarthe, France, and by the Aeronautical Society of Great Britain.

* * * In 1908 the Aero Club of the United Kingdom awarded them gold medals inscribed, "For their pioneer work." In 1908 the Society for the Encouragement of Aviation awarded them gold medals. In 1908 the Aero Club of America presented them gold medals with a resolution expressing the club's "felicitations on their great achievement in devising, constructing and operating a successful man-carrying dynamic flying machine." In 1908 the Aeronautical Society of Great Britain presented them with gold medals, "in recognition of their distinguished services to the science of aeronautics."

In 1908 the Smithsonian Institution awarded them the Langley medals "for advancing the science of aerodromatics in its application to aviation by their successful investigations and demonstrations of the practicability of mechanical flight by man."

In 1909 the Aero Club of Sarthe, France, presented them with a bronze group inscribed "Like bird. The muse of aviation showing to the first birdmen the secrets of flying."

In 1909 the French nation awarded them gold medals and made them chevaliers of the Legion of Honor.

In 1909 the Academy of Sports of France awarded them gold medals inscribed, "The two conquerors of the air who were the first to fly with a machine heavier than air driven by a motor."

In 1909 Congress awarded them gold medals inscribed "in recognition and appreciation of their ability, courage and success in navigating the air."

In 1909 the Legislature of the state of Ohio awarded them gold medals.

In 1909 the Academy of Sciences awarded them gold medals.

In 1909 the city of Dayton, Ohio, presented them with gold medals "In recognition and appreciation of their success in navigating the air," and they were also presented with the keys and the freedom of the city of Dayton.

In 1909 the city of Le Mans, France, presented them with gold medals.

In 1909 the International Peace Society awarded them bronze medals.

In 1909 the Royal Technical College of Munich, Bavaria, conferred upon them the degree of Doctor of Technical Science "in acknowledgment of discoveries, advancement and elucidation of rich consequence in the problems of flight."

Colleges conferred on them the degree of LL.D. and they were made honorary members of the Aero Club of America, the Aeronautical Society of America, the

Aero Club of the United States, the Aeronautical Society of Great Britain, the Oesterricheschen and the Flugtechnischen Vereines. The International Aeroplane Club of Dayton, Ohio, "in recognition of valuable contributions to the science of aerial navigation and conspicuous achievements in demonstrating the practicability of the airplane," and the Society of German Aeronautical Engineers presented them with a diploma "in acknowledgment of their pioneer services in the advancement of the techniques of flight."

* * * The world was not long in recognizing the fact that these men had done something. One day, long before we thought of war, I asked Wilbur Wright if he and his brother had ever given any thought to the military aspect of the invention and he answered that the use of the flying machine for war purposes had been one of their main thoughts, as it would open up possibilities of observation which might change the course of war. Poor Wilbur Wright died before the United States entered the war, but after the European war began he expressed himself in holy horror at the ungodly use to which their invention had been applied. It is to be observed that in 1909 the International Peace Society had awarded them bronze medals.

* * * This reminds me that the two brothers were really team workers. If you asked Wilbur Wright about some point in flying-machine construction he would answer, "I would want to consult with my brother Orville before reaching a conclusion on that subject," and if you would consult Orville Wright about some point in flying-machine construction he would answer, "I will have to see my brother Wilbur about that."

* * * Another side of the question of recognition comes to me. One summer day in the late seventies I was lying on the grass with George H. Corliss on the terraces in the shop yard, and he had been reviewing to me the history of the Corliss engine. He said to me, "Mr. Chordal, do you know anything about the Montyon prize?" I answered that all I knew was that it was a prize given in France for extraordinary accomplishments. He gave a peculiar sort of a whistle and a boy sprung out of the office and Mr. Corliss said, "Boy, Mr. Rainsford." Mr. Rainsford was, I believe, the secretary of the company and was Mr. Corliss right-hand man. Mr. Rainsford came out of the office and Mr. Corliss said, "Mr. Rainsford, the Montyon prize." Mr. Rainsford went to the office and returned with a formidable-looking engrossed parchment which he handed to Mr. Corliss and then departed. Immediately there was the whistle, and the boy, and the order, "Boy, Mr. Rainsford." Rainsford approached and Mr. Corliss said, "Rainsford, the bag of gold." Mr. Rainsford disappeared into the office again and came out and approached us with a chamois-skin bag full of gold and hied himself to the office again. Then Mr. Corliss handed me the document and the bag of gold and said, "Mr. Chordal do you read French?" I answered that I did not, and there was again the whistle, and again the boy, and again the order, "Boy, Mr. Rainsford." Mr. Rainsford again approached and Mr. Corliss said, "Rainsford, translate this for Mr. Chordal."

* * * The document was an award to George H. Corliss for some masterly invention advancing the mechanical arts. Mr. Corliss untied the bag and dumped the gold into my hat and we took a good look at it and then he put it back in the bag. He asked what I thought of it and I said that I thought well of it and I hoped that I would live long enough to have something of that kind said about me. Then he said, "Look at the date. Do you know when I got up my engine?" I answered that I believed it was in about 1859. Then he said, "It has taken that French Society 20 years to find out that I have done anything." He whistled again; the boy approached. "Boy, Mr. Rainsford." Mr. Rainsford approached, and Mr. Corliss said, "Rainsford, take the Montyon prize away."

Very respectfully,
CHORDAL.

French Women's War-Service Costume

The costumes for women workers, herewith shown, will no doubt interest those employing or about to employ female help. This is the type of dress that is



FRENCH WOMEN'S UNIFORM

worn by the women in the National Projectile Factory of France.

The group is a mother and her two daughters. Incidentally, it may be stated that they are all capable machine operators and are now working on American-made Gisholt turret lathes, which should convince those who are hesitating that it is possible for women to operate the heavier types of machine tools as well as the lighter ones.

Present Practice in Thread-Gage Making*

By FRANK O. WELLS
President of the Greenfield Tap and Die Corporation, Greenfield, Mass.

Many difficulties are experienced by manufacturers of thread gages in their efforts to maintain accuracy and standardization and at the same time meet the demands of increased production. The process of cutting threads in the lathe requires expert manipulation. Errors in the lead screw should be corrected and a good cutting tool correctly held is essential. Approved methods of thread lapping, grinding and testing are described. The question of tolerances is important. Unreasonable and useless accuracy of gage tolerance complicates the making and increases the cost of thread gages. The author recommends a set of values for medium tolerances. The figures are not too close and are offered as applicable in most practical cases.

THE manufacture of thread gages brings in all the difficulties of any thread product multiplied according to the degree of accuracy required. The usual methods of making threads must therefore be refined and improved, and at the same time standardized for manufacturing purposes. The maintenance and development of good methods of gage manufacture are also affected by the same disturbances that affect all manufacturers these days, including unevenness in steel material, delays in shipments and in machine arrivals after orders are placed, and, most of all, difficulties with labor.

To maintain and even to increase the accuracy and standardization of product, as is specially demanded, is no easy task, but it is being done by paying careful attention to the troublesome points.

Given the blank for a thread plug gage, centered and turned, the real trouble begins with chasing the thread. A lead screw should be as accurate as the product to be turned out by it. Errors in lead screws are of two kinds—errors in lead over a considerable length of the screw, and local errors from thread to thread. If, as is often the case, the lead screw was made from ordinary work instead of for precision work its lead or pitch will be irregular to a greater or less extent. The total deviation of the lead screw must then be determined, and the lead-adjusting attachment, Fig. 1, set to give the correct compensation.

The thread cut on a soft gage must always be slightly different from standard or finished pitch by an amount equal to the expected change during hardening. This correction must also be made by the lead variator.

Adjusting attachments like that in Fig. 1 compensate fairly well for errors in the lead screw which are constant at any part of its length. They do not, however, take care of the trouble of "high and low" threads. In lathes used for thread-gage chasing the lead screw ought to be well-nigh perfect from thread to thread, and the ways of the lathe should be scraped accurately parallel and level so that the head and tail centers will be in line.

Given a fairly good lead screw the next mechanical necessity is a good cutting tool correctly held. Such tools, with removable cutting blades, are shown in Figs. 2 and 3, one for inside and the other for outside chasing.

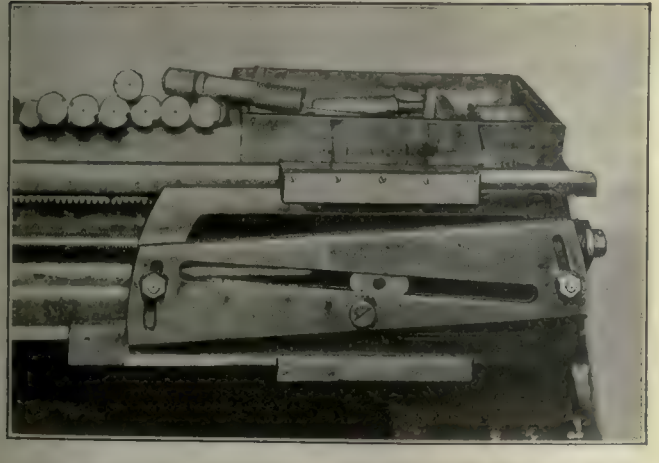


FIG. 1. LEAD-ADJUSTING ATTACHMENT FOR LATHE

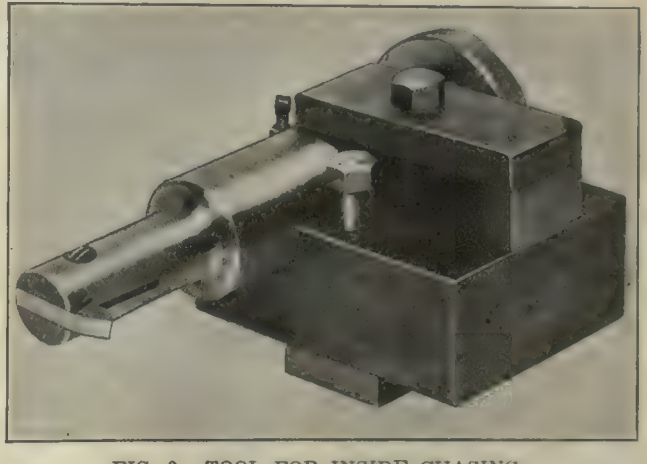


FIG. 2. TOOL FOR INSIDE CHASING

It is a question whether a single cutting tool or a multiple-toothed chasing tool is better for this work. The fixture for grinding the cutting points is also shown in Fig. 4.

The threading-tool blades in Figs. 2 and 3 are made to cut on a 20-deg. clearance angle. This clearance angle makes the actual included angle of the tool blade normal to the straight cutting edge of the tool blade 63 deg. and 8 min. The thread groove cut by a proper threading tool should preferably be from 15 to 30 min. sharp in order to facilitate the lapping operation. For all ordinary United States Standard pitches the threading-tool blade is set with its axis at right angles to the axis of the gage. It is only for Acme or similar very coarse thread work that it is necessary to incline the

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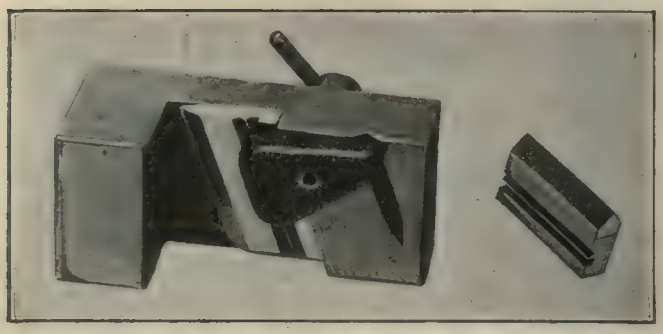


FIG. 4. FIXTURE TO SHARPEN TOOLS USED FOR CHASING

threading blade to a line parallel to the helix angle of the gage being threaded. When this helix angle is very steep it is necessary to modify the included angle of the cutting edge so that the angle cut on a plane with the axis of the gage will be as required by specification.

A clearance channel is universally acknowledged desirable in a thread gage so that no chip lodging in the gage will bind between the gage and the thread crest of the tested thread and give a mistaken impression of a close fit.

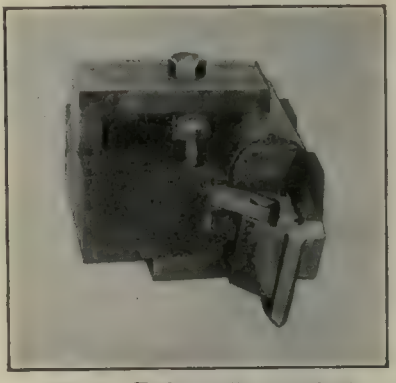


FIG. 3. TOOL FOR OUTSIDE CHASING

There is great difficulty in getting men who are good at threading. Good threaders seem to be born, not made. The work requires a combination of brain, mechanical ability, sensitive touch and, above all, patience. Some otherwise good mechanics can never make good threaders. A green man with a phlegmatic temperament is a likely candidate for development. Few girls can be developed into handling fine threading—it requires just a little more mechanical sense than any appreciable number have had time to acquire. The Government should be careful about taking men from gage-threading lathes, especially when on the same day another branch of the Government may send an urgent appeal to increase or even double the production of gages.

With good men, fair lathes, the best cutting tools and the exercise of constant care, threading of gages down to a limit of accuracy which falls within the variations due to hardening can be accomplished. If a perfect contour of thread and perfect angle, lead and walls could be obtained when threading in a lathe it would not be necessary to leave more than 0.0002 to 0.0006 in. over size, knowing that hardening would increase this to from 0.0015 to 0.0020 in. Due to irregular swelling, shrinking and warping from thread to thread in the hardening, however, a certain amount of stock must be left on so that no point of the gage will be distorted outside of the limits of the metal. If the thread, for instance, should take a quirk to the right so that its center line was displaced at the top of the crest by 0.0009 in. and the metal had been left 0.0015 in. larger than finished size the reduction to finish could be made and still leave a complete crest. Since a margin must be left for the vagaries of hardening, the necessary tolerance in lathe threading can probably be obtained by the precautions noted.

Formerly it was common practice to make the outside diameter of limit plug thread gages uniformly oversize in direct proportion to the oversize of pitch diameter. This practice was wrong because of the danger of the maximum, or no-go, plug forming contact on the outside diameter of the tapped hole and yet giving no indication of the actual size of hole on the pitch diameter or the thread walls.

In view of the go and no-go plugs being over basic, or maximum, screw size they should both be provided with a minus tolerance below the minimum tapped-hole outside diameter in order that the gage will positively check the angular diameter. This can be done, since there is no danger of the screws forming contact with the outside diameter of the tapped hole.

Manufacturing Government or priority war orders marked "Rush" entails some trouble in that the orders cannot be scheduled in the most efficient, sensible and, in the end, speediest way. There is really no reason why all orders calling for the same outside diameter and same length over all should not be grouped in turning, and in this way enable the operator to run enough blanks through so as to cover the orders for various pitches. Again, in the thread-lathe room gages of the same number of threads per inch, but differing by one or two thousandths in pitch diameter, could be chased out as members of the same group. They could be run through with one setup of the lathe and save on the average 30 per cent. of the cost of the same orders ungrouped. Since small similar orders like this, varying only by differentials, constitute about half of the output of the gage factory such a grouping would save about one-sixth of all of the expense of the department as conducted under present methods.

The reason that this cannot be done now is that when a rush priority order for say two $\frac{3}{16}$-in. 24-thread gages comes in it has to be routed, started, put through

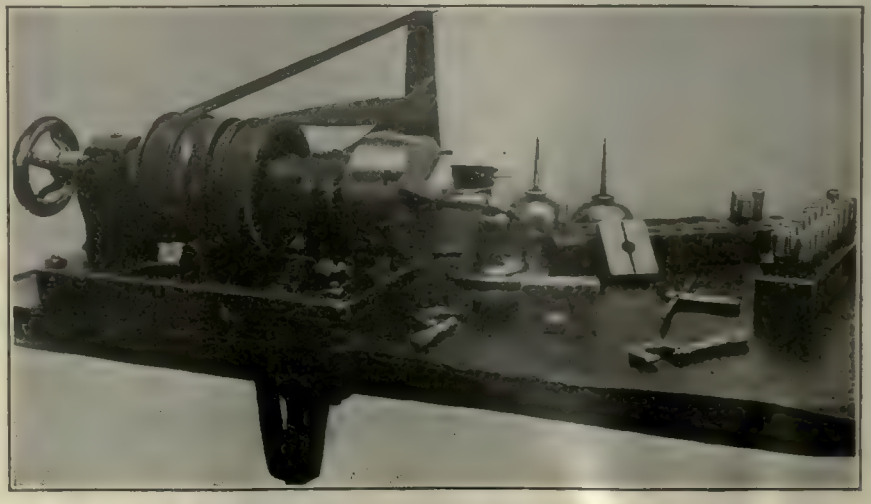


FIG. 5. THREAD PLUG GAGE LAPPING MACHINE

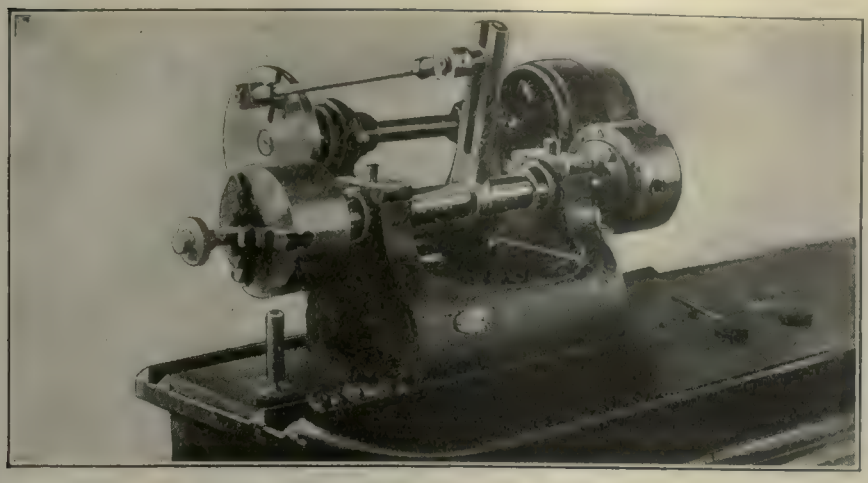


FIG. 6. DOUBLE LAPPING MACHINE

and finished at once. Then, if the next A1 priority order is for eight pieces of 3-in. eight-thread gages, these must immediately follow, without waiting for another small size which might be done with the same setting of the lathe and which perhaps is equally important but which happened to come in a little later. If a batch of the same size were put through all at once so much time would really be gained that the succeeding orders meanwhile sent in by the Government would be done considerably sooner in the long run and the Government be much the gainer in aggregate time.

Accurate micrometers or gages should be constantly used over all parts of the thread while in process, and accurate lead testers and gages should be constantly on hand in the workroom itself.

The hardening question has always been the bane of threading. A series of tests made some time ago by laboratories of manufacturing firms throughout the country demonstrated that threading on taps and dies can be got down to any reasonable limit of accuracy, but this is not true of hardening. The inaccuracies in taps and dies manufactured by quantity methods in general appear after hardening and are not present in the soft product. The same is true of gage threads, only the error in this case is of more importance on such fine work.

During the process of hardening there is in the majority of cases an increase, or swelling, in diameter and a shrinkage in length, resulting in a shortening of lead, but the extent to which this occurs will vary in different pieces. Even with the quenching bath and the temperature of the furnace kept uniform the swelling in diameter in one set of duplicate samples of about an inch in diameter varied from 0.0008 to 0.0024 in. and the lead error varied from 0.0005 to 0.0025 in.

The only way to control this is to find a heat treatment and a quenching bath that will always give the same expansion and contraction under standardized methods of working and dipping, then see that the handling methods actually are standardized. And not only must uniform handling methods be followed, but the steel must be of uniform quality. For this reason it is necessary to have a supply of steel from which any piece may be taken and relied upon to act like every other piece. If such steel cannot be secured from the steel men it is advisable to get the most uniform brand available and then standardize it still more by heat treatment.

In general the best hardening method adaptable for gages can be described as follows: Ascertain the lowest heat which will give the proper depth of carbonization in a reasonable time; next ascertain the heat at which the gage will properly harden upon quenching and maintain these two features within the closest possible limits of uniformity. What has been said previously regarding the brand of steel will remain true.

If the lathe work has been done correctly and the hardening without distortion the thread can be smoothed to a finish by lapping off not much more than 0.0002 in. Under ideal conditions this would be the amount of oversize that would be specified for gages coming into the lapping room. A much neater and quicker job of cleaning the thread to size could then be done, and the cost of lapping would go down.

However, not only excessive oversizes but distorted pieces come into the lapping room. The lapping process can to a certain extent take out these inequalities as well as smooth the surface of the chased thread. It should be emphasized that the lapping process is not for this purpose and that every correction that has to be made in the lapping costs excessively and slows up

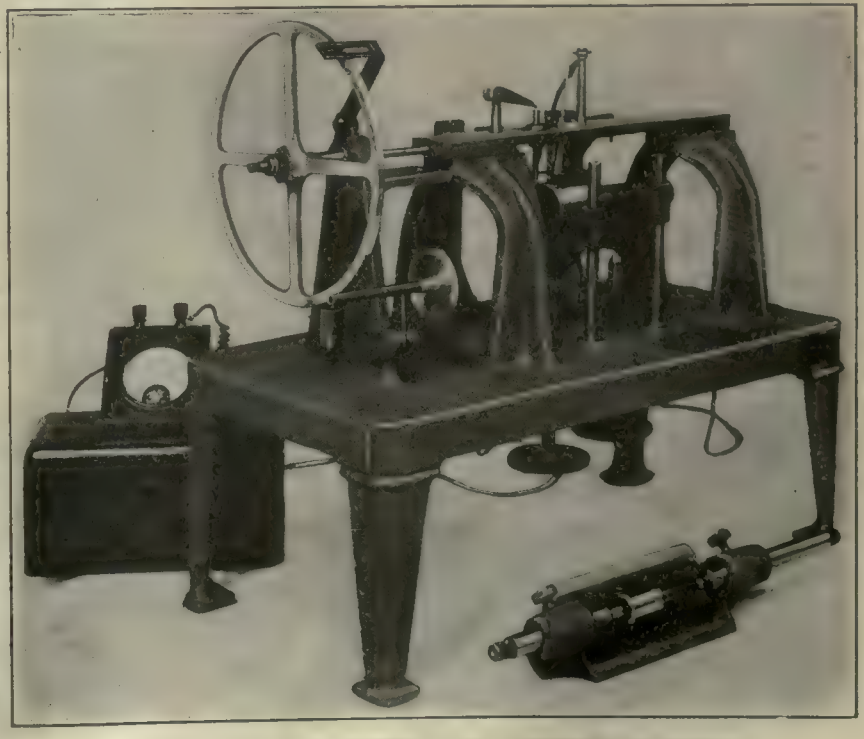


FIG. 7. BINGHAM-POWELL LEAD-TESTING MACHINE

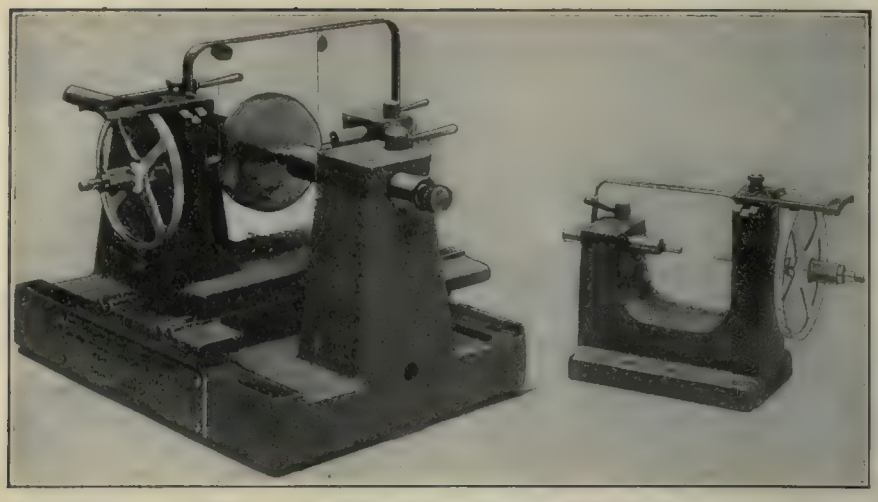


FIG. 8. MACHINE FOR TESTING PITCH

the other work. Lapping should not be depended upon to do correcting, but the threading should be in correct shape before reaching the lapping room.

If the angle of the thread is slightly too wide or narrow or tipped to one side a skillful lapper can correct it. If the lead is a trifle too long or short the lap can take it back to the proper length by wearing the surface off on one side or the other of each thread. If the pitch diameter is too large it can be worn down. But there is a limit to the amount that can be worn off by hand-applied friction, using the general form of thread as a guide, and still retain an accurate contour. It is practicable to take off a total of 0.0015 by lapping without spoiling the shape if it is done carefully on only one gage. Therefore, allowing part of the overstock for smoothing, if the errors are not cumulative or all in the same direction it is possible in lapping out 0.0015 in. oversize in diameter to take care of an error of 0.0005 in. in lead and 15 min. one way or the other in the angle.

Two forms of lapping machine for thread plug gages are shown in Figs. 5 and 6. In the best plug-lapping machines the plug is mechanically rocked back and forth through a fraction of a revolution while the operative holds the lap still in one hand, encircling the plug. Since the operative might as well be using both hands a double-ended machine is provided, Fig. 6.

Soft-steel laps are most easily chased out smoothly and are the most durable. Some prefer cast-iron laps, however. The lap is an important part of the work and must be threaded more accurately than the gage which it is to correct. Flour of emery makes the most satisfactory lapping medium for thread gages, particularly for lapping the thread walls. Fifteen-minute carborundum is satisfactory for lapping outside diameters. Sperm oil makes the most satisfactory medium for carrying the abrasive, chiefly because of its non-gumming quality and at the same time having more body than kerosene which is quite commonly used. As a thread gage can be no better than the lap which finished it, it stands to reason that laps must be made as accurately as possible; therefore to get the most use out of a lap the threaded work that is ultimately to be lapped must also be made accurately. It is not profitable to leave any more corrective work for the lap to do than can be avoided. As the lap is of soft material very little pressure applied in a false direction will be sufficient to ruin it. Girls may be used on lapping if those with level heads and the requisite sense of touch are selected.

Inspection instruments, including a sufficient number of gages, a projection apparatus, and micrometers should be on hand in the lapping room for the use of all employees, who should be trained to use them and to interpret the measurements.

Grinding out inaccuracies in large-sized threads is more expeditious and cheaper than lapping them out. Grinding threads becomes difficult, costly and impracticable, however, below a certain minimum size, in general, for the following reasons:

In grinding out a V-thread as near as feasible down to the theoretical triangular point, as is done in thread gages, there is intensified friction on the delicate edge of the wheel, and it wears away very quickly. It could not be used at all were it not that the extreme edge of the wheel does not have to be maintained absolutely sharp.

On all practicable manufactured screw threads upon which the gage is to be used, whether United States Standard, International or Whitworth, at least the top eighth of crest is flattened or rounded off. Therefore, although the profile of the gage thread must be kept accurately straight along seven-eighths of the wall, the remaining eighth in the extreme root can be allowed to become a little rounded off, since it will not engage any



FIG. 9. PROJECTION LANTERN FOR CHECKING SILHOUETTE OF THREAD



FIG. 10. PROJECTION MACHINE FOR CHECKING CONTOUR OF THREAD

part of the thread, but will be used as a clearance space. Now an eighth of a large pitch on a large diameter gives the wheel edge considerable margin for wear. The absolute length of this margin decreases toward the point in proportion as the pitch from thread to thread decreases, and soon the point is reached where the allowable eighth margin at the edge of the wheel wears away too fast for practicable replacement of wheels. One wheel should do at least one complete gage before needing to be trued at all, since the wheel cannot be taken out and put back in the same place with any success. This margin of wear on the wheel is now generally reached at a pitch of 16 threads to the inch, so that most gages below $\frac{5}{16}$-in. pitch diameter have at present to be lapped out instead of ground.

There are other difficulties in the way of grinding small threads. On the average the best thread-grinding wheel is about No. 150.H, as we find in our own work. For the grinding process from 0.003 in. to 0.008 in. of stock should be left on a thread gage to enable the operative to set his wheel in the center of the thread by adjustment and trial and also to permit him to correct inequalities in lead, angle or diameter due to hardening.

Out of 0.003 in. of stock he can increase or decrease the lead by 0.001 in. if the angle is already correct. Similar corrections in the other dimensions may be effected. Work coming from the grinding room is then lapped smooth before it goes to the inspection room.

Inspection in gage manufacture assumes an importance that it has in hardly any other branch of work. This is still more true of thread gages. The many dimensions that are on an apparently simple product require close attention to each separately and to all together.

To test the lead the Bingham-Powell machine is a good instrument. The method of holding the gage, the micrometer wheel and vernier and the electric telltale that indicates proper contact of the measuring fingers and the thread are shown in Fig. 7.

A testing machine fitted up with a slide rest in parallel so that only two wires are necessary is good for measuring pitch diameter by aid of a micrometer reading. This machine is provided with two removable tables, one for large work and one for small, Fig. 8. To test the micrometer a set of Johansson blocks should be on hand, and finally to resolve immediately any doubts one might have as to the accuracy of a particular block or measurement a good measuring machine should be on hand. Tenths and hundredths of thousandths are elusive things, almost imaginary, impalpable and invisible. A man traveling down among them and coming upon any doubt in his own mind as to his exact location is like a man lost in a wood, and it is necessary to follow the old prescription of wise travelers to always carry two compasses or two watches. If one is assailed by a sudden doubt that one may be wrong, look at the other. If they both say the same thing, one feels that it is a million to one that they are both right and he can go ahead.

To examine the contour of the thread, its angle, root, crest and smoothness of wall a projection machine, Figs. 9 and 10, is the only proper thing. It gives an enlarged silhouette of the thread, which speaks for itself, for the profile can be compared with pattern gages held upon the screen as in the illustration. The silhouette can also be photographed for transmission to a customer by inserting a film or plate instead of the ground glass. Mechanism is provided for holding the gage, for focusing it and for turning it to the helix angle so as to get a symmetrical projection of the walls.

Sulphur casts of female threads can be taken in quick time and at small cost, and the contour examined in the same quick way. The method of pouring the melted sulphur into a molding frame held against part of the thread so as to get enough of it to give contour and lead is shown in Fig. 11.

A great difficulty in the manufacture of thread gages is the unreasonable and useless accuracy of gage tolerance and wear allowance sometimes requested by purchasing firms. When a tolerance of 0.0002 in. is set on a gage specification it should mean that the cus-

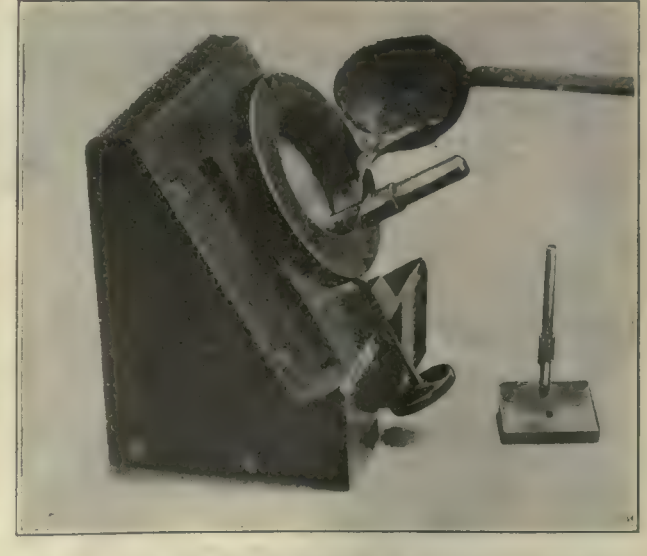


FIG. 11. MACHINE FOR INSPECTING FEMALE-THREAD TOLERANCE ON GAGES

tomer's tolerance on product is as close as 0.001 in. If the purchaser's manufacturing tolerance is any broader than that there is no use in keeping the gage so close. A 0.0002-in. error would be lost in the comparison. In order to facilitate the making and to lessen the cost of thread gages it is well to allow quite liberal tolerances in their manufacture, and we recommend the following as being applicable for most cases where medium tolerances are allowed on product: From 4 to 6 pitch allow a tolerance of 0.0006 in.; from 7 to 18 pitch allow a tolerance of 0.0004 in.; from 20 to 28 pitch allow 0.0003 in.; from 30 to 80 pitch allow 0.0002 in.

Checking the Effective Size

The foregoing applies to master gages. For inspection gages the tolerances would be slightly wider, and would begin where the master inspection gage tolerances leave off. These would be as follows: From 4 to 6 pitch a tolerance of 0.0009 in.; from 7 to 10 pitch, 0.0006 in.; from 11 to 18 pitch, 0.0004 in.; from 20 to 28 pitch, 0.0003 in.; from 30 to 40 pitch, 0.0003 in.; from 44 to 80 pitch, 0.0002 in.

All of the foregoing tolerances would be applied plus in the case of go male gages and no-go female gages, and minus on no-go male and go female thread gages.

The plus and minus tolerances given apply to pitch diameters of all thread gages and also to root or core dies of templets or female thread gages.

The maximum, or go, templet gage represents the maximum or basic screw, and its manufacturing tolerances should be minus on pitch diameter and root diameter. The minimum, or no-go, templet should be made to plus tolerances with an extra plus allowance on the root diameter, which will insure this gage really checking the effective size of the screw.

There is no need for a manufacturer to require every gage made to the finest point possible if he would not want to hold himself to the corresponding tolerance in his own product. People sometimes do not stop to think that to measure down to 0.0001 in. one must use exquisite care as to cleanliness, vibration and control of temperature between master and part. A change of a few degrees in temperature, etc., will add a couple of tenths to a fairly small piece without warning.

The wear and adjustment tolerance on a gage should be coarse or fine on a sliding scale according to the manufacturer's tolerance on his product. If a tolerance of 0.0002 in. is really necessary, all well and good; but if it should not be necessary it slows down gage production too much to be at all popular.

An Improvised Tumbling Barrel

By E. Amos

On a recent expedition in search of ideas the writer (to whom ideas do not come naturally as to some more fortunate individuals) saw what to him was a new departure in the way of tumbling "barrels."

A part of a certain shop's product is comprised of small pins, studs and special rivets which are made principally on automatics, these pieces being afterward tumbled in sawdust for the double purpose of cleaning them and of removing any small burs and ragged edges that may be left by the cutting tools.

Because of the small size of the parts it would be impracticable to use any commercial size of tumbling barrel, as a lot of 1000 or even 5000 pieces would be so insignificant in bulk as to be lost or overlooked in such a barrel; it was therefore up to the mastermechanical mind to provide a substitute, and the cut and following description show how he did it.

A pedestal that was part of a discarded machine was used, which had two bearings at the top for a small horizontal shaft. The shaft is perhaps $\frac{9}{16}$ or $\frac{11}{16}$ in. in diameter and has at one end a pulley for the driving belt and at the other a cast-iron flange 3 or 4 in. in diameter. The hubs of pulley and flange serve as collars against their respective bearings to prevent undue end movement of the shaft.

To the flange is attached, open side outward, an ordinary rectangular wooden box—not just any old



A TUMBLING "JARREL"

box, for it must be just right in dimensions, but one that can be built by anybody with a saw, a hammer, some nails and a few minutes' spare time.

The "inner chamber" of this apparatus is an earthenware crock, or jar, of the kind whose habitat is the eastern end of Massachusetts, and whose life is usually dedicated to holding "Boston baked" while in the oven. The wooden box before mentioned is made of just the right size to receive the jar without allowing it any room to move or shake about.

With the charge in the jar the latter is set in an upright position in the box, a swinging strap pivoted on the sides of the box is let down and a wooden wedge inserted to prevent the jar from working out, the belt is put on the driving pulley and the "barrel" turns merrily end over end as long as desired.

The work cannot get out of the jar, for the end of the close-fitting box keeps the cover on, and the jar cannot get out of the box as the only open side is closed by the strap and there is no real tendency for the jar to get out that way, anyhow.

To recharge the barrel, stop the box, turn the jar to an upright position, swing up the strap, take out the jar and substitute a freshly filled one. The whole thing can be done by one man in 10 sec. without even taking off the driving belt, as the latter drives directly from an overhead shaft, no pulley being needed. Simply grasping the revolving box with the left hand will cause the belt to slip while the operator changes the jar with his other hand.

Reasons for Consolidating the American Engineering Professions

By A. D. FLINN
Secretary of the Engineering Council

THE organization of engineers in America is chaotic, complex and illogical. As consequences there are confusion, waste, inefficiency and dissatisfaction, which, however, are exaggerated in some minds. If no associations existed it would be relatively easy to plan and create a system of organization that would satisfy demands much more effectively than does the present multiplicity of unrelated societies. But there have grown with the years traditions and loyalties and prejudices clustering about the societies that now are. An answer to the problem thus created is not easy. To me the solution is not obvious, but some progress in the process is now appearing. There must be extensive consolidations, more federation and much simplification, each of which demands elimination. Steps are being taken, or preparations made for them, in various ways and places and by a number of agencies. They will be accelerated as their benefits gain appreciation; but education, time and patience are needed for attaining the goal.

The Problems Confronting a Consolidation Scheme

What are the present desirable limits to consolidation and federation? To what goal should they tend? By what methods and means can they best be brought about? These and similar questions are not being answered conclusively because the necessary facts are not in hand. We have been muddling along in an unengineering fashion, attempting to plan and design and specify without a survey. On Sept. 12 Engineering Foundation by formal vote proposed to make the much needed survey and preliminary studies, the four Founder Societies concurring. Of the necessity for this survey I have been more deeply convinced with the passing weeks, as I have listened to ineffective arguments and to misstatements based on ignorance which can be corrected only by the results of the proposed survey of engineering organizations.

Without the enlightenment of such a survey it now seems that the following elements of organization are desirable for the engineering profession in America: Excepting possibly three or four cities having large numbers of engineers there should be in each community having a sufficient group of technical men to be organized one organization that embraces them all. Reasons for this are obvious. This organization may be an association of local societies and sections of national societies or it may be a society admitting to its membership men of all branches of the profession. Examples of both forms of organization exist in a number of places. Local organizations should have large measures of autonomy, but should conform to approved types and standards.

Logically the next step in organizing would be the combining of these local organizations into one or a few national societies, so that the loyalty, interest, comradeship and activities naturally developed by the local organizations would flow to the national societies. But at this step the difficulties increase. Many engineers cannot become active members of local organizations because of distances from headquarters; others do not desire local membership. If there were only one national society many of the difficulties of scheming a system of organization would disappear, but there are, and probably for some years will be, several national societies of importance, and in each local organization there will be members of two or more national societies. A number of plans have been submitted to me for overcoming these difficulties. None is wholly acceptable. These problems lie at the bottom of the tasks of the committee on development of the American Society of Civil Engineers and of the committee on aims and organization of the American Society of Mechanical Engineers and similar committees which may be appointed by other societies. Many engineers are giving them earnest thought.

There are said to be approximately 400 organizations of engineers in America of various kinds. Of these about one-quarter are the leading national societies and their local sections. In general the remaining societies have no official relationship, excepting the associations of local societies and sections in a few communities. Consequently the engineering profession, before the public and Government, has no one organization which represents it as a whole, as have the medical profession, the lawyers, the chemists, the architects, the Chamber of Commerce and even labor. In the memberships of the Founder Societies, aggregating 35,000 engineers, there have been variously estimated to be only one-third to one-sixth of the total number of engineers in the country. The engineering profession lacks solidarity.

Engineers Have Exceptional Facilities

Not a little of the dissatisfaction voiced in various quarters as to the shortcomings of the national societies grows out of ignorance or lack of apprehension of benefits actually received. In no small measure the complainants are at fault in not making better use of the facilities provided and the means of information put within their reach. Furthermore some important benefits of membership in large technical societies are intangible and not capable of definition; not a few persons overlook these. Nevertheless there are causes for reasonable dissatisfaction. The societies are endeavoring to remove these as they are recognized and remedies can be found. Humanity and its institutions will never be wholly rid of dissatisfaction, and to this truism engineers are no exception.

In this connection a quotation from the presidential address of Charles T. Main to the American Society of Mechanical Engineers, December, 1918, is of interest.

In the *Monthly Bulletin* of the American Institute of Mining Engineers, March, 1918, there appeared the following: "The vision dwells in the minds of many that ultimately these four great societies, lightening the emphasis they place upon their differences, may see the time when,

for the solidarity of the profession, for their best interests, as well as for the increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation freedom for individual development may be achieved through divisions along the lines of technical interests, which might either follow the present four grand divisions or be more minutely subdivided. An organization of this sort could and probably would be more strictly professional than any of the four have been heretofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring grave consequence."

This great vision is worthy of the most careful consideration and might be carried with safety to a point where the national societies would be gathered in under one executive head, without any one losing any vital portion of its individuality. This would be a great step in advance and perhaps as far as we should go for some time to come.

Whatever scheme of organization be ultimately selected it must be flexible, so as to meet successfully constantly changing conditions, and it must provide for both technical and social requirements of the membership while maintaining high standards. "Social requirements" is here used to mean, in addition to social intercourse among members, services of the organizations to Government and to the public and services to engineers individually, such as assistance in securing engagements and better standing in corporate and governmental employment. Technical and social functions probably will be best kept distinct. Some engineers even suggest separate organizations, but at present prefer separate departments of one organization or of a federated group of organizations.

So far as known none of the leading organizations has stated a definite policy on these questions. Opinions herein expressed are only personal. The statements in this paper are merely a contribution to the general discussion of this subject by one who for several months has had especial opportunities for learning the opinions of others and gathering a little information.

The United Engineering Society

As regards the joint activities of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers the present organization seems involved, and even some members of the governing bodies of these societies have difficulty in keeping relationships straight. It is, however, not so complex as some persons assume. It may be simply stated as follows: The four Founder Societies named have joined in creating the United Engineering Society to hold and administer property and to perform other broad functions for them. At their request the United Engineering Society has established three departments, the Library Board, the Engineering Foundation and Engineering Council.

The Engineering Societies Library has possibilities for active usefulness to the engineering profession and to the industries of this country. Its present passive services are good and of great value, but the library can do much more. Funds are needed at once for complete recataloging of the books, for strengthening the collection of books and for instituting new lines of service. The books of the societies have been brought together, but they have not yet been assembled as one library. Never, except during the war, has it been so important that all useful recorded technical information should be fully and quickly accessible to engineers —not only to those in the New York district, but also to those scattered throughout the whole land.

The Engineering Foundation now has an endowment of $300,000, yielding an annual income of $15,000. It rendered vital financial assistance to the National Research Council at the latter's inception in 1916 and for the year terminating in September, 1917. That council performed services of great importance to the Government during the war. For the future it already has in hand many projects. One of the most important of these is the promotion of industrial research, in which the Engineering Foundation is coöperating. The Engineering Foundation investigated a scheme for spray camouflage of ships; is conducting long-time tests on the wear of gears, and is making a research on the selective control of wireless communication. It has offered to undertake a "survey of existing engineering organizations, and from information thus developed to formulate a series of constructive recommendations which may be serviceable in guiding the further development of local and national engineering organizations in their relations to the profession of engineers, to the public and to one another." Other projects are being studied, but cannot yet be announced. Engineering Foundation's policy is to devote its energies and resources to undertakings of broad application, such as bringing about and stimulating coöperation among existing agencies engaged in research and outlining programs and organizations for research in specific fields.

Progress of the Engineering Council

The Engineering Council, since its organization meeting on June 27, 1917, has made progress in exploring its proper field of activity and fixing some of its boundaries. It has accomplished much useful but negative work. In other words its rejections have been important and have consumed much time. But there are also noteworthy constructive achievements on the credit side of its records. During hostilities the council rendered no small aid to the Government through the American Engineering Service, which procured thousands of engineers for the War, Navy and other departments, and through the War Committee of Technical Societies, which assisted the Naval Consulting Board and the Army General Staff in examining scores of thousands of suggestions for naval and military devices. Through efforts of its public affairs committee the council aided in having the military draft adjusted to permit the continuance of training in the engineering schools of the vitally necessary technical men. Through the industrial affairs committee vigorous opposition was offered to "antiefficiency legislation" in Congress. Ten days after the signing of the armistice the Engineering Societies Employment Bureau, with the four Founder secretaries as its board of directors, was substituted for the war-time American Engineering Service. The fuel-conservation committee acted in a consulting capacity to the Fuel Administration and the Bureau of Mines in securing war economies, and is continuing its much needed services into the era of peace. The water-conservation committee is prepared to promote right, and to oppose wrong, national or state governmental actions relating to water power or other utilization of water, by supplying statements of facts rather than joining in controversial support or opposi-

tion of any particular measure. The license committee, with members judiciously distributed throughout the country, is collecting information on the licensing of engineers by the various states and is preparing to render proper assistance in these matters whenever needed. The patents committee, coöperating with other similar bodies, is preparing important action for the improvement of the patent law and practice. During the spring and summer the secretary visited groups of engineers representing the local societies and sections of national societies in 20 different cities from the Atlantic seaboard to the Pacific Coast. In 30 or more communities local correspondents have been selected for direct communication between Engineering Council and engineers at distances from headquarters. Furthermore, important projects of interest to all engineers are in preparation and may soon be announced. One of these is the formation of a national service committee, which is to have an office in Washington as the representative of the American engineers at the national capital. All aims and endeavors of engineers through their national and local societies and their joint instrumentalities must be pervaded by a sincere spirit of service, not alone of one to another but by all to the community, the state and the nation. Such public service by engineers, architects, chemists, scientists, doctors, lawyers and clergymen is our professional obligation, the *noblesse oblige* of a free and democratic people. Each profession has its distinct service to perform. In each profession there are big men and small men; each must contribute according to that which he has. Service is the only true stepping stone to that eminence which alone is worth attaining. Greater opportunities have never opened to American engineers than those which confront them in these rapidly passing years of war and reconstruction.

Unique Shell-Profile Turning Attachment

By DONALD A. BAKER

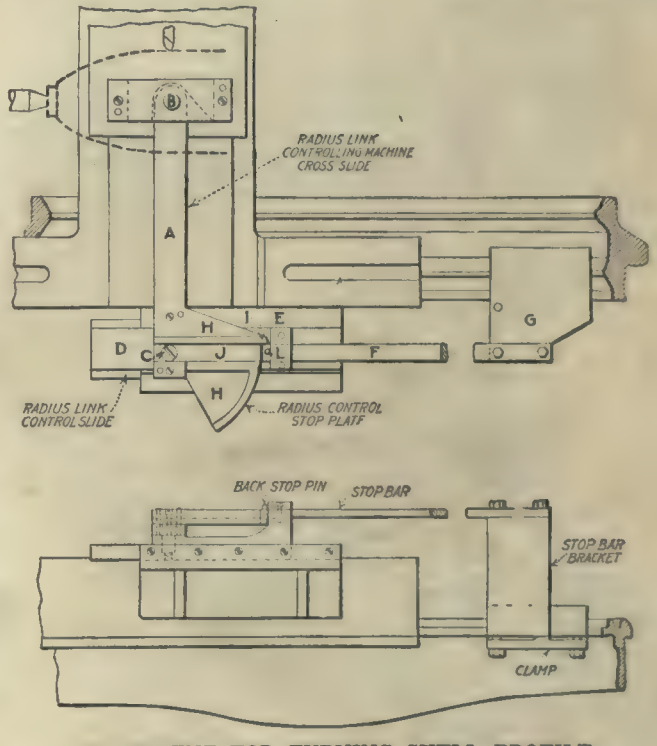
Turning the curved nose of projectiles has introduced to regular practice a feature that in the old days was seldom encountered—that of turning a radius over part of the surface to be finished, the curve of this radius running smoothly into the remaining parallel portion. Many methods have been devised for accomplishing this movement, one of which is here appended.

FOR turning the profile on the nose of large-caliber shells no regular equipment is provided for the ordinary engine lathes. It is therefore necessary for each manufacturer to provide special attachments for this work either in the form of a link of proper length for controlling the radius or of a suitably shaped cam plate. The former is to be preferred where the profile consists of a simple radius, while the latter will be necessary if the profile consists of two or more radii or is an irregular curve.

The attachment here shown is of the link type, which I believe is unique. The design was got out for a customer who desired a fixture that would start the cut at the small end of the shell, turn the radius up to the point where it joined the straight side of the shell and then turn parallel until the operator disengaged the feed.

With a link attached to a fixed member at the back of the lathe it is necessary to disengage the feed before the carriage reaches this point and finish the turning by hand up to the stop, otherwise there would be danger of the link swinging too far and so gouging into the shell as the pivot of the link passed into the other quarter of the arc. This is the undesirable feature in the majority of link-controlled profile-turning fixtures, and it was to overcome this difficulty that the fixture here described was designed. The nose of the shell to be turned is shown by the dotted lines, while the tool, mounted on the compound slide, is shown in the position it would occupy after finishing the profile.

The fixture consists of the link *A* which pivots on two studs *B* and *C*, one at each end and spaced a distance apart equal to the radius of the profile to be turned. One of these studs is attached to the cross-slide of the lathe by means of a bridge that is screwed and doweled to the slide, while the other stud is attached to the slide *D* of the attachment. This slide is a close



ATTACHMENT FOR TURNING SHELL PROFILE

sliding fit in the bracket *E*, which is attached to the back of the lathe carriage and travels with it. In order to operate the cross-slide of the lathe with this fixture it is necessary to remove the regular cross-feed screw and adjust the tool to the work by means of the compound-rest screw.

In operation the action is as follows: From the beginning of the cut until the curved portion of the profile is finished the slide *D* remains stationary and

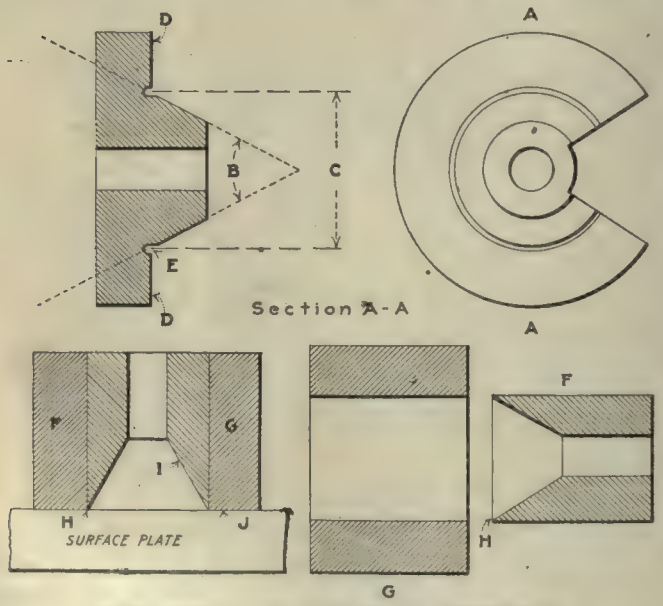
the link swinging on the studs causes the point of the tool to generate a curve the radius of which is the length of the link. Slide *D* is held stationary by means of the stop bar *F*, which is attached to a bracket *G* that can be clamped at any place on the length of the shears. As the tool is fed forward, turning the curved profile, the slide *D* is prevented from moving by the stop bar, which bears against the circular edge of the stop plate *H*. At the moment the curve is finished a projecting corner *I* of the stop plate strikes against the projecting end of the stop bar and prevents the link from turning farther. At the same time this contact occurs the stop bar has come into alignment with a slot *J*, which passes entirely through the stop plate, and as the carriage continues to move forward the stop bar is free to pass through this slot, the link being held against further movement, and so the tool will follow a path parallel to the center line of the lathe. After completing a cut the carriage is returned to starting position, all parts moving together as one unit until the back stop pin *K* brings up against the cap *L*.

At this point the stop bar has withdrawn from the slot in the stop plate, unlocking the latter, and at the same time stopping further movement of the slide *D*. Consequently further movement of the lathe carriage swings the link around its center stud *C* and returns the tool to its original position.

Making Some Difficult Duplicate Gages

By E. A. Dixie

The illustration shows a gage which was ordered in quantities. What makes the job difficult is that there is nothing more tangible than air to hook one's calipers on when ascertaining the dimension *C*. This dimension *C* is a circle the diameter of which is to be measured



THE WORK AND MEANS OF CHECKING

at the imaginary circular line in the groove *E* where the projection of the surface of the cone *B* cuts the projection of the plane *D*. The difficulty is augmented by this diameter having to be kept within a tolerance of plus or minus 0.0001 inch.

I have forgotten the exact dimensions of the original, but no dimensions are necessary to show the method whereby duplicate gages were made which passed the very rigid tests of the Government inspectors.

One idea was to make them in the usual way, measuring them as accurately as possible and trust to luck that the Government inspector could do no better. This however was abandoned for a more positive method which gave accurate results and expedited production.

From the measurements stated on the original blueprint the diameter *C* was readily calculated.

A piece of steel was roughed out, hardened and chucked in the grinding machine. This piece is shown in section at *F*. The outside and angular mouth was accurately ground to dimensions at the same setting. A second piece of steel in the shape of a ring *G* was then accurately ground in the bore and on one face at the same setting. The ring *G* was just warmed and placed face end down on a true surface plate, the plug *F*, which was made a tight push fit for the ring, was then pushed in it till the edge *H* came to a stop on the surface plate. When both pieces assumed the same temperature the plug *F* was a very light shrink fit in the ring *G*. With this master gage and a little prussian blue the toolmaker could with care produce any number of duplicates. The gaging surfaces *I* and *J* were covered with a thin film of prussian blue and used to check up progress of the gages in the grinding machine.

The gages were mounted on a mandrel through the central hole and the cone and flat surface finished at the same setting.

155-Mm. Howitzer Production

This diagram below relates to howitzer manufacture and shows how the American Brake Shoe and Foundry Co., Erie, Penn., had advanced in the production of the

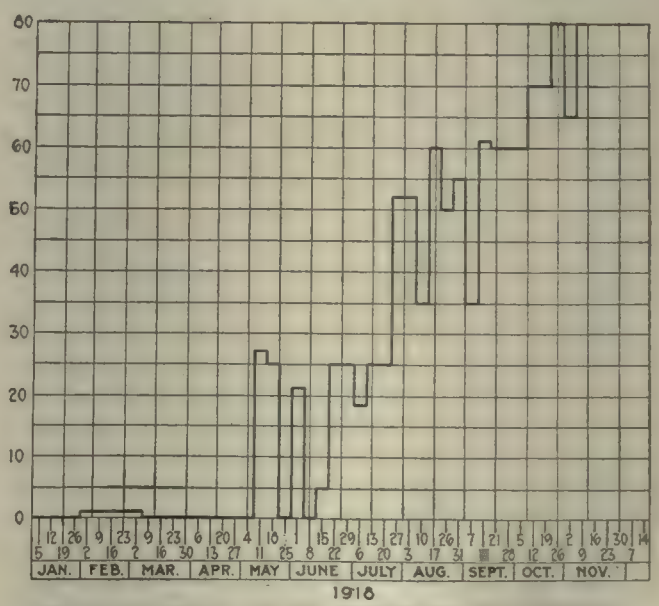
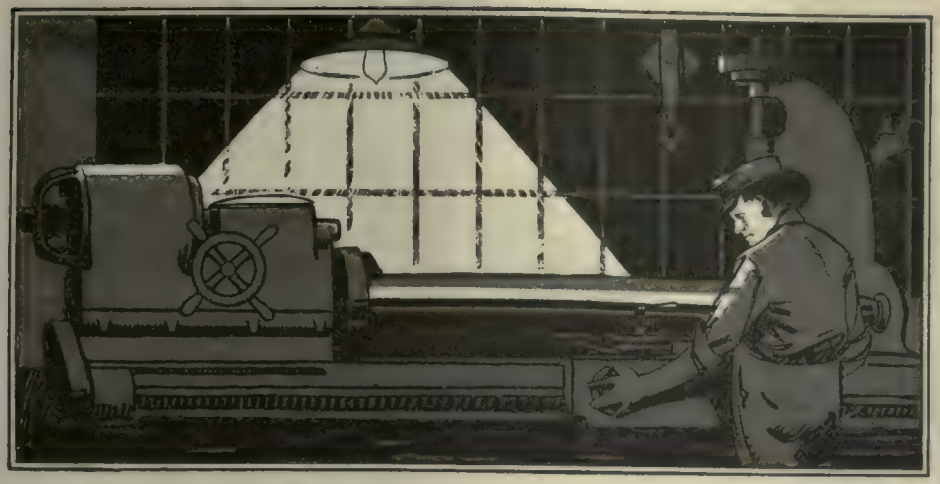


CHART SHOWING 155-MM. HOWITZER PRODUCTION

155-mm. howitzers up to the time of the signing of the armistice. The setbacks were in many cases due to lack of forgings or causes not the fault of the concern. However, in spite of everything, its splendid organization enabled the company to reach and pass its agreed output of 10 a day when running to full capacity.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Motors for Drilling and Boring Machines

This article explains some important points in the use of electric motors for drilling and boring machines. Simple formulas are used to illustrate methods for calculating speeds of drills in terms of other factors, together with a common formula for determining the cubic inches of metal removed per minute. Empirical constants are given for calculating the horsepower required to remove metal based on the latter formula. Tables are included of the motor horsepower recommended for drilling and boring machines of various sizes. Illustrations of motor-driven drilling and boring machines are included and are referred to in detail in the text.

THE many practical advantages of the electric motor and its flexible methods of control for machine-tool driving are quite generally recognized. These advantages, however, are sometimes looked upon merely as general points of convenience without much regard for economy, which must usually be the determining factor when a decision is to be made of the kind of drive to employ for given machinery.

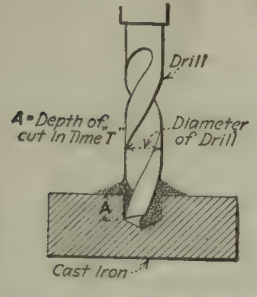


FIG. 1. DIAGRAM OF A TWIST DRILL

In order to bring out the points connected with economy of the motor as a method of driving machinery, there is perhaps no better way than to take up some typical machine or group of machines and make a brief study of the elements which enter in the use of a motor for the given equipment. In this article drilling and boring machines will be considered from the viewpoint of the shopman, and certain fundamentals concerned with the motor and the control mechanism as a part of these machines will be pointed out.

Attention has been directed in previous issues of the *American Machinist* to the importance of looking at motor drive as an aid to greater and better production rather than merely as a means for saving power. At one time there was a natural tendency to use the saving in power by the motor in place of a lineshaft drive as one of the principal talking points of motor salesmen. It is not our purpose to underrate the importance of reduced power losses and a lower power consumption for a given shop output, since this point deserves the most careful attention of shop owners and managers under present national conditions.

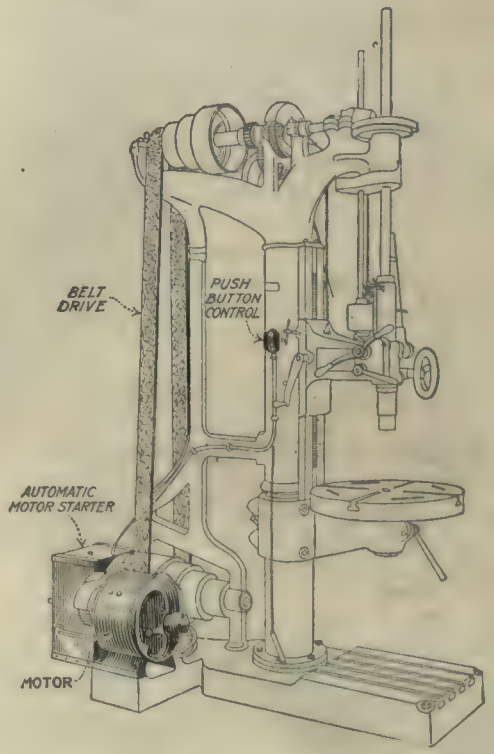


FIG. 2. A DRILLING MACHINE WITH AN AUTOMATIC MOTOR STARTER OPERATED BY A PUSH BUTTON

Possible power saving by the use of motors is only one point to consider, and it is usually of less consequence to the shop management than the question of how the motor may affect the rate of production. On this account it is the purpose to emphasize the latter rather than the former. It should also be observed that even if the adoption of a system of motor driving should result in an actual increase of power consumed, the

system might prove beneficial if a better and a larger product resulted through the use of the motors instead of a purely mechanical system of power transmission.

The above point was presented in an instructive way in these columns by H. F. Stratton based on a

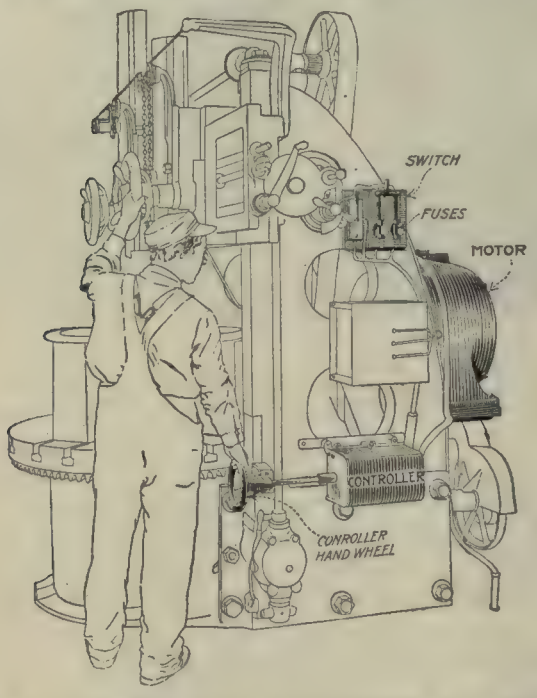


FIG. 3. BORING MILL WITH CONTROLLER AND HANDLE NEAR OPERATOR'S WORKING POSITION

technical paper of A. L. DeLeeuw and may be summarized as follows to illustrate what has just been stated. A shop was cited in which the amount of metal passing through the plant per day averaged 9 tons, this metal being used as the basis of a finished machinery product. It was assumed that all of the power used in the shop was for the removal of metal by machine tools from this 9 tons of material. In the given case a little more than 1 ton of metal was removed per day of 9 hours, which is equivalent to about 300 lb. per hour or 5 lb. per minute.

The power used in this shop amounted to about 225 hp. and this may readily be reduced to the equivalent of 45 hp.-min. for each pound of metal cut or removed, or roughly, about 0.8 lb. of metal was removed per horsepower-hour. The shop was electrically driven, with a cost for power of about $40 per horsepower-year, or a gross annual power cost of 225 × $40 = $9000.

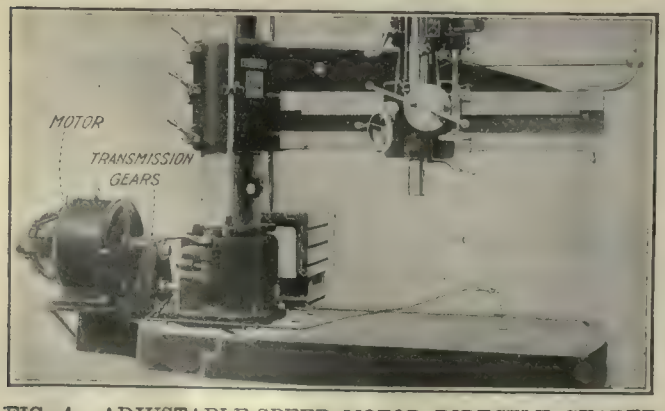


FIG. 4. ADJUSTABLE-SPEED MOTOR DIRECTLY GEARED TO RADIAL DRILLING MACHINE

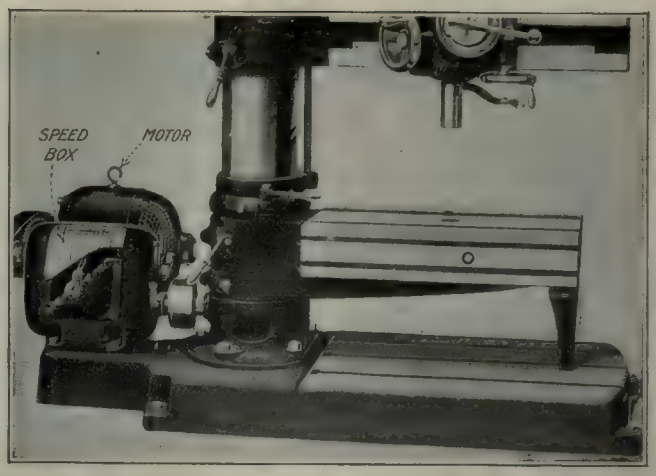


FIG. 5. INDIVIDUAL MOTOR ATTACHED TO A RADIAL DRILLING MACHINE THROUGH A SPEED BOX

The main point of the argument is in the comparison of a given power saving with a given increase in production. Suppose a new method of drive could effect a saving of 50 per cent. in the power consumed by the shop; one-half of $9000 would be $4500.

The shop employs about 500 men and the value of the plant output is about $2000 per man per year. If a new method of driving the machinery made it possible to increase the production 1 per cent. this would be equivalent to $20 per man per year increase, or a total of 500 × $20 = $10,000 for the entire shop. This is more than double a saving of 50 per cent. in power. Hence, it may readily be seen that a 1-per-cent. increase in production (or a saving of about 6 min. per man per eight-hour day in the time required to get out a given amount of work) may be of greater importance than even a 50-per-cent. power saving. The practical significance of this principle will be made clearer further along in this article.

Simple Formula for Drills

In the application of motors to machine tools it may be advisable to know something of the simple methods for determining speeds, feeds and horsepower. The twist drill shown in Fig. 1 may be used as a basis for some of these relations. Suppose, for example, the desired cutting speed in feet per minute and the diameter of a drill in inches are known and the revolutions per minute of the drill is to be found. Reduce the cutting speed from feet per minute to inches per minute and divide by the circumference of the drill in inches; that is,

$$\frac{\textit{Cutting speed in feet per minute} \times 12}{\textit{Diameter of drill in inches} \times 3.1416} = \textit{revolution per minute of drill.}$$

This same relation may be used to calculate the cutting speed of the drill in feet per minute when the diameter of the drill and the revolutions per minute of the drill are known, in which case the formula takes the following form:

$$\frac{(\textit{Diameter of drill in inches} \times \textit{revolutions per minute of drill} \times 3.1416)}{12} = \textit{cutting speed in feet per minute.}$$

Tables are available and may be consulted for finding the feeds in inches per revolution of the drill (or in



FIG. 6. LARGE TWO-MOTOR HORIZONTAL MULTIPLE-SPINDLE DRILLING MACHINE

other terms) for a given class of metal worked upon, and for given drill diameters and revolutions per minute corresponding to a given cutting speed.

Convenient tables have been prepared for the aid of those who must decide on the horsepower rating of a motor to use for a given size and kind of machine tool. Several tables of this kind are given below, for which it is understood in each case that either of the three general types of shop motors on the market may be used; that is, the adjustable-speed direct-current motor, the constant-speed direct-current motor, or the induction motor, which is a constant-speed machine. The exact choice of which of these types of motors to use depends on other and important considerations besides the mere choice of rating of the motor as given in Tables I, II and III.

TABLE I.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS FOR DRIVE DRILLING AND BORING MACHINES

Size	Hp.
Sensitive drilling machines up to ½ in.	¼ to ½
Upright drilling machines, 12 to 20 in.	1
Upright drilling machines, 24 to 28 in.	2
Upright drilling machines, 30 to 32 in.	3
Upright drilling machines, 36 to 40 in.	5
Upright drilling machines, 50 to 60 in.	5 to 7½

	Horsepower	
	Heavy	Average
Radial drilling machines, 3-ft. arm	3	1 to 2
Radial drilling machines, 4-ft. arm	5 to 7½	2 to 3
Radial drilling machines, 5 to 6 and 7-ft. arm	5 to 7½	3 to 5
Radial drilling machines, 8 to 9 and 10-ft. arm	7½ to 10	5 to 7½

If it is desired to make a rough calculation of the horsepower required to drill a certain kind of metal this may be done by the use of the following simple relation for the cubic inches of metal removed per minute for drills; that is,

Cubic inches of metal removed per minute $= 0.7854 \times D^2 \times \frac{A}{T}$ where D is the drill diameter in inches, and $\frac{A}{T}$ is the feed of the drill in inches per minute (see Fig. 1). Based on the result of the cubic inches of metal removed per minute as just found the horsepower required for removing the metal may be found from the table of constants:

Metal Drilled	Approximate Horsepower per Cubic Foot of Metal Removed per Minute
Cast iron	0.6 to 1.0
Wrought iron	1.2
Machinery steel	1.2
Steel 0.50 per cent. carbon and harder	2.0 to 2.5
Brass and similar alloys	0.4 to 0.5

Note—Where the cut is very light the friction of the machine tool may alone be the determining factor in the size of motor to use. However, if the cut is heavy, friction may sometimes be ignored as an item of negligible importance.

Turning to the details in the application of motors to drills and boring machines it will be possible to explain some of the ways in which the economies of the motor show themselves in actual practice, and it should be remembered that the saving of time in finishing a given piece of work need not necessarily be large to make the use of a motor a paying investment.

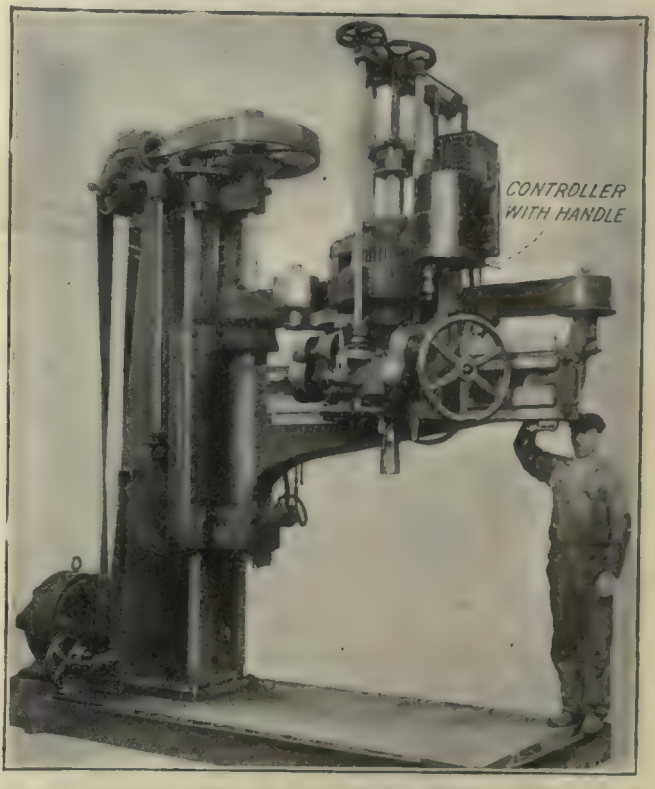


FIG. 8. RADIAL DRILLING MACHINE WITH CONTROLLER WITHIN EASY REACH OF OPERATOR

First, the use of the electric motor brings with it the possibility of many points of excellence in the way in which the machine tool is started and stopped and its speed adjusted or varied. This, in fact, is one of the great advantages possessed by electric-power applications. Fig. 2 illustrates the automatic starter with push-button control, which gives the operator the convenience of starting and stopping the motor by merely

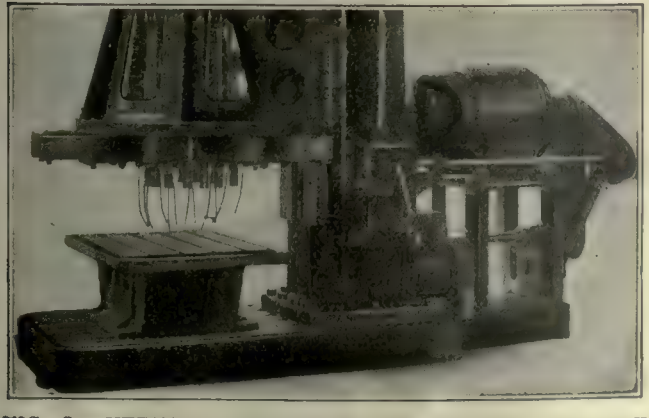


FIG. 7. VERTICAL MOTOR-DRIVEN MULTIPLE-SPINDLE DRILLING MACHINE

TABLE II.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS TO DRIVE BORING AND TURNING MILLS

Size	Horsepower—Average	Horsepower—Heavy
37 to 42 in.	5 to 7½	7½ to 10
50 in.	7½	7½ to 10
60 to 84 in.	7½ to 10	10 to 15
7 to 9 ft.	10 to 15	
10 to 12 ft.	10 to 15	30 to 40
14 to 16 ft.	15 to 20	
16 to 25 ft.	20 to 25	

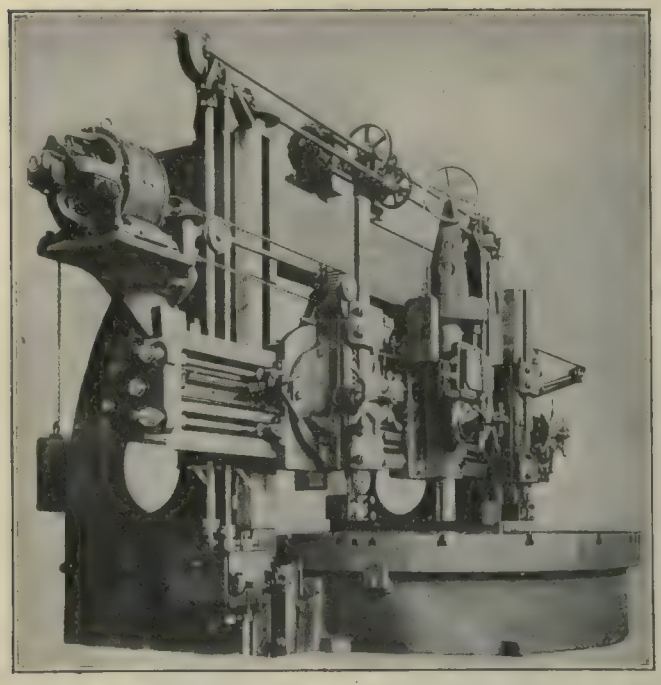


FIG. 9. SURFACE-GRINDING MACHINE WITH VERTICAL DRIVING MOTOR

pressing the push button. This is only one of the advantages of the motor. The drilling machine in Fig. 2 has its speed controlled and adjusted by the ordinary cone pulleys and belt, and no effort is made to use speed control by electric means.

In Fig. 3, however, a motor-driven boring machine is shown with a controller located on the side of the machine, and a handwheel is so placed that the operator has it within convenient reach when in his normal operating position. The controller may be used for starting and stopping only, or for the control of the speed of the machine.

Figs. 2 and 3 have contrasted motor-driven belted drilling machines with those direct connected, and the advantages of the latter have been emphasized from the point of economy through control. Another contrast may now be made of two direct-connected motor-driven drilling machines, in one of which speed changes may be made by the motor controller (Fig. 4), and in the other the speed changes are secured through a speed box (Fig. 5).

TABLE III.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS TO DRIVE CYLINDER-BORING MACHINE

Diameter of Spindle, In.	Maximum Boring Diameter, In.	Hp.
4	20	7½
6	30	10
8	40	15

A number of points must be given due weight in making a comparison between Figs. 4 and 5. First, the speed control through the motor is usually preferable, due to its convenience and its greater flexibility. To accomplish this the motor must possess the necessary characteristics for adjusting its speed over wider limits than can be obtained with the ordinary direct-current shunt motor. Direct-current motors with these wider limits of speed adjustment are known as adjustable-speed motors and they cost and weigh more per horsepower than the ordinary direct-current shunt motors, so that the cost of the motor itself is increased by this advantage of wide speed control, making the initial investment charge higher than where, as in Fig. 5, speed adjustments are secured through a speed box and a motor of constant-speed type.

The advantages of the motor often rest largely in its ability to secure wide speed limits with close graduations of speed, and this advantage may easily offset whatever difference in first cost there may be between the two cases illustrated in Figs. 4 and 5. These two examples are given to bring out one of the fundamental points in the adoption of a system of motor drive, and the reader can see that the problem is one which should be solved on a basis of careful preliminary estimates as to what the adjustable-speed motor equipment is going to be worth to the shop in comparison with the less costly types of motor outfits, and on a basis of actual experiences in other shops where data are available on the points at issue.

Motors on Large Multiple-Spindle Drilling Machines

To bring out the importance of this question in its relation to large drilling machinery, Figs. 6 and 7 are shown. The two views refer to a large two-motor horizontal multiple-spindle drilling machine and to a vertical machine of the same type.

The reader will find it of interest to note both in Fig. 6 and Fig. 7 how the adaptation of the motor to the machine tool has been made mechanically. This point is an important one and the success of the combination depends partly upon the design of the machine tool itself, and partly upon the coöperation of the motor manufacturers in designing their motors and control equipment to meet given special requirements.

This is illustrated, from the standpoint of control equipment, in the placing of the motor controller in a

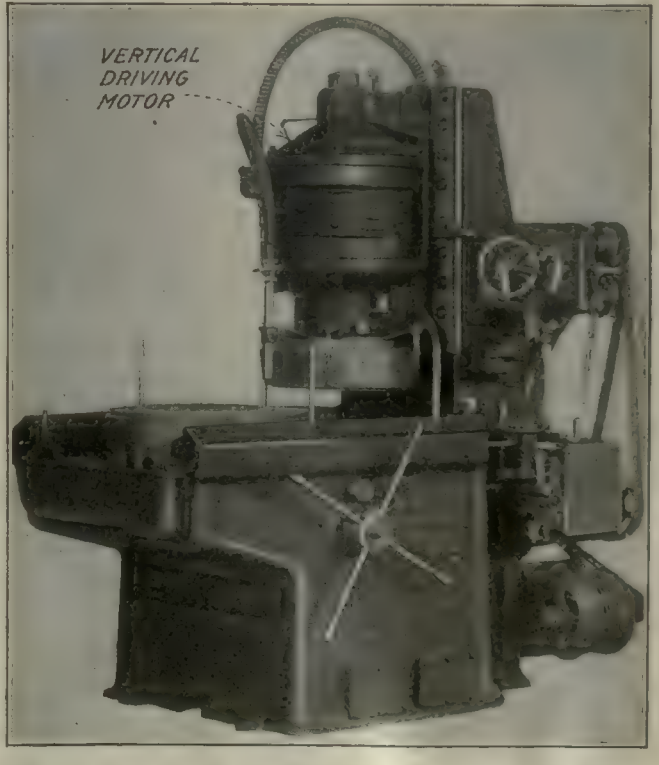


FIG. 10. STANDARD BORING MILL WITH MOTOR DRIVE

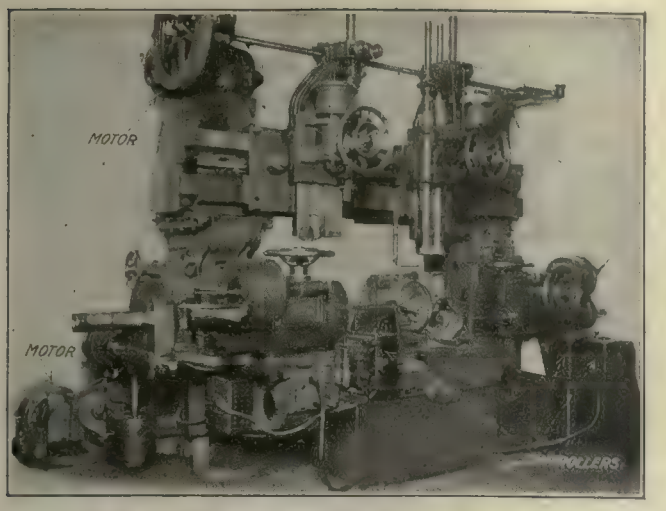


FIG. 11. MOTOR DRIVEN FIVE-SPINDLE BORING MACHINE

convenient position near the operator as clearly indicated in Fig. 8. From the standpoint of the motor, Fig. 9 shows very nicely how the type of motor may be suited to special uses. This machine is equipped with a vertical 7½-hp., 440-volt motor, and its compact appearance as well as that of the motor as a unit is in itself an indication of the care which has been taken to adapt the motor to the machine in the best manner.

The preceding notes are equally applicable to the boring machine, except perhaps in those few cases where specific information was given for drilling machines. In closing this discussion it is desirable to refer briefly to several examples of boring machines as one of the many fields for the motor-application engineer.

For this purpose Figs. 10 and 11 are included to illustrate some of the points in the successful application of the motor to such machinery. Fig. 10 shows a large boring machine with the driving motor at the upper left portion of the view, and an auxiliary motor at the top center of the machine. This view may be taken as a good example of a motor-equipped standard type of boring machine, while Fig. 11 is intended to bring out the motor and control equipment for a special type of boring mill, this particular one being a five-spindle mill. In the latter case three motors are employed, two of which are shown in the view, and the three corresponding controllers are properly indicated by arrows.

These notes, although related mainly to two types of machine tools, are intended to emphasize more than a description of the electrical equipment of two standard machine tools, and therefore place a good deal of weight on the important principles of motor-application work, using the drill and the boring machines merely as a convenient basis for the discussion.

A Scientific Santa Claus

BY JOHN R. GODFREY

"'Twas the day after Xmas,
And all through the shop
The workers were cussing
The men at the top."

THIS was the nice Christmas spirit Johnson found waiting for him when he landed in the shop on the morning of Dec. 26. Now Johnson is a good sort of a scout even if he did fall for the Foolem and Gouger bunch, and Christmas meant a lot to him. Gave him a chance to go around and say "howdy" to the men, to ask after the kiddies and to be real human, as was his nature. But he sure did get a jolt when he stuck his nose into the shop on Dec. 26.

He didn't have to be told that something was wrong; he could feel it, and he called in one of his old-time foremen to ask him what it was all about. Dooley was a bit reticent at first, but Johnson pried a few answers out of him.

"Now, see here, Bill Dooley, what's the matter out in the shop? I've been away and I don't know what to think. But something has surely happened to sour the disposition of every man I've looked at. Tell me the worst, Bill; I want to know—and I want to know now."

So Bill Dooley loosened up in his own way and told Johnson just how a scientifically managed Christmas was pulled off.

"You see, Mr. Johnson, 'twas this way: Young Gouger comes around and wants a list of every man in my department. Wanted to know his age, habits and condition of matrimonial servitude. Leastwise, he wanted to know if he smoked, had a family and other personal information. Then he wanted to know whether each man would rather have a turkey, cigars or three bucks in coin of the realm.

"That wouldn't have been so bad, but he got his lists mixed and had turkeys assigned to the men who wanted smokes and cash. That made things interesting and got the boys a bit peeved.

"In the old days when they brought the plunder into the department, or at least had the turkey all ready to pick up as they went home, there was a kind of a Christmasy feeling about it. Each foreman sort of played Santa Claus to his own department and passed the personal touch down the line. Everybody knew you couldn't 'Merry Xmas' the whole gang, and they sorter felt as though we foremen acted in your place.

"This year it was different. After they got the pedigree of every pup in the kennel they gave him a number and told him to freeze tight to it—same as he would a hat check at a policemen's ball. Then they posted diagrams which showed distributing points for the various kinds of gifts.

"The three-dollar men had to go out on the street and line up past the window of the cashier's office; the smokers lined up alongside the pattern shop, and the turkeys were given out by the main gate.

"Perhaps you remember what a nice night it was on the 24th—a nice cold, cheerful rain that almost froze as it struck the sidewalk. Made a man feel real cheerful and merry to line up to get his three bucks, especially when he'd been counting on a good, fat bonus same as he had last year. Your personal stock dropped way below par that night, Mr. Johnson, because most of us thought you must know all about it.

"Perhaps you can't just see the effect of all this cut-and-dried scientific stuff the way we do; but I'll bet seven dollars to a plugged nickel that the production of the plant drops lower than you've seen it for some time. The men used to take a real personal interest in the work; this has knocked that into a cocked hat. Six o'clock and payday will be the bright spots in the life of most of the men from now on. It wasn't the money; it was the idea of being handed a lot of bunk about good-will and Merry Christmas and then being led up to a cold-blooded bread line like a soup kitchen in Belgium. Three of my best men gave notice this morning."

Johnson didn't know whether to be peeved at the fluent criticism or to look at the other side and see the men's state of mind. While he was thinking, the boy brought in two envelopes, one, a large one, evidently containing a picture. This was another evidence of the wrath of the men in the shop. For there was a halftone cut from a local paper showing a banquet given by some of the officers a few nights before and underneath: "Our Officers Eating our Xmas Bonus."

As a matter of fact each officer had paid his share of the eats, but the men didn't know that. And the shot found its mark. In the other envelope was a notice from the Red Cross saying that three dollars had been subscribed in his name by one of his men. Later he found that several had not called for their three dollars at all—the cold, drizzling rain, the possibility of catching cold and the general "darn the scientific Xmas" spirit being clearly shown.

Now, as I said before, Johnson was a real human being when he took time to think about it. And these things hurt him more than he would admit. He valued the good-will of his men and he also knew that what Bill Dooley had said about production was true. You can't buck a grouch of the whole shop when they feel they have a good reason, and he admitted to himself that they had. So he took the bull by the horns and called a meeting of the shop foremen, subforemen and all the old timers he could get into his office. He also sent for Foolem and Gouger. And this is what he said:

"Boys, I've been away and I've just heard about the sort of scientific Xmas that was put over on you while I was gone. Let me tell you right now there'll never be another like it in this shop. Our friends Foolem and Gouger get through tonight, but they didn't know it till now. I've stood for a lot of "damfoolism" because I thought perhaps they had some things we needed. *I'm* doubtful now if they have anything. Anyone who will take every human element out of Xmas as they did can't have much else that we want in our shop.

"Tomorrow I'm going to consult a real manager I've run across and see whether there's any of their junk we can use or not. If there isn't it all goes out into the street. I can't say anything very definite yet about the future, but I ask you to try and forget the nightmare we've had and give us a chance to get the shop back into the human column once more. We'll need your help, every one of you, and the help of every man in the shop. Pass the word along too when you go back. We've got to pull together—and we will—whether we are scientific about it or not."

Who says Johnson isn't a real human being?

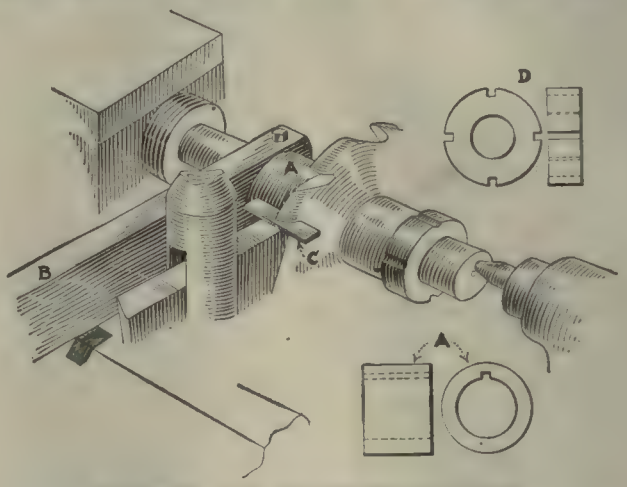
Eccentric Mandrel for Relieving Form Cutters

By George F. Kuhne

The sketch shown is an eccentric mandrel for use in relieving the teeth of form cutters. Although machines and attachments are on the market for such work this one is intended for the shop in which such cutters are seldom made and the purchase of a machine would therefore be inadvisable. Little explanation is needed, as the cut shows practically all the detail.

The collar *A* is splined to the mandrel by means of a Woodruff key that is let into the latter, the object being to keep the cutter from shifting its position when the nut is tightened.

The mandrel is operated by the lever *B*, which should be so located that as it descends and the forming tool is cutting it will strike the lathe apron before the next tooth of the cutter strikes the forming tool. In locating the cutter the lever *B* should be brought down onto



MANDREL FOR RELIEVING CUTTERS

the apron after the cutter is on the mandrel, and the tooth above the one to be relieved should be set against a flat piece of metal *C* held on top of the tool.

After setting in this manner the threaded collar *D* is tightened to hold it in position for relieving. A stop should be used on the cross-slide to make sure that the relief is made uniform.

Welding High-Speed Forming Tools

By J. S. Atkinson

I was much interested in the article by Harold V. Styers on page 1186, Vol. 49, of the *American Machinist* regarding breakage of dovetail forming tools.

His sketch shows a fracture starting at the sharp corner of the dovetail and running across the entire piece, which is a good example of what often happens to tools of this shape. Sharp corners of this kind could well be obviated by a small fillet, which would tend to prevent hardening cracks at this point. Toolmakers are well aware that a sharp corner of this sort invites breakage. A slight clearance would of course be necessary on the holder so as not to bear in the filleted corner.

I believe this would be a good point for designers to bear in mind rather than to always rely upon the toolmaker to make a fillet.



The Salvage of High-Speed Steel Tools

By J. H. Vincent

The salvage of high-speed steel is drawing attention to obtaining maximum life for every tool or cutter made from it. Many milling cutters have been thrown in the scrap heap when ground until there is insufficient chip space left. These are now being salvaged at comparatively small cost by a method of grinding without drawing the temper of the cutter, which is a big advantage.

WHEN high-speed milling cutters and reamers were worn down to the point where there was little or no chip space left, as shown in the headpiece, it was customary for the toolroom attendants to throw them into the scrap heap, and it was seldom this steel was later used for any purpose. During the past year or two, since the value of high-speed steel has so materially increased, some attention has been given to keeping this high-speed-steel scrap separate and selling it for more than ordinary tool-steel scrap, from 15 to 20c. per pound being obtained from jung dealers. This, however, is little better than nothing when it is considered that a cutter such as shown in the photograph may take from 10 to 30 lb. of steel in the blank to produce it.

With high-speed steel selling at about $2 a pound, and hard to get at any price, the material tied up in cutters and reamers of this description is a big item, so when these tools can be salvaged the methods employed should be of interest. The Goddard & Goddard Co., Detroit, Mich., has been salvaging cutters for their customers for some time, the cutters illustrated in the headpiece being reproductions of some of the worn-out tools that were sent in for the purpose. What can be done with them is amply shown in Fig. 1, which gives a group of similar tools that have gone through the shop and been put into shape for returning to their owners. It will be observed in this group that reamers, end mills and high-speed drills are included among the salvaged tools. The drills had been worn so badly that they were undersized and no longer had clearance. On being reground to a smaller size and the necessary clearance ground on them they are as good as new drills.

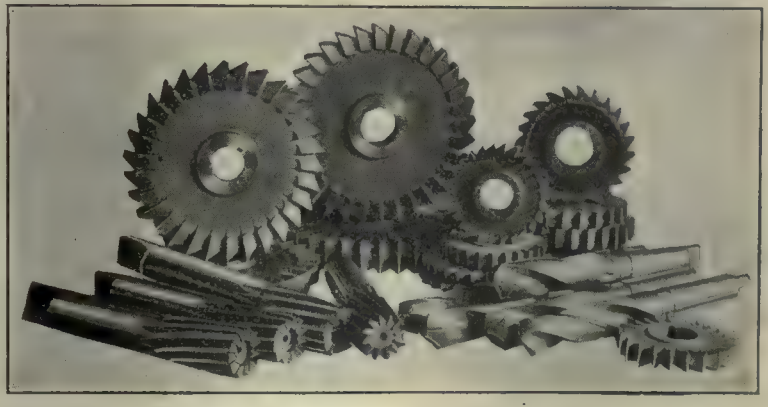


FIG. 1. GROUP OF RECUT TOOLS

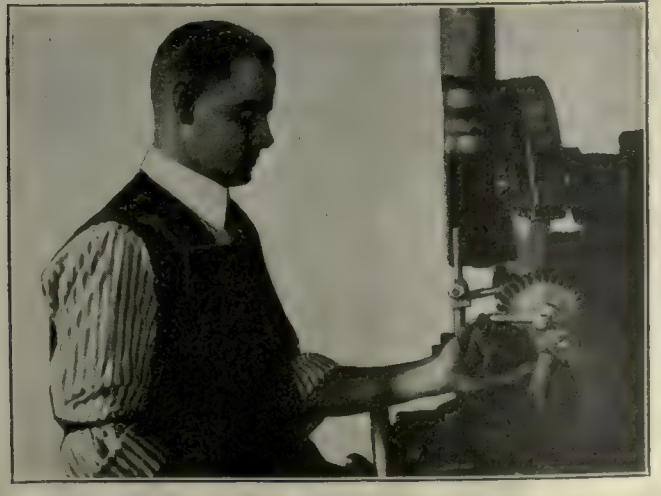


FIG. 2. GRINDING CHIP SPACE ON MILLING CUTTER

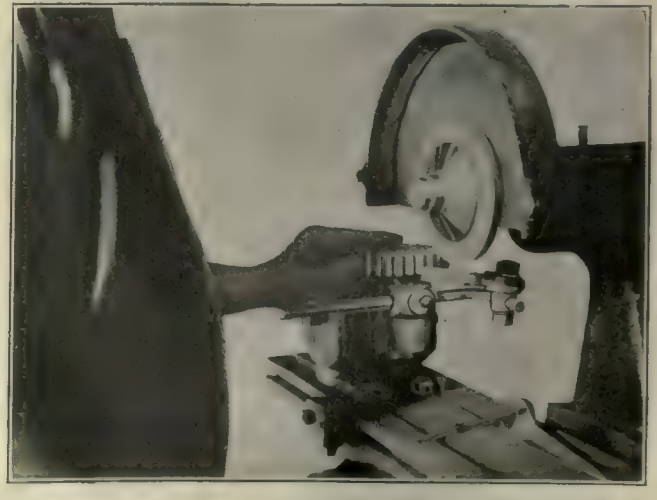


FIG. 3. GRINDING SIDE FACE OF MILLING CUTTER

When a manager receives a report from the foreman of the toolroom that certain milling cutters require regrinding he should have him specify the sizes of the smaller cutters of similar type used in the plant to which these worn cutters may be ground. Any plant using large numbers of cutters has a variety of small sizes and it is usually possible to grind the larger size down to do service. In sending in such cutters for regrinding the customer should mention the size sent in as well as the size to which he wishes it ground. In this way nothing is left to chance.

The development of regrinding is a trade in itself, and has demanded the study of those who are expert in the work in order to obtain the best results. The practice of Goddard & Goddard is to regrind all tools without drawing their temper. This requires the employment of exceptionally well-trained grinders. The work is done dry, Figs. 2 and 3 showing the method of grinding the chip space on the outside periphery and flat side of a milling cutter.



FIG. 4. ACID STENCILING SIZES ON SALVAGED TOOLS

The company also makes new milling cutters that are designed to give longer life and better opportunities for regrinding or salvage. For this reason the web is left thicker on the new cutter instead of unnecessarily thinning it when they are first made. End mills have their centers bored out to a considerable depth, so that when grinding new chip space the grinding wheel will not run into a solid center.

I have frequently heard complaints from toolroom foremen in regard to reground or salvaged cutters being permitted to retain their old dimension markings, in consequence of which mistakes were constantly being made when the tools were issued to the workmen. The Goddard & Goddard Co. has overcome this by grinding off wherever possible the old tool dimensions or markings, and after the work has been finished the cutters are sandblasted so that they look new in every way. As the tools have been hardened ordinary stencil marking cannot be used to indicate the new sizes, but an acid-marking process provides an effective substitute.

The woman in Fig. 4 is engaged at stenciling. After each tool has been checked and rechecked by inspectors the correct tool size is put on a tag which accompanies the piece, and then goes to the stenciling department. A light coat of varnish is applied to the space to be stenciled, and the lettering is stamped on this with a rubber stamp wet with a potash solution which eats through the varnish, leaving an acid-proof background. A little acid is then applied to the letters and allowed to stand for a few minutes. When washed off the letters have been etched on the tool and the varnished background is cleaned with alcohol.

The cost of salvage is remarkably low in comparison with the cost of new tools at the present time, and everyone should be urged to make a regular inspection of his tool-scrap bin to see whether anything is being scrapped which could be salvaged.

Don't Jump at Conclusions

By H. K. Porter

Some men are inclined to feel that somebody or everybody has a grudge against them and that plots intended to bring about their downfall are being hatched whenever their backs are turned or whenever they are away from the shop or plant for a day or for a few days.

A factory or plant manager must not, however, possess such a nature if he expects to make a complete success of his work or management, for suspiciousness may be reasonably interpreted as ignorance. No man should believe that his "friends" or employees are plotting his ruin, for if he does his actions will lower his efficiency and undermine the respect of his superiors and subordinates.

I once knew such a man who narrowly escaped such a fate because of his belief that his men were working against rather than with him. The only thing that saved him was the fact that he was the head of the shop and no one had the authority to "fire" him.

He had just taken charge of a shop which though ideally situated had been run in a loose manner for years, with expenses equaling and often exceeding the profits, and right away he started in to "shake up" the force so as to get the plant on a money-making basis. He wanted a real organization. As a consequence he made some enemies among the employees who prior to the time he took charge had worked as they saw fit. Let me add, however, that it is but natural for every successful man to have some genuine enemies. A progressive man brushes aside the laggards and they usually resent it.

For this particular executive things were going ahead at a fair clip when suddenly the air compressor of the plant broke down, shutting down the plant. Immediately the superintendent convinced himself without the formality of an investigation that the men whom he had forced to toe the mark had thrown sand in the bearings. He raved in a manner entirely unbecoming an able leader. Two or three men were virtually kicked out, and the whole force was upset.

An expert was put to work on the job to get the plant in operation again as soon as possible, and instead of finding sand in the bearings the expert found that improper lubricant was the cause of the trouble. A lubricant "expert" had slipped a cog and recommended the wrong kind of oil.

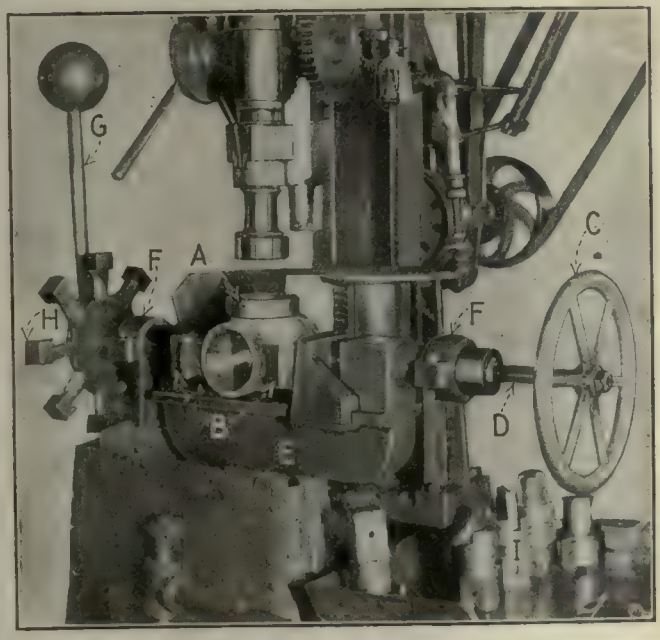
After the smoke had cleared away, the superintendent came down to earth again and is now reformed.



Tapping Fixture for Pipe Fittings

By H. J. Ventner

The fixture shown in the illustration is employed in the plant of the Jarecki Manufacturing Co., Erie, Penn., for drilling and tapping small lots of large pipe fittings. This fixture is used in a standard drilling machine and enables the operator to drill and tap all sides of these



TAPPING FIXTURE FOR PIPE FITTINGS

fittings at one setting, thus insuring the correct alignment of the various threaded holes.

The tee *A*, which in this case was made of aluminum, is held in the vise jaws *B*, which are closed by the handwheel *C* and screw *D*.

The main body of the fixture *E*, carrying the vise jaws, has trunnions on each end that rest in bearings on the bracket *F*, thus permitting the central portion to be freely revolved.

The revolving body is counterweighted by the bar *G*, with the ball on its outer end. The indexing is accomplished by the spider *H*, which has indexing points at 45-deg. intervals, thus making this fixture available for fittings other than 90 degrees.

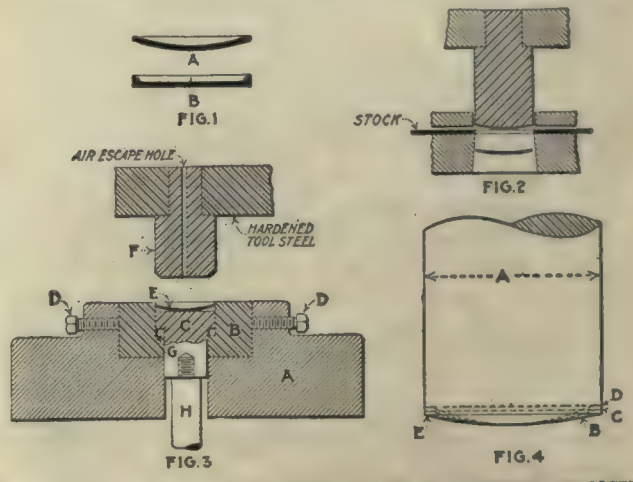
Tools used for clearing the fins and burs from the holes and preparing the casting for the tapping operations are shown on the tray *I* at the right of the machine. The machine is geared to a slow speed and is readily reversed to withdraw the tap.

Trying to Thicken the Edges of a Disk

By Hugo F. Pusep

In an article by Joseph A. Ahlers on page 707, Vol. 49, a description is given of an unsuccessful method of thickening the edges of a disk. For the benefit of Mr. Ahlers and others confronted with similar problems I submit sketches of tools which will produce the disk in question. The disk *B* of the original article can be produced in two press operations, namely, blanking and swaging.

As an illustration of what can be done by this method the sketch *B* in Fig. 1 represents the cross-section of a



FIGS. 1, 2, 3, 4. BLANK, TOOLS, AND BLANKING PUNCH

brass disk, which was produced very successfully in two operations. Fig. 2 shows the first-operation tools for blanking and drawing the shallow cup *A* in Fig. 1. These consist of a simple blanking die and a punch, the face of which is ground convex. The stripper should be a little higher from the face of the die than is usually the case on ordinary blanking dies to allow free passage of the stock, which is subject to slight distortion around the punched hole caused by the convexity of the punch.

The final operation is swaging the blank into the thickened edge disk shown at *B*, Fig. 1. Swaging dies for this operation are illustrated in Fig. 3. The cast-iron die shoe *A* is bored out to take the hardened and ground tool-steel die ring *B*, the larger hole in which is ground to the diameter of the finished blank, while the smaller hole is made a sliding fit for the stem of the hardened and ground knockout *C*. The head of the knockout is accurately fitted to the larger hole in the die. Although the die ring is a press fit in the shoe

additional precaution in the form of setscrews *D* is taken to guard against its loosening through continued jar of the knockout.

In operation the swaging die works as follows: The shallow cupped blank *E* is placed in the die as shown, resting on the knockout and being centered by the die opening. As the punch *F* descends it carries the blank down along with the knockout *C* till the latter is stopped by the shoulder *G* of the ring. Further downward movement of the punch flattens the center of the disk and swages the edges down into the corner of the die against the face of the knockout, while the top side of the disk is shaped to the form of the punch. On the up stroke of the press the finished disk is ejected by the positive movement of the knockout *C* actuated by the rod *H*. The knockout *C* is so set that it will come flush with the top of the die ring on ejecting the swaged blank, returning to the position shown in the sketch, just as the press ram comes to rest at its highest position in order that the blank, which is swaged tightly into the die, may be completely ejected and still allow a new blank to be centered properly by the die.

The success of the process of thickening the edges of disks of brass or like material depends largely on the form of the first blank. Mr. Ahlers did not state the material his blank was made of, but I assume it to have been either brass or other composition of like nature, on account of the press methods he tried in its production. Steel does not swage to form like this when worked cold, and if a disk had to be produced as specified in Mr. Ahlers' article either the drop hammer or the upsetting machine could have been used successfully for the purpose.

All swaging dies of the kind described should be made massive in proportion to withstand the stress of swaging. Punches and dies alike must be highly polished on their working surfaces. The punch and the knockout should be a perfect fit in the die to prevent the metal from squeezing past them and forming objectionable burs. All blanks should be annealed before swaging and must be free from oil and other foreign matter. Sometimes air holes must be provided in the punch or the knockout, or both, depending on the form of the thickened rim to be swaged.

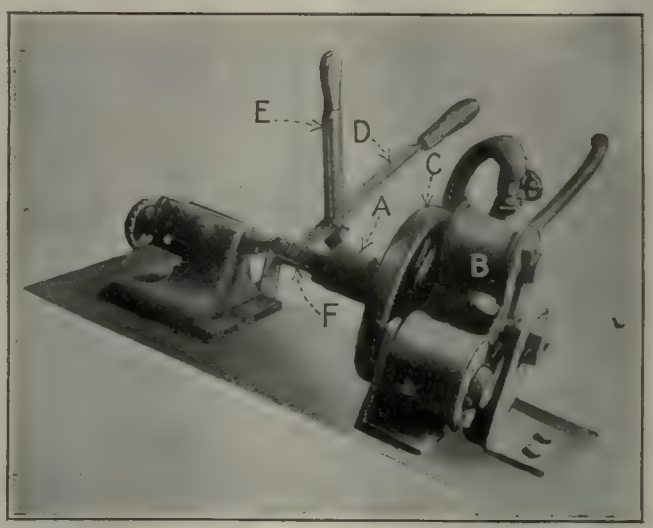
It is always advisable in swaging to provide a press with ample power; rather use one with power to spare than one that barely does the work. Another important point, the overlooking of which sometimes causes trouble and even rejection of the method, is that the punch must be shouldered into a hardened tool-steel punch holder of sufficient thickness and size to prevent the punch from sinking into it as it would if it were made of cast iron or soft steel.

The correct form of the blank for swaging can best be determined by trial. The best and cheapest way to do this is to build the blanking die complete, because the diameter of the blank will not change, being governed by the diameter of the swaging die. The blanking punch is now made and ground after hardening to the right diameter as at *A*, Fig. 4. The face of the punch is ground by guess to the form as shown at *B*. A trial blank is produced with this punch, and if it is found there is not sufficient stock in this blank to fill out the swaged disk, the face of the punch is ground as represented by line *C*. After further trial it may be necessary to increase the convexity of the punch face to line *D* or until the desired result in the swaged blank has been attained. From this it will be seen that all the alteration takes place in the face of the blanking punch and is accomplished simply by grinding. The square corner at *E* should be always left in a combination cupping and blanking punch; it assists materially in the blanking operation, as it overcomes some of the distortion in the strip stock and also leaves a clean, smooth hole. Although the blank, for the swaging of which the tools described in this article were designed, differs somewhat from that of Mr. Ahlers' original articles, it is, if any, the more difficult of the two to make.

A Pneumatic Thread Chaser

By E. V. Allen

Bruised or oversized threads on a bolt or screw are usually rectified by running a die over them. In some cases a slightly bruised thread may be touched up with a file. The method used in the Northwestern R.R. shops, Chicago, is to chase down both oversized and bruised threads in the little machine shown. In this case the



A PNEUMATIC THREAD CHASER

bolts are those used in piston heads and are centered for the threaded end.

The machine is made somewhat similar to a small lathe, with an adjustable tailstock center and a headstock carrying a spindle with a socket *A* on the nose into which the head of the bolt is placed. The spindle is driven by means of an air motor *B* the pinion of which meshes with the internal gear *C*. The thread chaser *D* is carried in a lever-bracket *E*, which is made to slide freely back and forth in a guide bar *F*.

As the bolt turns, driven by the air motor, the workman presses the chaser teeth into the thread and allows the chaser to feed along, cutting down the oversized thread or cleaning out the bruised places, as the case may be.

One big advantage of this little machine is that it can be carried anywhere in the shop and used, as there are few places in a railroad repair shop where compressed-air connections are not available.

The scheme is also much quicker than the use of a die.

Punching and Coping Metal Sills For Railway Cars

By C. M. Rogers

The box car shown in Fig. 1 is one of several hundred being built by our company for the expeditionary forces in France, which must interchange with French cars. There is a hook and link attachment at each end of the car, with two safety chains, for coupling one car



FIG. 1. CARS USED BY EXPEDITIONARY FORCE

to the next, and a buffer near each end of the end sills, with a heavy spring back of it to take the buffing shock.

Since a large part of this shock is transmitted to the side sills it is necessary to have the end of side sills a snug fit into the end sills. The construction of the corner of the steel underframe is shown in Fig. 2.

The center sills, side sills and end sills are made of 10-in. ship channels weighing 21.8 lb. per foot. The side sills are 36 ft. 2 in. long. There are 318 round holes of six different sizes to be punched in the face of the center and side sills and eight ends to be coped to fit the end sills.

I have devised an arrangement for punching and coping these sills by which the operations are all completed in one pass through the machine and which

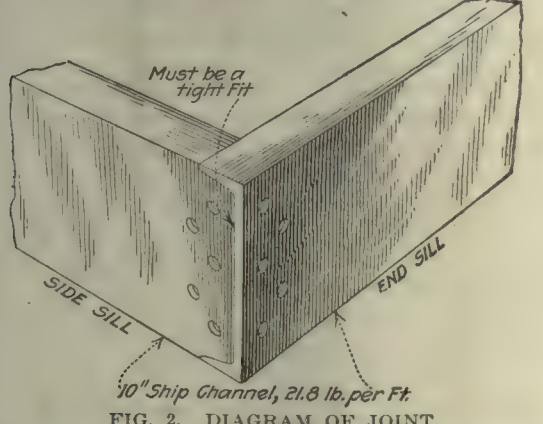


FIG. 2. DIAGRAM OF JOINT

should prove to be of interest to others who are building similar cars.

I am using a punching machine having a 3-in. stroke. The head and base are 36 in. square. Special die blocks *A* and *B*, Fig. 3, which were made of cast iron, and 17 punches are so arranged that all holes can be punched in any sill without shifting it sidewise.

As the channel passes through the machine it is gripped at either end by clamps on a traveling carriage, the rollers of the table being adjusted to the same height as the bottom of the die block *B*, thus maintaining the weight of channel. The coping operations do not use the carriage.

For the first operation the channel stands up edgewise with the end under the square cope knife at the back of the machine.

The cut-out part of the top die block *C* is to clear

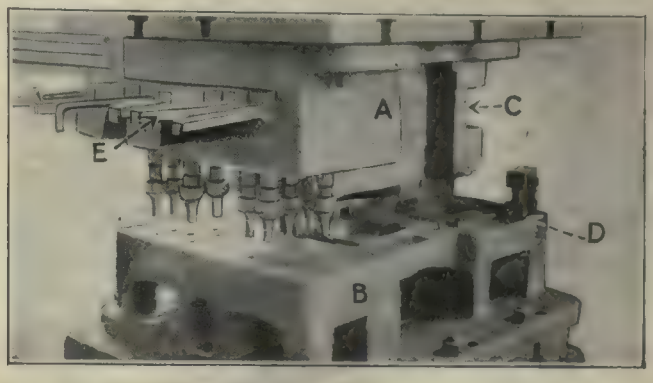


FIG. 3. ARRANGEMENT OF GAG PUNCHES AND COPING TOOLS

the top flange of the channel while the bottom flange is being cut. For the second operation the channel is turned over and the other flange is cut with the same knife. The top knife is shown at *D* in Fig. 3.

The third operation is coping the face of the channel, which is done at the center of the head, the blades for this cut being shown in Fig. 4.

After coping the first end, on the left side of the machine, the channel passes through the machine at the front, where the holes are punched. The other end is then coped on the right side of the machine, making the sill complete. On this last operation the sills are gaged from the end already cut, as they must come to the exact length.

The punches are arranged in seven rows and have eight gags as shown at *E*, Fig. 3. One, two or three holes are punched at each stop of the carriage. The channels are marked from a wooden templet so as to insure punching all the required holes.

There is a 6-in.-square guide between the flange copes

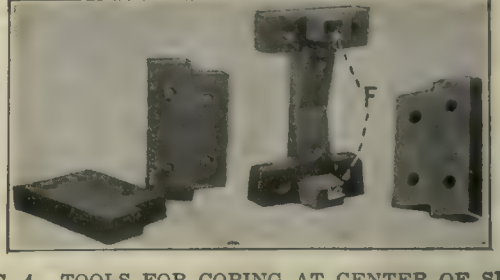


FIG. 4. TOOLS FOR COPING AT CENTER OF SILL

on top the head and it extends down into the bottom block. The raised parts *F* in Fig. 4 also serve as guides to keep the male knife from springing, since only one side is used at a time.

Two sets of face-coping knives are required, the center sills being coped $\frac{5}{16}$-in. deeper than the side sills, because they meet the end sill at an angle.

The Solution of the

WHY should Uncle Sam be content to dispose of his war-purpose machine tools at a loss when he can dispose of them at a profit to their owners, the public, of 1000 per cent. or more?

We have seen a number of plans put forward for the disposal of these tools, varying in practicability from one similar to the rumored method of disposing of the German fleet by sinking it in the ocean, to a more sensible, if hardly more profitable, one of allocating these surplus tools back to their own manufacturers for disposal through them to the public.

All of these plans entail a distinct loss to the public pocketbook and present no possibilities of getting back the first cost of these tools, to say nothing of making a profit on them. The types of tools that have been purchased for war purposes, by virtue of their intended use, have been those with which every machine shop at home and abroad is fairly well supplied for peace purposes. For a long time to come even the most sanguine can expect no great demand for these types of tools. Thus any plan that contemplates putting these machines into the market must of necessity impose a long wait or a low price.

Neither of these things is desirable. A long wait means an accumulation of storage charges and an accumulation of depreciation, for depreciation often piles up at a faster rate when a machine is kept in dead storage than when it is kept busy. Low prices as a means of disposal of these machines are not in line with public interest, since by establishing a fictitiously low level of value for the article—a cut price, below cost-selling policy, in other words—they must inevitably lower wage standards.

There is a way to dispose of these machine tools so that they will earn tremendous profits for the United States.

That way consists of USING THEM TO EQUIP A NATIONAL SYSTEM OF TRADE TRAINING SCHOOLS, in which the mechanical talent of America can be fostered and developed.

IT is true that we have and have had technical high schools, trade schools and manual-training schools, but it is also true that the mechanical equipment of 99 out of 100 of these schools is on the average from 15 to 20 years behind the times. Handicapped as they have been by the necessity of training their students on equipment that the average manufacturer would consider fit only for the scrap pile it is a striking tribute to the value of industrial training that these schools have done as well as they have.

We must encourage trade training as a national policy, and particularly the training of MECHANICAL SKILL, which furnishes the means for the application and extension of skill of all other kinds. The prosperity of America is primarily and basically founded on the sum total of its industrial skill. As we have fostered and developed this skill in the past, and through its possession applied machinery and engineering to the development of our natural resources, so has this country prospered.

WE are an industrial nation. Our inventors, mechanics and scientists are in the aggregate our most valuable citizens, measured by their essentialness to material prosperity, and national material prosperity is the forerunner of progress of every kind. Eliminate these people from our social structure and you bring poverty, hunger and want upon every man, woman and child in America. You paralyze transportation, sever the farm from the city, shut down the coal mines, the steel mills and the factories, put an end to the lives of individuals and communities. Can you think of any other class of citizens the elimination of whom from our scheme of things would bring such chaos?

FOSTER the development of our mechanics, inventors and scientists, and in proportion as you do, so do you add to our national prosperity and individual well-being.

Material prosperity is absolutely limited by the quality and quantity of mechanical skill that exists in the community. All wealth comes from the development of natural resources, and this development is made efficient only by machinery. Mechanical skill gave us the low-priced automobile, the modern locomotive, the ocean greyhound, the sewing machine and the typewriter. Mechanical skill and machinery have given us every labor-saving device that helps to make the world's task an easier one.

During the quarter century previous to the war, mechanical skill and its result in the form of improved machinery caused wages to rise gradually and continuously, while at the same time the cost of manufactured products as consistently and steadily decreased. Mechanical skill has been and will continue to be the world's most potent factor in increasing the purchasing power of money.

War-Tool Problem

NEVER in our history have we needed more than we do now to foster and develop factor that will increase the purchasing power of our dollars. War has forced economic conditions out of balance. Why search for new and untried expedients for restoring this normal balance—for making the dollar as powerful as it was before the war—when we have at hand a means that has demonstrated its effectiveness during a quarter century?

That means is the intensive national cultivation of mechanical skill.

In normal times the development of mechanical skill through the individual efforts of states, communities and progressive manufacturers was perhaps sufficient for the needs of those times. But times now are not normal nor will they ever again be the same as they were before the war. Scattered efforts toward progress must be replaced by intensive, coördinated plans of nation-wide scope.

Double during the next ten years our sum total of mechanical skill and you will not only double our per capita wealth, but, more important, you will double the purchasing power of our dollars.

When you survey the collective inefficiencies of our present-day methods of industrial training you are confronted with an overwhelming sense of the possibilities of achievement through a coördinated plan. And the difficulty in almost every case has been the impossibility of securing proper equipment. Machine tools are expensive when they are modern and worth while. The average industrial community is without the means of obtaining trade-school equipment except such as has outlived its usefulness and productivity.

HERE is an opportunity for our farsighted statesmen to further immeasurably the material welfare of America. Here is an opportunity for Uncle Sam to outfit complete in every community a trade school which will not be a collection of antiquated junk, but will represent the last word in equipment.

Make these surplus machine tools, which everyone is wondering what to do with, available to the educational institutions of America.

Here is an opportunity for statesmen to foster the genius of a coming Watt or Fulton or Stevenson, and thereby to bring upon America the far-reaching benefits of invention. Here is an opportunity for the tens of thousands of American boys who by taste and instinct are unfitted for academic training in scholastic subjects, but who, born with mechanical instincts, can be trained to become valuable mechanics through the development of these instincts instead of being thrust at an early age into occupations of drudgery.

LET CONGRESS SECURE a committee of advisers from among the leading vocational educators of our various states. Let these educators pass upon the surplus mechanical equipment under Government control, eliminating from this such material as cannot be adapted to equip trade schools.

LET THE REMAINDER OF THIS EQUIPMENT which *can* be adapted to equipping trade schools be withdrawn from the custody of the various Government departments that now have it in control and placed in the custody of a national board of commissioners for a period say of two years.

LET THESE COMMISSIONERS pass upon requisitions duly made out by accredited boards of education, universities or colleges that desire to equip trade schools in their communities. Let it be understood that the requisition from any community must be accompanied by satisfactory evidence of the availability of a building to house the machinery and of the assurance of the necessary funds to maintain the trade school.

After the two years or other predetermined period has expired let such machine tools and equipment that have not been requisitioned be disposed of in the market according to one or more of the plans now proposed.

He is a wise investor who places his assets for future profit instead of sacrificing them for present loss. Here are these tools which the Government has bought and paid for—these tools that by their very prevalency, which makes them difficult to sell, makes them exactly suited for training purposes. Let us not sacrifice them at a loss but invest them for a profit.

WE have been behind Germany in preparation for war; we have been behind England and France in preparation for peace. Here is the opportunity for our statesmen to reclaim the American title for progressiveness by using this material that is at hand to establish a broad foundation for enduring prosperity.

How Uncle Sam Will Help Solve Your Export Problem

WITH the kaleidoscopic changes created by the automatic retirement of war-time committees which so ably functioned for our Government during the war industry finds itself relaxed from its extraordinary efforts and is today confronted with readjustment.

Priorities and Government price control have been abandoned and the most practical methods of transposing production from a war to a peace basis which will still maintain employment and wages are being sought.

Many efforts and suggestions have been advanced along the line of export organizations which have been made possible by the Webb-Pomerene bill which permits of the combination of manufacturers for new business in foreign lands, but comparatively few of our manufacturers possess a fundamental knowledge of the necessities for conducting export business.

Previous to the war and owing to the conditions existing in the mercantile marine the greater proportion of the manufacturers of this country did not seek foreign markets and most of those who did held to a rigid system of credit protection. It is a sad commentary on the actions of a part of American industry that in Latin America an erroneous impression prevailed as to the integrity of America's business methods. But the world war transposed these conditions with the closing of the markets of Europe, and our own trade with the 20 countries of South America increased from the year 1913-1914 from $750,000,000 to $1,750,000,000 in 1917-1918, or 253 per cent.

Our larger banking institutions, principally in New York City, established branch offices in all of the countries of South America and the natives of these various countries have come to appreciate the service offered them by our own financial institutions. This places us now in a position to do business on a credit basis, and, with our merchant marine, we are today in a position to compete as never before for this desirable business.

While American manufacturers have been deeply engrossed in their production of war-time requirements there apparently has been overlooked the available information at hand in our own Government agencies. Appreciating the extent and helpfulness of this information the *American Machinist* presents in this issue a diagrammatic chart of information prepared by the Bureau of Foreign and Domestic Commerce, which is



self-explanatory and which portrays the extensive plans of the Department of Commerce in its efforts to serve American industry.

The thoroughness of this foreign-trade service has been outlined in the annual report of the chief of this bureau. All of the information stated in the chart is available for those interested in foreign-trade expansion.

Application for information regarding export business should be addressed to the Bureau of Foreign and Domestic Commerce.

Definite Work for War-Service Committees

AT THE meeting of the Council of War-Service Committees of the National Chamber of Commerce, held at the Waldorf Hotel Jan. 3-4, President Wheeler said:

I have had this feeling about the meeting of the council. At Atlantic City you asked that we should have a meeting at the earliest possible moment to try and get our bearings and relate ourselves together as a new organization. The organization is loose we will have to admit. It has to evolve out of what it is today into the useful machinery it must become, and we cannot expect in a meeting of this kind to develop just what the council will constitute as a force in this country either in relation to the respective industries that are here represented or the business interests of the country as a whole. It was unfortunate that we should have to call a meeting just at this time. It is not an appropriate time to get together. Things are more or less in a state of flux everywhere, and we cannot drive quite as substantially to a common program and definite center as we may be able to do a few weeks from now. In consequance there is more or less embarrassment both in respect to the War Service Executive Committee in calling the council together and in the council's deliberations.

But I want to give you just this word. We have 60 days in which to do intensive work, and if we spend 60 days in completing a perfect piece of machinery we would find the machinery all set up and no opportunity to operate it. The thing that now is necessary is not so much talk but a lot of action, and I have felt that you would be better off for having come into this meeting with your War-Service Executive Committee constantly on the job in Washington, as it will be by sections if not as a whole, there watching your interests and flagging out to you from this time on whatever we think you ought to have relating to your respective industries. But that War-Service Executive Committee is incapable of doing all the work that is going to be necessary in connection with this readjustment. It is up to the War-Service committees to flag into the executive committee in Washington the things that your industries want consideration for and all suggestions that you may have to make that we must pass on to the necessary authority, whatever that may be, in order that there may be coördination between the War-Service executive committee and these War-Service committees that will work intensively during the next 60 days in order to clear up things in our minds which we have not been able to express quite clearly now.

I found in the last few weeks in the many War-Service committees organized, some representing war and some nonwar industries, the question arising as to their relationship to this central body. The nonwar industries say, "We are going back to peace production, and restraints and restrictions are being removed and we have no war orders and no special relationship to the war program, so what relation have we to this council?" The answer is this: This is a council representing every industry in the United States through its War-Service committees charged with the responsibility of safeguarding those industries.

The industries that are particularly beset with problems that have arisen out of the armistice and cessation of war vitally need the support and wise suggestions of the War-Service committees in behalf of every unit of the industry. These industries that are so-called nonwar industries that have not been related to the war program except as to conservation measures and restrictive measures are getting back to normal operations, but are tremendously interested in the fact that if any industry is beset by the problems of today or depressed by conditions that depression relates to every industry and becomes a direct menace to the nonwar industry just as much as the war industries.

In this matter we are absolutely a unit. Unfortunately we are unprepared for the conditions that now confront us. Unfortunately we are always thrown into a new situation without the opportunity of building machinery as other countries have been taught to build theirs. It is the old American policy of tackling the thing when it is on our backs and getting out from under the burden with as little disruption as possible. That is our situation today. We must approach this gulf immediately before us with intelligent action and get over into the period of prosperity which is on the other side of the gulf and will last for several years and which will give us the opportunity of bringing about changes necessary in legislation, the reconstruction of our economic forces and transportation agencies and return to private ownership of those agencies and adjustment of other factors which we cannot do today in the short session of Congress. At this time we must concentrate on the immediate problems of validation of contracts. My judgment is that your War-Service executive committee will do the best that a group of men can possibly do for you, with or without your constant suggestion and coöperation and good-will. But your War-Service executive committee will be multiplied in its power and force if every chairman and vice chairman of a War-Service committee will get his War-Service committee together at the earliest possible date and will study the problems of its industry and let us know the things that the industry is suffering from or likely to suffer from and suggestions that are necessary for its safeguarding.

Constructive suggestions of a national character we need in order that we may be better able to map out the program necessary in Washington, and then by the time this council is next called together we will have a definite, concrete, constructive program to put up to you for discussion and to carry back to the industries in a way that we cannot do today.

We will drive to three central problems which are immediately before us. We want these contracts that are informal validated, and we want aid given to some units of industries now desperately in need of assistance in order that there may be no distintegration in any industry or any unit of industry. We want the question of the resales of property of whatever character delayed and put in the hands of a proper agency so that the departments that now have the control under the law shall understand that these goods are not to be offered promiscuously in the market until such time as we are ready to absorb them without destruction of new production; and in that matter generally one of the strongest factors we can have to support the creation of proper agencies for the distribution of those materials will be labor, as labor is most vitally interested in this matter, for if through uncertainty depression and a resulting cessation of business occurs, because of not knowing what is going to happen on the morrow, and with this great mass of stuff uninventoried and with unfinished war contracts, labor necessarily will be laid off, for there is no production possible under such conditions that will parallel the production of the war period. Labor thus finds itself in a disagreeable position, and we will have to depend upon our forces of industrial production and the forces of labor to combine into a body that shall insist upon legislation necessary for the creation of agencies necessary to bridge us over this period of the next few months.

Oversea Commission to Be Chosen

I want to talk to you about another thing. You wanted that there should be a commission created to send over to the other side, and I think you are entitled to a statement on that matter, for it is something the council is interested in. We could have taken up your suggestion and created a commission; have had it ready at this time to proceed to the other side with an indefiniteness as to program and purpose that would have been unfortunate and might have made for conflict. We have, on the other hand, taken this course. We have been in constant consultation with the administration and by cable with interests on the other side of the water to try and ascertain as nearly as may be at this time the precise conditions that exist over there.

There was no desire on our part to create an agency representing American industry on the other side that would conflict in any way with the practical development of the official agencies that are likely to be created by our Government work and with other governments. The con-

sequence is this matter was handled in this way. We are ready to proceed with the creation of a commission representing American business at the very moment that it seems necessary and desirable to create it and start it across to the other side. We want first to ascertain, and we will know within the course of the next two weeks, precisely what the requirements are and what our own administration and our own business confrères shall agree on as the procedure we should adopt in order to conform so far as possible to the needs they themselves have in mind.

If we find that our own administration in charge of the negotiations will create a suitable and competent and representative group and feel that group can work not under restraint but freely we obviously will tie to that group as our representation. If, on the other hand, we find that official representation on such a commission as may be created cannot freely represent American industry, would operate under certain restraints because of its official connections, and that commission, aside from the official commission necessary to go over there with freedom of action and speech and report in order that American industries may be flagged with the latest information of a correct character, we will supplement such body with a body of our own that will operate without restraint.

Best Means of Accomplishing Purpose

That, we think, is the best means to accomplish the purpose you had in mind at Atlantic City, and within the next two or three weeks we will have information for you as to the course that should be pursued in order that American industries shall be properly represented, if not officially, then unofficially, but so related to the official group that there will be no conflict and there will be freedom of action; and information you want for the safeguarding of your industries will be available to guide you in future operations.

I have a very great desire to see this council take its proper place in the work that is just ahead of us, and it can only take its proper place if each chairman or vice chairman of the respective War Service committees shall function as earnestly in the unwinding of conditions as it functioned in the winding up of those conditions.

Mr. Butterworth said we have been brought up to a certain peak by conditions that have forced us to it and under influences that have been difficult and forced sacrifices on the part of many, and readjustment and reconversion on the part of many is necessary; we have been brought up to this peak and left there, and we have got to either fall off and get bumped or get down by gradual processes in a manner that will bring us to the normal level without the disruption that would come from a sudden fall. The industries themselves know what they ought to have. The War-Service committee of each industry can best advise the safe method of return to normal.

Your War-Service executive committee will stay in Washington and work for you, but you must tell us what you want and indicate the dangers that confront you and give us the aid without which we cannot function effectively and to the fullest extent in your interest. Many problems will come up later on. After the present session of Congress adjourns we will have to call upon this council, possibly drawn together in some different form of organization than today's, to advise us on matters regarding the passage of legislation of economic character that cannot possibly be considered at this time, for we would now scatter our forces so as to make impossible the accomplishment of the things immediately necessary. Keep your War Service committees together and have them meet as soon as you can for the discussion of problems of each industry. Give us a digest of your findings so the War-Service executive committee may have constantly coming into Washington the latest and most effective and complete advice with respect to the manner in which the industry is functioning and the dangers as you see them.

We, on the other hand, will pledge that as rapidly as there is anything in which you are interested takes place in Washington and as rapidly as we see a place where the War-Service committees can exercise force to bring about the things necessary to a return to the proper basis of operation of all industry we will flag it out to you, and you can then exercise your influence with your industries to support these things.

It is altogether a difficult situation. There are very many complex conditions. We cannot have all laws repealed and new ones completed in a short time. We must utilize the machinery that exists now and supplement it by new machinery that can be quickly installed. If we stick together as the units of American industry and as War-Service committees representing all those units for the next 90 days in intensive work on behalf of the difficult conditions that exist we will bridge definitely a gulf that will put us over into a period where for three or four years we will not only have prosperity in this country such as we have not seen for many years, but we will be able during that period of prosperity, coöperating together, to wisely adjust the elements of production so that in any subsequent period of depression we will be prepared to cope with that period rather than have it come upon us as suddenly as the cessation of war came upon us.

We want to have the broadest policy with the agencies of the Government which are trying to function with us. Our industries' needs cannot be known by the agencies except as we give them the information. We want to be generous in our opinions of what they do and we want to be friendly and open with them in our representations to them. Out of this council and of the emergency of the war and out of the coöperation between Government and business that has resulted during the period of the war, and out of the new vision which the public itself has been bound to get of the unselfish effort of American business to advance the war program, have come the complexities of the present moment, because we have waited for no complete contracts. We have only asked to be told what it was necessary to do to win and we have accomplished that to the best of our ability.

The American public, knowing that, has today a different concept of the relation of industry to the Government and of the broad spirit in which industry has operated than it has had for 15 or 20 years. Into this organization and our committees together let us gather our information impartially and honestly for presentation to the agencies that need it and hold ourselves in readiness for service, because the armistice signed or the peace treaty ultimately signed does not mean a release of the war efforts of the agencies that have been in this problem until such time as we have safeguarded the return of industry back to normal operations as before the war.

Our task is only begun. We have got to function through until normal conditions are again with us and until we have solved the difficult problems up to today and have controlled the complex conditions which now confront us and have enabled us to return in safety our industries to their normal position and have again come into relationship with our labor which will be that relationship which must continue during the period beyond the period of readjustment.

Chamber to Aid Readjustment

Just a word as to the chamber. The Chamber of Commerce was organized six years ago at a time when war in the world was considered impossible, because we were led to believe that finance, commerce and industry generally would make impossible the chaos that has resulted in the last four years. We have learned many things about organization. We have learned many new angles of the industrial situation and much of coöperation we did not know before. The chamber will be your servant to make every trade organization as nearly 100 per cent. strong as it may be made in these months that are immediately ahead of us, until trade organizations representing American industry can be largely representative of the whole industry.

You may command us for any service that you think we can render, for any influence that units of the industry think they need with those who have not seen their way clear to associate with you; to come to meetings whenever called and exercise all the power and influence we can exercise in order that the industrial organizations of the country as represented by the trade associations shall be as nearly as possible 100 per cent.

You can trust us further, that the chamber functioning in that way for you will endeavor to make such readjustments of its own machinery as to make a central agency that shall be able to speak as representative of all the agencies of commerce, whether they are agencies of production or distribution or foreign trade or what not, in such fashion that you may be able to rest your case with this central agency which we together have been able to create.

There is a tremendous work for us to do. It is not going to be a work that will ever be done by speeches. It is only going to be done by intensified action. So far as I can pledge the chamber I pledge you its whole efforts to bring about the conditions that are necessary to safeguard industry and restore it to normal conditions, and I ask of you that, having placed in the hands of the chamber this difficult task to perform and having made it necessary for men to still further absent themselves from their own busi-

ness to carry out for you the program you have got in mind for your industry, you will within your industry stay together and hold your organizations exactly as they are, making them operate intensively during these next difficult months and support the chamber in its effort to bring about the conditions you desire.

We want your help for part of this program. We are going to make a part of the program anyway, because there is a determination to use the influence we possess and all the powers we possess to bring about conditions that we know ought to exist; but by united action of the organization which we have in Washington and the organizations that you have in your respective industries we can move across this period that immediately confronts us and into the future with confidence that whatever may come we shall bridge the present dangers safely and safeguard our industries over the gulf we are approaching.

Mr. President, if it should arise in the subsequent meetings of this council and in your deliberation that you should find a substitute machinery in place of the War-Service executive committee as now constituted by your order at the Atlantic City convention, will you let me state to this body that the Chamber of Commerce through that War-Service executive committee will hold its place and perform its work to the best of its ability and with as much unselfishness as it can until the new machinery might be ready to operate.

If at any time American industry as represented by the War-Service committees should find that it can create a central committee that will function better than the committee that you have now functioning for you we will gradually pass back into our own affairs as your committee passes on, thanking you for the opportunity of being relieved of a task which we are doing as best we may in your interest, but which we will relinquish to better machinery as soon as you are ready to supply that machinery. In the meantime, beginning Monday, you will find the War-Service executive committee in Washington in your interest and when we flag back to you the fact that we need your support and that every unit of your industry should be rallied behind a movement that is necessary in obtaining legislation for the erection of machinery necessary to negotiate this period we are going to expect you will be on the job and give us the support we need in order that your own interests may be properly carried on.

Payment for Informal Contracts

As was to be expected there is every reason to believe that Congress will soon pass a bill legalizing such war contracts as were accepted and conducted in good faith but which were not made in the manner required by law. The Committee on Military Affairs has recommended the passage of the following bill (H. R. 13,274):

That the Secretary of War be and he is hereby authorized to adjust, pay or discharge any agreement, express or implied, upon the basis of reasonable value, but in no case greater than the agreed price, that has been entered into in good faith during the present emergency and prior to Nov. 12, 1918, by any officer or agent acting under his authority, direction or instruction with any person, firm or corporation for the acquisition of lands or the use thereof, or for any supplies, material or equipment to be used in the prosecution of the war, when such agreement has been executed in whole or in part, or expenditures have been made or obligations incurred upon the faith of the same by any such person, firm or corporation prior to Nov. 12, 1918, and such agreement has not been executed in the manner prescribed by law;

Provided that payment under such agreement shall not exceed the fair value of the property transferred or delivered and accepted by the United States, as determined by the Secretary of War, and where no property has been transferred, delivered or accepted payment shall not be in excess of the actual cost incurred in preparation for performance as such cost is determined by said secretary;

Provided that this act shall not authorize payment to be made of any claim under such agreements after June 30, 1919;

Provided further that the Secretary of War shall report to Congress at the beginning of its next session following June 30, 1919, a detailed statement showing the nature, terms, and conditions of every such agreement and the payment or adjustment thereof;

Provided further that nothing in this act shall be construed to confer jurisdiction upon any court to entertain a suit against the United States upon any agreement of the character herein provided for;

And provided further that no settlement of any claim arising under any such agreement shall bar the United States Government through any of its duly authorized agencies or any committee of Congress hereafter duly appointed from the right of review of such settlement nor the right of recovery of any money paid by the Government to any party under any settlement entered into or payment made under the provisions of this act if the Government has been defrauded, and the right of recovery in all such cases shall extend to the executors, administrators, heirs and assigns of any such party or parties;

And provided further that nothing in this act shall be construed to relieve any officer or agent of the United States from criminal prosecution under the provisions of any statutes of the United States for any fraud or criminal conduct;

Provided further that this act shall in no way relieve or excuse any officer or his agent from such criminal prosecution because of any irregularity or illegality in the manner of the execution of such agreement.

Provided further that the names of such contractors and the amounts of such partial or final settlements shall be filed with the clerk of the House for the information of Congress and printed in the "Congressional Record" or in the "Official Bulletin," or as a public document, 10 days before confirmation, and payment is authorized upon such contracts.

Government contractors and subcontractors representing $1,500,000,000 met in Cleveland recently to discuss the facilitation of such action, which now seems to be assured.

The Need for Mechanical Training

BY LUTHER D. BURLINGAME

During the war one of the most serious needs, and one most difficult to supply, was that of unskilled labor. This was due not only to the demands of the war industries and the withdrawal of large numbers for military service, but also to the stopping of immigration.

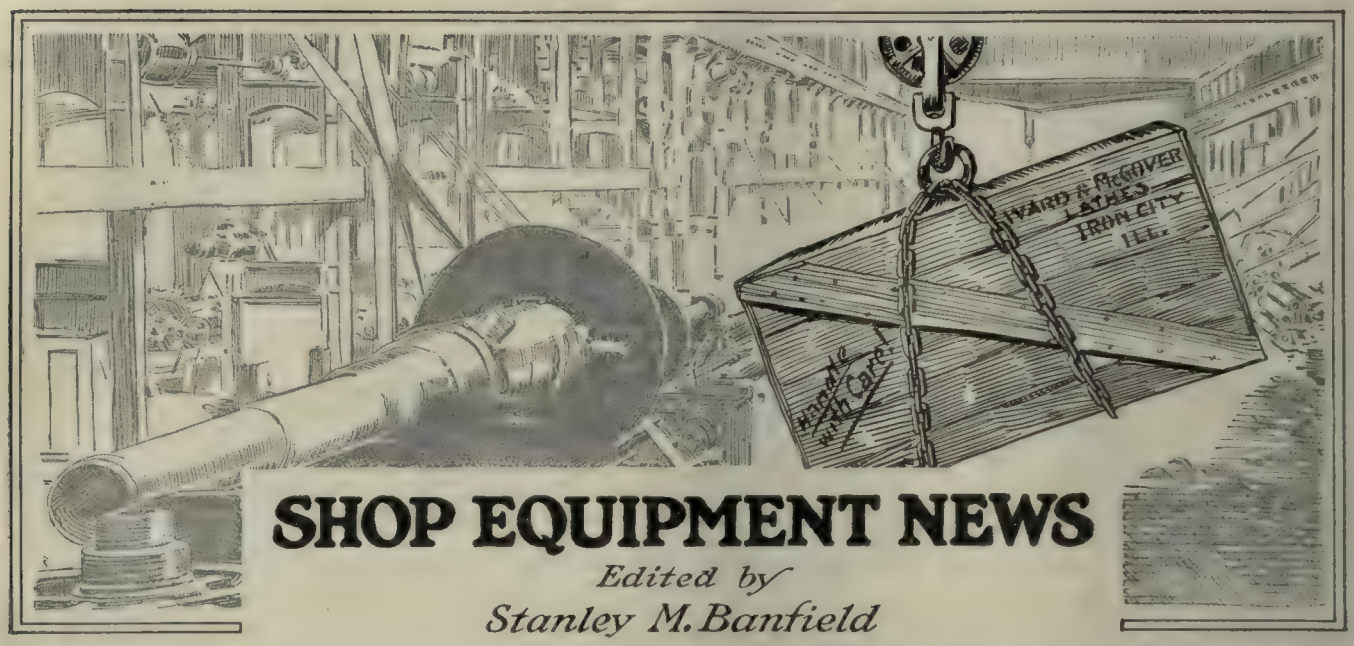
While there is a wide difference of opinion as to immigration following the close of the war it is evident that when settled conditions return in Europe large numbers of foreign-born workers in this country will return home, and while in some cases this may be temporary, to find and help relatives and friends, it is probable that many will stay to help in the restoration of their home countries.

It is also probable that immigration from countries that have furnished most of it in the past will be held back, and there will probably be a departure of the foreign born now here.

To overcome this labor scarcity an effective way would be the introduction of labor-saving devices, machines and methods for performing unskilled work, which would permit one workman to perform the tasks of many.

The story has been told of a French army officer who had won a medal for bravery being at a loss to know how to adjust his relations with his valet following the war, as he did not see how he could ask him to polish his shoes when the valet had won the Croix de Guerre. What an opportunity for exploiting nickel-in-the-slot shoe-polishing machines in France!

The supplying of mechanical aids is a direct field for inventive ingenuity and for business enterprise, which if worked out will give stimulus and prosperity to the mechanical trades.

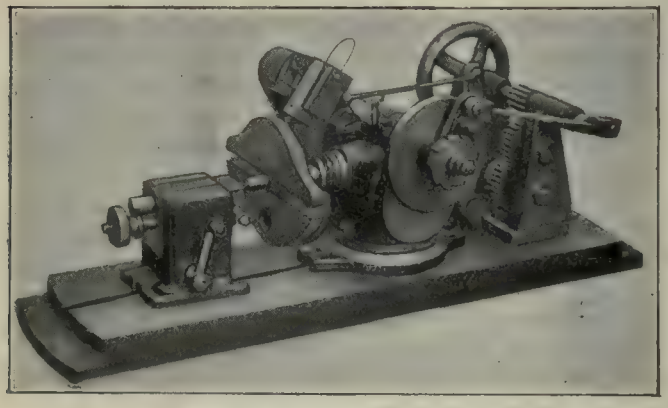


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Schipper Graduating Machine

The Schipper Machine and Tool Co., Aurora, Ind., is making the graduating device shown. It is an attachment fitting the 10-in. universal index head made by the company. It will graduate disks or dials at any angle from 45 to 90 deg. inclusive. It will graduate parts up to 10 in. in diameter, cutting four short marks and one long



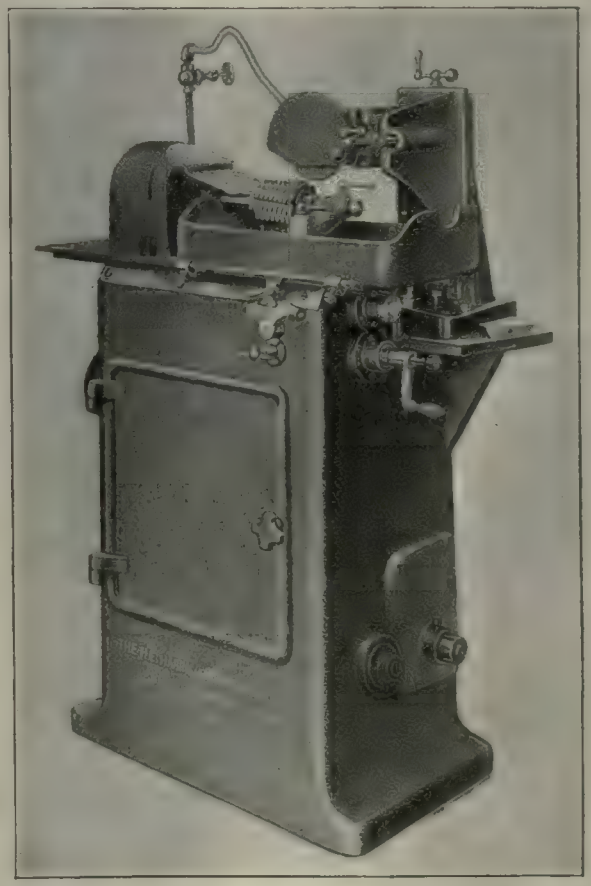
SCHIPPPER GRADUATING MACHINE

one and repeating automatically as the handwheel is turned.

The device can be mounted on a milling or planing machine table or a bench. It weighs complete 110 lb. and when not needed is easily detached from the index head, which can then be used for other work.

Harris Automatic Universal Hob and Form Cutter Grinding Machine

The illustration shows the new No. 4 automatic universal hob and form cutter grinding machine that has recently been placed on the market by the Harris Engineering Co., 1047 Broad St., Bridgeport, Conn. It is claimed that hob-grinding work may be done on this machine with lower-priced labor than is ordinarily used for this purpose and the points of advantage of the machine cited are as follows: Hobs and form cutters can be accurately and evenly ground. The amount of material ground away at each stroke of the machine is a minimum and therefore crowding and its attendant heating and burning are avoided. Flood lubrication is used, avoiding overheating. The speed at which the



HARRIS NO. 4 AUTOMATIC HOB AND FORM CUTTER GRINDING MACHINE

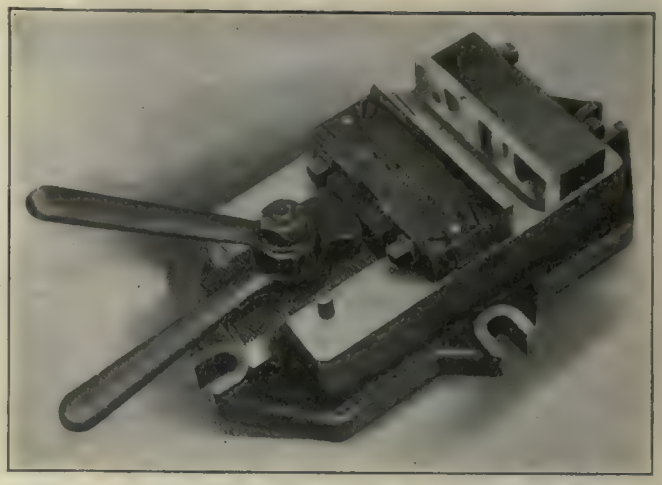
hob or form cutter is fed to the grinding wheel is constant and an experienced operator is not required, and the machine being automatic in action the operator can run it in connection with other work. Setting up operations are simple, thus avoiding the tendency to use

hobs or form cutters until they are excessively dull. The machine may be used for salvaging milling cutters by regashing the teeth and will grind any form cutter or hob within its range, including radial mills, fluting cutters, gear cutters, irregular form cutters, hobs for female-thread gages, dies, etc., hobs for worm wheels, hobs for gears and other such work. The grinding spindle runs on ball bearings and is provided with micrometer adjustments in both horizontal and vertical directions. The wheel is covered with a guard into which the lubricant is fed. After being used the lubricant drains from the wheel and the work into the pan surrounding the table from where it runs back into the tank located in the column. The work is carried between centers on a reciprocating table provided with an adjustable stroke. The table carries the necessary means for setting and holding the work and also carries that part of the indexing mechanism which indicates and clamps the hob or form tool in position for each double grinding stroke. It is interesting to note that a device has been incorporated to prevent back lash to permit grinding on both the forward and back strokes of the machine. The operating mechanism for the indexing is contained in the column below the table and is timed to coördinate with a mechanism for the table movements. The automatic mechanism for operating the table can be instantly connected or disconnected at any time by means of a positive clutch operated by handle within reach of the operator.

All wearing surfaces are provided with adjustments for taking up wear and are protected from dust and particles of abrasive. The wheel head, together with its slides, idlers and other mechanism, is placed on a large circular mounting at the rear of the machine, this allowing the wheel to be swung and clamped at any angle desired. This movement does not affect the axial position of the wheel in relation to the work, but adapts the wheel to suit the spiral flutes to be ground. The spiral mechanism is mounted at the rear of the machine and operates directly on the arbor, an adjustment being provided for the amount of spiral required. This adjustment is so made that it can be quickly set for a cutter, the spiral of which is not known exactly. It is possible by means of transverse adjustment of the wheel to grind the faces of the teeth radial, with an undercut or rake, or at an obtuse angle. The amount removed from the face of the teeth is controlled by rotating the hob slightly in relation to the indexing mechanism after each complete revolution, an adjusting screw being provided for accomplishing this movement. This insures the shape of the tooth being the same no matter how much material is taken off. The machine is also adapted for special work in which it is necessary to use formed wheels and may also be so arranged as to back off the teeth of taps at the cutting end.

Hartford Quick-Acting Milling Vise

The Hartford Special Machinery Co., Hartford, Conn., has recently placed on the market a new 5-in. quick-acting milling vise. The parts of the vise are made of drop-forgings, casting and bar stock, and are machined all over to gages to permit interchangeability. All fitting and sliding surfaces are hardened and ground and the sliding jaw is scraped to the base. In the sliding

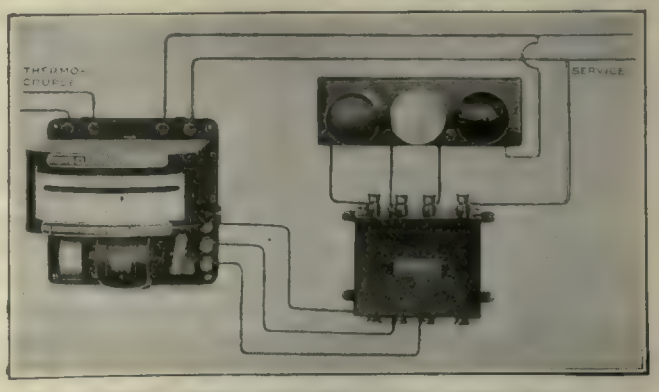


HARTFORD QUICK-ACTING MILLING VISE

jaw is a T-slot which receives the head of the bolt carrying the bearing, which has serrations to engage those on the sliding jaw. The eccentric of the binder handle fits in the cam handle and both swing on the same bearing, which is clamped to the jaw by the bolt. In operation the sliding jaw is adjusted to the work by clamping the bearing in its proper place. The cam moves the jaw up to the work and partially clamps it, while a movement of the eccentric gives a final tightening.

Brown Automatic Signaling Pyrometers

In most plants where pyrometer equipment is used it is customary to use three colored lights to indicate the temperature to the furnace operator; one light is for too low a temperature, the second for too high a temperature, while the third indicates the proper temperature. This system ordinarily requires the maintenance of a central operator to flash the signals and considerable other apparatus. In order to save the expense of the operator's time and the elaborate installation the Brown Instrument Co., Philadelphia, Penn., has recently placed on the market a new automatic signaling pyrometer. A contact table that is adjustable throughout the whole scale range carries three contacts corresponding to the three lights, the pointer on the pyrometer being automatically depressed once a minute on the tungsten contacts. An automatic three-position relay is operated by the closing of the contacts in the instrument. This closing of the contacts lasts but a few seconds, the relay serving to keep the proper light in operation at all times. In case it is desirable to be able to read the temperature



BROWN AUTOMATIC SIGNALING PYROMETER

of other thermocouples besides the one being automatically signaled a hand-operated switch is installed that can be used to connect the pyrometer with other thermocouples. In this case the relay keeps the same light burning at the furnace being automatically signaled until the pyrometer is again connected in circuit.

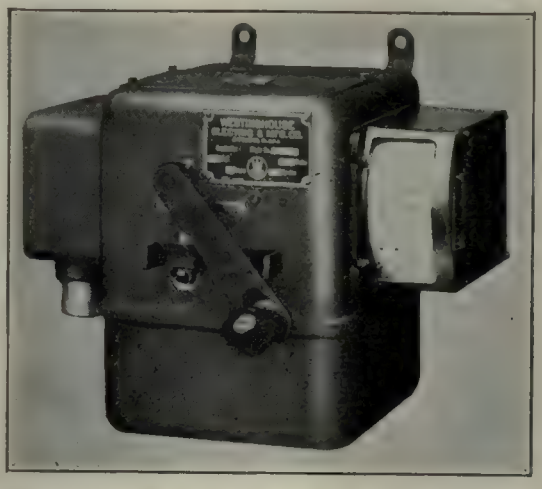
By introducing an automatic motor- or clock-driven switch in connection with the pyrometer the temperature of practically any number of thermocouples can be automatically signaled by one instrument. Standard instruments are furnished for operating up to 12 furnaces in this manner, this method eliminating the expense of maintaining a central operator and an elaborate installation of a switchboard and hand-operated signal lights.

Another recent improvement that has been developed is an automatic advancing mechanism for the contact, this device causing the contacts to advance at a predetermined speed across the scale. This is claimed to be of great advantage in certain processes like kiln firing where the temperature must be advanced slowly at a predetermined rate. The same type of instrument is also supplied for automatic control of temperature either with electric switches for electric furnaces or with valves for steam, gas or oil. The automatic control can be so installed as to maintain the temperature at a given point or to advance it at a predetermined rate.

Westinghouse Quick-Make Motor-Starting Switch

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has recently placed on the market the quick-make motor-starting switch shown in the illustration. Its characteristics are 10 to 100 amp., 25-hp. maximum, three-phase, 220, 440 and 550 volts. The device may also be used to control feeder circuits and is supplied in any of the following combinations, each having the quick-make and quick-break feature for either hand or shipper-rod operation: Nonautomatic switch, switch with low-voltage protection, switch with inverse time element overload protection, and full automatic switch with low-voltage and inverse time element overload protection. It is said that the switch is particularly suitable for shipper-rod operation on account of its positive action, it being impossible for the operator to retard the motion of the contacts after they have started to close. The contacts, which are opened or closed in oil, are made very quickly, and the rolling action confines the arc to the tips and prevents pitting.

Drawn-steel construction is used to give maximum strength with light weight and to assure uniformity and interchangeability of parts. The oil tank is supported by snap ring latches, the removal of this tank exposing the contacts. The contacts and contact supports are of the same construction used in Westinghouse type A auto starters and magnetic contactors. Micarta insulation is used throughout and openings are provided for conduit wiring into the top of the case. Overload and low-voltage attachments may be added without change in the switch mechanism as the toggle trip is common to all combinations of the switch. Low-voltage protection not only opens the contacts on failure of power, but makes it impossible to close them again until the return of voltage. Since the low-voltage coil is connected in the line circuit continuously means have been provided to close the armature of the low-voltage circuit when the switch is in the off position, thereby giving protection to the coil and preventing burn-outs. A safety stop may be provided by connecting one or more push buttons in series with the low-voltage coil. The overload relay is the same as that used on the Westinghouse type A autostarters, and has the inverse time element feature and is equipped with a regulating device, adjustment of which controls the degree and duration of the overload possible on a motor or feeder circuit. A hand reset is an additional safety feature that makes it necessary to set the mechanism before the switch contacts can be closed. After having been opened through the operation of the low-voltage coil, the overload relay or by moving the switch handle to the off position it is impossible to close the contacts again until the switch handle has been moved to the reset position, this feature protecting workman and machinery as well against the accidental starting of the motor.



WESTINGHOUSE QUICK-MAKE STARTING SWITCH

Demands for Industrial Physicians Growing Rapidly

The demand upon the newly established Working Conditions Service of the United States Department of Labor for industrial physicians and surgeons has grown so rapidly that the service has been compelled to establish a bureau of registry of physicians specially skilled in this growing phase of medical and surgical specialization.

The new registry bureau is prepared to furnish industries with the names of skilled industrial medical advisers on request and hundreds of physicians are listed in the Government's registry bureau in Washington and hundreds are being added to the registration files.

In each instance the service satisfies itself of the training of the physicians before their names are allowed on the list. In this manner industries are assured reliable information from authorities who have studied industrial problems with expert training in hygiene, sanitation and related subjects.

Employers and employers have expressed approval of the plans inaugurated by the Working Conditions Service and have shown a desire to coöperate in the establishment of factory-hygiene department.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



The Simplex Automobile Co., New Brunswick, N. J., was bought by the Wright-Martin Aircraft Corporation on Dec. 23, 1918.

In the 3 per cent. revenue tax the United States Government received $23,981,368 from automobile manufacturers for the year ended July 30, 1918.

The Senate Finance Committee has passed the new war-revenue bill with the elimination of the 5 per cent. tax on the sale prices of motor trucks, motor-truck trailers and tractors.

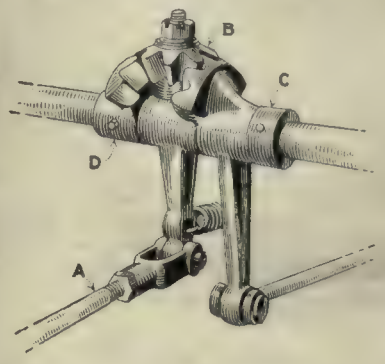
A new endurance-flight world record of 32 hours in a nonrigid dirigible balloon was established by Ensign T. E. Maytham at the United States Naval Air Station at Key West, Fla. Six hundred miles were covered before a leak and a threatening storm compelled landing.

A big exhibition ground has been established on the Champ de Mars, Paris, where the French military authorities are selling 1134 trucks, 1655 light trucks, 2884 touring cars, 1826 motorcycles and 2145 units, such as motors, transmissions, etc. Up to the present these sales of war-worn automobiles have enriched the state treasury to the extent of more than $6,000,000.

A feature of the new La Crosse tractor, model G, is the line drive. To the automatic-type steering gear a line-drive device has been added so that the tractor may be stopped, started and steered by the pull of the lines from the seat of any horse-drawn implement. The tractor is an open design and is burning kerosene by using a Kingston carburetor and a Bennett air cleaner.

The Fiat Co., Turin, Italy, will be represented with four new models on the market, two models with a four-cylinder Monobloc engine 8-12 and 12-16 hp. and two with six-cylinder Monobloc vertical engines 25-35 and 35-45 hp. Interesting features of these models are the adaptation of detachable cylinder heads, and each model will be fitted with electric lighting and starting specially designed for that particular chassis. In the after-war production program the Fiat Co. is taking up the manufacturing of commercial vehicles, also the production of the agricultural tractor.

The illustration shows a brake-equalizer design used on the United States motor trucks. The importance of a brake equalizer lies in the fact that the same pressure is applied to both wheels and makes skidding from uneven brake pressure impossible. The



action of the brake equalizer here shown is as follows: When strain is applied to the lever *A*, which carries the bevel pinion *B*, sectors *C* and *D* and the shaft are related until resistance is effected by one of the brakes being engaged. But should resistance of one brake take place somewhat ahead of the other, motion through the bevel pinion *B* is caused on the opposite sector until it is also engaged; then the differential movement ceases and equal strain is applied to both brakes.

The Ford Motor Co. announced on Jan. 1, 1919, a new minimum wage scale of $6 a day, which is a flat increase of $1 a day for approximately 28,000 employees. Coincident with the announcement of the wage increase it was made known that Henry Ford had formally resigned as president of the company and his son Edsel became executive head of the corporation, which represents an investment of nearly $200,000,000.

The Tractor Division of the S. A. E. submits the following recommendations about the speed and widths for power belts and pulleys: "Tractors shall be equipped with pulleys giving a belt speed of 2600 ft. per minute at the crown of the pulley. The pulley shall be as large as possible and the widths vary according to the horsepower delivered. Under 20 hp. the pulley width shall be 6½ in. and the belt width 6 in. For 20 to 30 hp. a pulley width of 7½ in. and a belt width of 7 in. are recommended."

The Motor Division, Quartermaster Department, has informed the Liberty truck manufacturers that they can manufacture and sell the parts of this truck or complete assembly of the chassis for commercial use. However the drawings, workmanship and material have to be held in connection with the Government specifications, giving the right to the Government to purchase the Liberty motor parts if an emergency arises.

The Selden Motor Vehicle Co. is represented with seven truck models in 1919. The three 1-ton trucks are offered with worm or internal gear drive, the two 2-ton trucks having four speeds this year, and the 3½- and 5-ton models have their gearsets mounted amidships. Each of the seven models has a Continental engine, a Brown-Lipe dry-disk clutch and a Brown-Lipe selective gearset. Starting and lighting equipment is supplied with each model.

The "dope" used on airplane wings to render the fabric taut and waterproof commonly consists of a solution of cellulose acetate. Among the more common solvents for the acetate are acetone and combinations consisting largely of tetrachlorethane and alcohol. To dissolve the nitrate the usual solvents such as amylacetate and acetone are used. To preserve the flexibility of the coating and modify the shrinkage power some substance such as castor oil is usually added to the "dopes." The great difference between the coatings given by cellulose acetate and cellulose nitrate "dopes" is the inflammability of the latter. That cellulose acetate "dopes" leave a noninflammable finish is well illustrated by the fact that when gasoline is poured on a piece of fabric coated with a good cellulose acetate "dope" and allowed to burn the fabric does not ignite. The same test applied to a cellulose-nitrate "dope"-coated cloth results in the immediate ignition of the coating. Smoothness and adhesion are very important requirements of airplane "dopes." An interesting calculation has been made by the National Advisory Committee for Aeronautics, showing that in a moderately large machine the difference in wind resistance between a "doped" and an "undoped" fabric would correspond to a difference in lifting power of from 150 to 180 lb. As regards the adhesion a good "dope" should adhere well to the fabric, so that in case of a break in the cloth the coating will not be started and peel off.



Sparks from the

Independent Steel Firms Open Export Office

Eight of the Largest Producing Companies of the Country Are Represented in the New Organization

The organization formed by the independent steel manufacturers to handle their export trade has been incorporated in the state of Delaware with a capital of $10,000,000. Active business was started on Jan. 2 with the opening of general offices in the City Investing Building, New York.

The Consolidated Steel Corporation, which is the name finally adopted, will be the exclusive agency for exporting the merchant iron and steel products of the following companies: Bethlehem Steel Co., the Brier Hill Steel Co., Cambria Steel Co., Lackawanna Steel Co., Republic Iron and Steel Co., Sharon Steel Hoop Co., the Trumbull Steel Co., Whitaker-Glessner Co. and the Youngstown Sheet and Tube Company.

Together these companies control more than one-quarter of the steel-making capacity of the country and their annual ingot capacity is about 12,000,000 tons. It is expected that other companies will join until substantially all important steel producers of the country, outside of the United States Steel Corporation, will be represented.

The president of the organization is E. A. S. Clarke, who resigned from the presidency and directorship of the Lackawanna Steel Co. in order to devote his full time to the new enterprise. H. H. Barbour, the vice president, was formerly with the Lackawanna Steel Co., and the same is true of L. W. Hesselman, secretary and comptroller, and A. Van Winkle, treasurer. Mr. Hesselman was comptroller of the Lackawanna company, and Mr. Van Winkle was secretary to Mr. Clarke when he was at the head of that concern. The traffic manager is William Heyman, formerly foreign freight agent of the Delaware, Lackawanna & Western R.R. The board of directors consists of the heads of the constituent companies.

Foreign offices are to be opened and representatives appointed to cover every part of the world where American iron and steel products are usable.

* * *

Use Motion Pictures to Present Annual Report to Stockholders

It is announced by Tampton Aubuchon, general manager of the Louisville Industrial Foundation, the so-termed million-dollar factory-fund of Louisville, Ky., that the organization's annual report to the stockholders will be partly rendered in motion pictures, and will include views of the manufacture of automobile axles, overalls, clothing, tobacco, wood products, soap, oil, bed springs, heating apparatus, furniture, etc. It will be expressive in a measure of the character of industries located in Louisville as well as the type of skilled mechanics employed.

About twenty new industries have been located in the city of Louisville as the result of the foundation's activities, and camera men are busily engaged in photographing the salient features of the various new factories in order that an intimate review of the industries, their processes and products, may be presented to the stockholders and the citizens.

The idea of presenting an annual report in moving pictures is unique, and it is believed to be original in its application in Louisville.

* * *

Date of Third Sample Fair at Bordeaux Fixed

Preliminary announcement of the holding of the third sample fair at Bordeaux, France, has recently been made by the committee of organization and administration, and the date is now fixed for May 16 to 31, 1919. A special invitation to participate is extended to American exporters and manufacturers.

The Bordeaux Sample Fair, which is held under the auspices of the General Council of the Department of the Gironde, the Chamber of Commerce of Bordeaux, and the municipal council of the city of Bordeaux, appears to be on a permanent basis, being backed by a group of local financiers known as the Société de la Foire de Bordeaux. Though inaugurated since the war began and under trying conditions the exposition has prospered and grown, the total turnover of business for exhibitors amounting in 1916, the first year, to 15,000,000 fr. and in 1917 to nearly 25,000,000 fr. Exhibitors at the first and second fairs numbered approximately 1200 each year and a considerable increase is expected for 1919.

American exporters and manufacturers who are interested in expanding their trade with France and in French colonial territories should find this fair an excellent opportunity to reach buyers from all parts of the country. With the prospects for the bettering of both shipping and commercial conditions by next spring the Bordeaux fair will be all the greater in importance. Applications for space, descriptive booklets and terms should be addressed to the Comité d'Organization et Administration de la Foire de Bordeaux, Hotel de Ville, Bordeaux.

Market in Finland for Machinery, Machine Tools, Etc.

Four years ago Finland depended largely on Germany for its manufactured articles from household utensils to the heaviest machinery. Today it is generally conceded that the United States will be the most serious competitor of Germany in the Finnish market.

One of Finland's largest importers recently remarked that there are plenty of first-class firms in Finland that would be only too glad to accept the agency of solid American firms, and most of them are already looking for first-class connections in America.

Among the numerous articles needed by Finland are agricultural machinery, gasoline engines, machine tools and instruments, sewing machines, bicycles, automobiles, motor boats, household utensils, typewriters, adding machines, cash registers, safes, locks, rifles, revolvers, post-office boxes, copper, moving-picture machines, rubber tires and all kinds of rubber articles.

* * *

War Plant to Find Peace Jobs For Men

The Minneapolis Steel and Machinery Co., Minneapolis, Minn., acting upon its own initiative, is establishing a department by means of which it hopes to find employment at once for every man thrown out of work by the completion of Government munition contracts. About 2500 will be affected at different times as work on the various contracts is finished, and it is the plan of the company to be able through this department to place every man with some other industry.

* * *

Lackawanna Steel Co. Makes Official Changes

Changes in the official personnel of the operating forces of the Lackawanna Steel Co.'s plant at Buffalo have been announced as follows: T. H. Mathias, formerly assistant general superintendent, has been appointed general superintendent, succeeding G. F. Downs, who has been made a vice president in charge of operation, and G. W. Whitehead, formerly assistant superintendent, who has been appointed assistant general superintendent. Both of the new appointees have their headquarters in the general offices of the company at the plant.

* * *

The A. S. M. E. Spring Meeting

The spring meeting of the American Society of Mechanical Engineers will be held in Detroit and the date has been tentatively announced as June 17 to 20.

World's Industrial Forge

By E.C.Porter, News Editor

Discovers a Substitute for Platinum

Announcement is made by the Chemicals Division of the War Industries Board of the discovery of a new substance to take the place of platinum in the manufacture of sulphuric acid. The discovery was made during the later days of the war. Sulphuric acid is required in the manufacture of high explosives, and a serious stringency was being faced due to the scarcity of platinum and the difficulty of obtaining it, even in small quantities, from Russia.

In the manufacture of sulphuric acid, sulphur dioxide (SO_2) is first obtained by burning sulphur pyrites. This sulphur-dioxide gas, after being dried, is passed over magnesia containing a small percentage of platinum. In this process the sulphur dioxide takes up an additional atom of oxygen (O), thus forming sulphur trioxide (SO_3). This sulphur trioxide in turn is passed through water (H_2O), forming sulphuric acid (HS_2O_4).

In the above operation the platinum performs the function of a catalyst in that it quickens the process of converting the sulphur dioxide into sulphur trioxide. Not only has the new catalyst been demonstrated as practical in laboratory tests, but a commercial plant has been established which is producing the substance in quantity. Not only is it cheaper than platinum, but it has been found to be less sensitive to "poisoning." Altogether, the discovery is regarded as a distinct advance in the art.

The same catalyst has been tried out successfully in a modified Deacon process for making chlorine gas in connection with the manufacture of mustard gas. By its use it has been found possible to effect a considerable saving in the electrical horsepower required by the process. Ordinarily for the manufacture of 100 tons of chlorine 20,000 hp. would be required. With the use of the new catalyst the same quantity can be made from 2000 horsepower.

The Fellows Gear Shaper Co.'s Annual Bonus

In accordance with a policy decided on three years ago the Fellows Gear Shaper Co., Springfield, Vt., this year paid a bonus to every man and woman who entered its employ before Dec. 1 and was still employed on Dec. 24, the date on which the bonus was distributed. This bonus was based on the yearly earnings, including the regular 10 per cent. bonus for full time and all overtime. The minimum rate was 2 per cent. for the first and second years and 1 per cent. for each succeeding year up to 10 per cent. For instance, those entering the employ of the company during 1918 received 2 per cent. on their total yearly earnings, and those in the employ of the company for 10 years received 10 per cent.

For the year 1918 over 400 employees shared in the bonus, which amounted to a total of approximately $14,500. Thirty per cent. have been with the company more than three years, receiving the bonus since its inauguration, and slightly over 5½ per cent. of these employees have been with the company 10 years or more. This is rather remarkable when we consider the conditions which were brought about by the war.

A further policy of the company is that in reference to employees who have entered the service of our country. These men upon their return will receive a bonus which will be based on their earnings for the time of previous employment. At the same time all employees who have entered Government service will not upon their return be considered as new employees, but will still retain their same rank as far as number of years of service is concerned.

While it is true that within the past year a large number of new employees have entered the service of this company the old spirit of loyalty has been maintained. The endeavor throughout is to create and maintain a family spirit, having the surroundings, conditions of labor and so forth as congenial as it is possible to make them.

Local Meetings of the A. S. M. E.

A meeting has been arranged for Jan. 29 at the Hotel Statler, Buffalo, at 8:30 p.m. Nathan L. Lieberman will deliver an address on "Horsepower Requirements of Aeroplanes and Power Consumption through Parasite Resistance."

The Philadelphia local will hold its monthly meeting in the Engineers' Club on Jan. 28. William B. Dickson, vice president and treasurer of the Midvale Steel and Ordnance Co., New York, will deliver an address on the subject of "Relations Between Employer and Employee."

Kempsmith Komments

Kempsmith Komments is a live little paper of 28 6 x 9 pages published by the Kempsmith Manufacturing Co., Milwaukee, Wis. Not only is the paper full of items of interest to the employees, but there is a good article on apprenticeship by Stewart Scrimshaw, supervisor of apprentices of Wisconsin.

Machinery Import Rules To England Relaxed

New Order to Continue Until Mar. 1, and Is Expected to Be Extended After That Date

For the information of exporters in the United States who are interested in the relaxations of import restrictions in countries abroad the War Trade Board announces in a new ruling (W. T. B. R. 490) that it has received advice that the following commodities may be imported into Great Britain without the necessity of obtaining an individual import license therefor:

THE LIST OF COMMODITIES

All machinery driven by power and suitable for use in cutting, working or operating on wood, including sawing machines of all descriptions, general joiners, mortise, tenon and boring machines; lathes and rounding machines; box and cask making machines, and all machinery accessory thereto; scraping and sandpapering machines; wheelwright machinery; firewood making and bundling machinery; wood, wool, fiber and pulp machinery; saw sharpening and setting machines; saw stretchers and brazing apparatus; all machines for grinding, planing or molding irons; all machine tools and machinery driven by power and suitable for use in cutting, stamping or working metal, including lathes, milling machines, drilling machines, planing machines, shaping machines, screw chucking machines, boring machines, slotting machines, grinding machines, boring and turning mills, power presses, punching and shearing machines, forging machines, cutting-off machines, gear-cutting machines, centering machines; leather gloves; coffee, and tobacco, manufactured and unmanufactured, including cigars and cigarettes.

This list, together with the list contained in W. T. B. R. 390, Dec. 9, 1918, contains all the commodities as to which the War Trade Board has had notice of import relaxations by Great Britain up to the present time. It is stated that these relaxations are to continue only until Mar. 1, 1919, but it is anticipated that at that time they will be again extended.

The War Trade Board is also informed that shipping recommendations from the Priority Board at Cairo are no longer required in connection with transshipments in the United Kingdom of goods destined for Egypt, and that the government of India has withdrawn its prohibition against the importation of motor cars, chassis, motorcycles and parts and accessories thereof.

Babcock Printing Press Co. Takes Over Property

Title to the property of the Reed-Prentice Co., formerly the Brown Cotton Gin Co., New London, Conn., was taken recently by A. B. Leach & Co., bankers of New York, acting on behalf of the Babcock Printing Press Manufacutring Co.

It is stated that this company will make some changes and will modernize some of the old buildings of the plant. It is the intention to put the business on a production basis. Jigs and fixtures will be used and the product will be so standardized as to permit interchangeability of parts.

The present officers are: President, Charles A. Collard, who has been connected with the sales management of the company for many years; vice president and manager, James E. Bennett, connected with company for the past 12 years, and is secretary of the Printing Press Manufacturers' Association of the United States; treasurer, Mrs. George P. Fenner; secretary and assistant treasurer, Wilfred D. Wells, who has been connected with the company for over 30 years; chief engineer, Fred S. English; general superintendent, Howard L. Hetherington, both of whom have been with the company for nearly 20 years.

* * *

Making More Edge Tools Now

With the coming of peace there has been an increase in the assortment of tools in contradistinction to the radical reduction which was a marked feature of the conservation policy of the War Industries Board.

In the line of edge tools, such as axes, hatchets and hammers, where there was only one finish, natural colored black, there is a restoration of polished, bronzed and in some cases nickel-plated finishes.

Other lines of edge tools temporarily discontinued, such as certain styles of planes, are now being furnished by manufacturers as in the days before the war.

* * *

Greatest Oil Output in 1918

Preliminary estimates by the United States Geological Survey, Department of the Interior, indicate that the quality of petroleum marketed from oil wells and field storage tanks in the United States in 1918 amounted to 345,500,000 bbl., an apparent gain of 3 per cent. over the former record output of 335,315,601 bbl. established in 1917.

The output in 1918 includes no less than 6,500,000 bbl. of crude oil removed from field storage during the year. The surface reserve of crude oil held by oil producers and pipe-line companies in the United States at the end of 1918 is estimated at 123,000,000 bbl. compared with 150,000,000 bbl. at the end of 1917. The Geological Survey's detailed statement of petroleum production will be made public in a few days.

Business Items

The Vanadium-Alloys Steel Co., Pittsburgh, Penn., has opened a Chicago office at 566-568 Randolph Street.

The International Oxygen Co. has moved its general offices from 115 Broadway, New York, to the company's Waverly works at 796 Frelinghuysen Ave., Newark, N. J.

The Fansteel Products Co., Inc., has moved its New York office from 2 Columbus Circle to 15 Park Row, New York.

The Lancaster Steel Products Co. has opened a Western office in the United Motors Building at 2715 South Michigan Ave., Chicago, Ill. Frank N. Adgate has been placed in charge of this office.

Obituary

WALTER V. TURNER, manager of the engineering department of the Westinghouse Air Brake Co., died in Columbia Hospital, Wilkinsburg, Penn., Jan. 9, 1919, following a brief illness.

LEO JULIUS LEFFLER, secretary of Chas. Leffler & Co., 59 Clymer St., Brooklyn, N. Y., died on Dec. 20, 1918.

ROGER SHERMAN MITCHELL, late of the Philadelphia sales office of the Worthington Pump and Machinery Corporation, Deane Works, died at his home in St. Davids, Penn., Dec. 20, 1918, after a lingering illness of several months.

WILLIAM M. LANGWILL, who had been in charge of the Watertown warehouse of the Crane & Ordway Co., died on Nov. 12, from pneumonia. Mr. Langwill was born Sept. 6, 1885. He entered the employ of the Crane & Ordway Co. in 1908, took charge of the Watertown warehouse in 1910, and continued in that position until the time of his death.

* * *

Scarcity of Timber Supplies in European Countries

Metal construction will undoubtedly replace wood construction to a great extent in many of the leading European countries owing to the numerous demands made upon the timber supplies during the past four years of war. It is reported that one-half of the forests in Great Britain were cut down during the war.

* * *

Will Use Shop Refuse for Fuel

New Orleans sash and blind factories will use shop refuse as fuel this winter as a fuel-conservation measure. Many of the plants in this Southern city have decided to use no coal and are remodeling their boilers in order that they can use scraps as fuel.

Will Hold Automobile Show

The Automobile Dealers' Association of New York has completed its arrangements for the automobile exposition which will be held in Madison Square Garden from Feb. 1 to Feb. 15. This will be the first time that the dealers of the city have conducted an automobile show. The regular national show, which would have been held early in January, was called off several weeks ago by the National Automobile Chamber of Commerce owing to the war.

With the improved conditions in the motor industry since the signing of the armistice, the announcement by the Government that all restrictions on production would be taken off after Jan. 1, and the abrogation of the proposed war taxes on automobiles by the Senate committee in charge of the Revenue bill, the dealers felt that the time was ripe for a New York show. The Grand Central Palace, where the recent shows have been held, could not be obtained, as the building has been taken as a Government military hospital.

The first week of the show will be devoted exclusively to passenger cars and accessories, and the second to commercial cars of all types.

Personals

P. J. F. BATENBURG has resigned his position with the Four Wheel Drive Co., Clintonville, Wis., with which he has been associated as chief engineer and designer for the past eight years.

THOMAS P. ORCHARD, formerly production manager of the New Britain Machine Co., New Britain, Conn., has joined the Service Engineering Co., 25 Church St., New York, as sales engineer.

STURE OSMAR, vice president and general manager of Lindstedt & Co., Stockholm, Sweden, is expected to arrive in America about Feb. 1. The purpose of Mr. Osmar's visit is to make agency arrangements with leading American manufacturers of machinery, tools and accessories. Correspondence for Mr. Osmar may be addressed for his personal attention in care of the Swedish Gage Co., 245 West 55th St., New York. The capital of Lindstedt & Co. has recently been increased to 4,000,000 crowns (approximately $5,000,000).

GEORGE W. FELTON, formerly assistant chief engineer with the New Process Gear Corporation, Syracuse, N. Y., has taken the position of factory superintendent with the Crofoot Gear Works, Inc., Cambridge, A Branch, Boston, Mass.

JAMES J. SHANAHAN has been appointed general manager of the Chicago and Moline offices of the E. L. Essley Machinery Co., 551-557 Washington Blvd., Chicago.

GEORGE A. FRENCH, formerly with the Cutter and Wood Supply Co., Bos-

ton, Mass., has become sales engineer for the Shepard Electric Crane and Hoist Co., Montour Falls, N. Y.

S. E. HACKETT, formerly sales manager of the Chicago office of the Jones & Laughlin Steel Co., has been made general sales manager of that company to succeed the late John L. Haynes.

H. C. WHITE, formerly factory manager of the Holt Manufacturing Co., Stockton, Calif., is the new factory manager of the Harris Engineering Co., Stockton, Calif.

FRED E. ROGERS, JR., formerly with the J. G. White Co., New York, has taken the position of sales engineer with the Fafnir Bearing Co., New Britain, Conn.

JOHN J. EYRE, recently with the Worthington Pump and Machinery Corporation, has accepted the position as factory engineer with the Sturtevant Aeroplane Co., Boston, Mass.

Trade Catalogs

Mallet Articulated Locomotives. The Baldwin Locomotive Works, Philadelphia, Penn. Record No. 91. Pp. 44; 8½ x 6 in. A thorough description and illustration of the various types of Mallet articulated locomotives, which are used by several railroad companies is given. Formulas for calculating the traction force of locomotives and tables of weights and dimensions are also presented for general information.

1919 Diary. Morse Chain Co., Ithaca, N. Y. It is 2½ x 4¼ in. and contains many pages of general information with illustrations and tables regarding chain drive. Calendars for 1919 and 1920, postal information, weights and measures and other useful information. Many blank pages with dates are given for making notes, etc.

Small Tools. Greenfield Tap and Die Corporation, Greenfield Mass. Catalog No. 40. Pp. 288; 4¾ x 7¼ in. This is a new catalog, and lists a line of taps, dies, screw plates and reamers. Many tables of general information regarding numbers, sizes prices, etc., are given.

Space and Speed in Steel Buildings. Milliken Bros. Manufacturing Co., Inc., Woolworth Building, New York. Booklet. Pp. 24; 6¼ x 9¼ in. This booklet is descriptive of the standardized truss unit system of building construction designed and manufactured by the company. It contains a number of halftone illustrations showing the use of the standardized truss unit system. A copy will be forwarded to those interested.

Economical Handling of Coal and Ashes and Reserve Coal Storage. Link-Belt Co., Philadelphia, Chicago and Indianapolis. Book No. 353. Pp. 52; 6 x 9 in. There are 88 illustrations of various kinds of machinery for handling coal in this brochure and much descriptive matter explaining the different kinds of elevating machinery for the economical handling of coal and ashes. It is new and will be forwarded to interested persons on request.

Spur Gear Cutting Machines. Waltham Machine Works, High St., Waltham, Mass. Booklet. Pp. 14; 4¼ x 6¾ in. It gives halftone illustrations and sectional-plan views of the machine, together with general specifications and a detailed description of the driving mechanism, cutter spindle and slide, work spindle and slide and general directions.

Subpresses and Dies. Waltham Machine Works, High St., Waltham, Mass. Booklet. Pp. 16; 4¼ x 6¾ in. An illustration is given of the cylindrical subpress, pillar subpress, simple dies, tandem or follow dies and compound dies. The booklet also contains several paragraphs on blanking, piercing, bending, trimming and shaving. The last page shows a table of standard dimensions of subpresses.

Thread-Milling Machines. Waltham Machine Works, High St., Waltham, Mass. Circular, 6½ x 10½ in., giving general specifications of thread-milling machine for bench use, also for the extended machine and some features of design.

New Publications

The Automobile Storage Battery: Its Care and Repair—Two hundred eighty-four 5 x 7½-in. pages; 186 illustrations; Bound in limp leather, handbook style. Published by the American Bureau of Engineering, Inc., 1024 South Wabash Ave., Chicago. Price $5.

Many books have been written on storage batteries used in stationary work, but the stationary storage battery is never subjected to the racking service of the storage battery used in the modern gasoline car. Consequently the books on the stationary type are of very little use to the man who has to do largely with those used in automobiles. It is perfectly true that the chemical actions are the same in all lead-acid storage batteries, but the design, construction and operation of the starting and lighting battery are unique and require special description and care. This book deals only with the automobile type of lead-acid storage battery and is just the book that the practical repair man, student or progressive car owner wants. No one but a practical man and an engineer could have written the book, for it covers the subject so thoroughly and in such a clear way that even those with no previous knowledge can understand the battery construction, details and troubles. The book is divided into two sections. The first deals with the theory, design, operating conditions and care of the battery; the second with the actual work of repairing and rebuilding the storage battery. This section is of especial value to repair men.

The first section is divided into chapters as follows: Introductory, Batteries in General, Chemical Actions Which Produce Electricity, How Chemical Actions Produce Electricity, Loss of Charge in an Idle Battery, The Discharge Phenomena, The Charge Phenomena, Capacity of Storage Batteries, Internal Resistance, Battery Diseases, Conditions of Operation, How to Take Care of Battery on the Car, Manufacture of Storage Batteries.

The chapters in section II are: The Workshop, General Instructions, Analysis of the Condition of the Battery, Work on the Battery, Special Instructions and Cadmium Test-Storing Batteries.

Descriptive Geometry. — By William L. Ames and Carl Wischmeyer. One hundred and twelve 5 x 7½-in. pages; 197 figures. Fifth edition. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price, $1.

This is an enlarged edition of the original "Notes on Descriptive Geometry," by Professor Ames, first published in 1893, and which was probably the first book on the subject which used the third quadrant. It is an odd fact too that while the third quadrant is used almost exclusively in drafting rooms today the various books on descriptive geometry largely teach the first quadrant projection. Professor Ames was formerly professor of machine design in Rose Polytechnic, and Professor Wischmeyer is at present associate professor in the same institution. Both men are especially qualified to compile a book of this kind—Professor Ames as the originator and Professor Wischmeyer as reviser and selector of the additional material put into this edition. The principal changes are the increased number of examples given for the instruction of students. The chapters deal with the Introduction, Representation of Points, Representation of Lines, Representation of Planes, Representation of Simple Solids, Assuming New Planes of Projection, Change of Position by Rotation, Lines with Reference to H and V, Planes with Reference to H and V, Development of Surfaces, Line Contained in Plane, Intersections, Perpendiculars, Angles, Distances, Tangent Planes, Shades and Shadows, Sections, Intersections of Surfaces, Helicoidal Surfaces, Hyperboloid of Revolution of One Nappe, Practical Applications, Impossible and Indeterminate Exercises.

The Gasoline Motor.—Vol. I.—By P. M. Heldt. Six hundred and thirty-six 5¾ x 8¼-in. pages; 378 illustrations; 32 plates. Published by P. M. Heldt, Nyack, N. Y. Price, $5, postage paid.

The fact that this is the fifth edition indicates that this book has become a recognized authority in its field, which, although not indicated in the title, is that of the motor vehicle. Much of the information is useful in other lines, but the book deals with the motor used for transportation purposes and may perhaps be likened to Unwin and Carpenter, except as to the field covered. It begins with the working principles of the interval-combustion motor and then takes up the essential parts, shows what work each performs and how it should be designed. It takes up the materials used, the calculation of stresses and necessary dimensions, common faults in different parts and how these may be avoided. Manufacturing methods are also discussed and the practice of different makers shown. There are 22 chapters and an appendix, these including Balancing; Offset Cylinders; Crankshafts; Connecting-Rod; Camshaft and Valve Mechanisms; Oiling Systems; The Different Cycles; Air and Water Cooling, special chapters being devoted to testing methods and to designs of unusual and unconventional types. The appendix contains many tables of value for the designer. It seems to be the general belief that we are to see many changes in motor design during the next few years, utilizing to a considerable extent the experience gained with airplane engines, but whatever changes are made the designer will do well to have a copy of this book at his elbow, for the author is known to be a careful engineer and an authority on the subject of motors.

Storing: Its Economic Aspects and Proper Methods.—By H. B. Twyford. Two hundred 6 x 9-in. pages; 96 illustrations and forms; bound in green cloth boards. Published by D. Van Nostrand Co., 25 Park Pl., New York. Price, $3.50.

Various problems of the proper storage of raw and finished product are constantly confronting the manufacturer and his staff. Each case must be studied individually, but it is helpful to know how certain problems have been handled by others and what equipment is available. The author of this book treats in a broad way of the handling methods, storage methods and forms to be used in keeping an accurate record of stock. He has no "scientific management" hobby to ride, and his handling of his subject cannot fail to be helpful to those looking for information of a constructive nature. The illustrations are well chosen and the text is clear and to the point. The various chapter headings are: General Considerations; Economic Questions Connected with Storing; Economic Questions Connected with Storing (Continued); Specifications, Definitions and Standardization; Location and Equipment of Storeroom; Appliances for Use in Storeroom; Manual Operations; Clerical Work-Inventories; The Stores Department; Receiving Material; Inspecting and Placing Material in Storeroom; and Deliveries for Storeroom.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37 60	$37 60
Northern Basic	34 80	34 80
Southern Ohio No. 2	35 80	35 80
NEW YORK, Tidewater delivery		
Penna. 2X	39 55	39 15
Virginia No. 2	41 70	41 70
Southern No. 2	41 70	41 70
BIRMINGHAM		
No. 2 Foundry	34 00	34 00
PHILADELPHIA		
Eastern Pa. 2X	39 15*	38 85*
Virginia No. 2	40 50†	40 50†
Basic	36 90*	36 60*
Grey Forge	36 90*	36 60*
Bessemer	39 10*	38 80*
CHICAGO		
No. 2 Foundry Local	34 50	34 50
No. 2 Foundry Southern	39 00	39 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35 40	35 40
Basic	34 40	34 40
Bessemer	36 60	36 60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4 07	$4 27	$4 20	$3 97	$4–4 04	$4 07	$4 20
Soft steel bars	3 97	4 17	4 10	4 07	4–4 04	3 97	4 10
Soft steel bar shapes	3 97	4 17	4 10	4 07	4 14	3 97	4 10
Soft steel bands	4 57	4 77					
Plates, ¼ to 1 in. thick	4 27	4 52	4 45	4 42	4 39	4 27	4 20

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3 50	$3 50
Warehouse, New York	4 75	4 70
Warehouse, Cleveland	3 90	4 98½
Warehouse, Chicago	4 10	4 10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	New York			Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	4 70	6 22	6 52	6 445	5 75	6 45	6 22	6 445
*No. 26 black	4 60	6 12	6 42	6 405	5 65	6 35	6 12	6 405
*Nos. 22 and 24 black	4 55	6 07	6 37	6 295	5 60	6 30	6 07	6 295
Nos. 18 and 20 black	4 50	6 02	6 32	6 245	5 50	6 25	6 02	6 245
No. 16 blue annealed	4 10	5 37	5 72	5 645	4 95	5 65	5 37	5 645
No. 14 blue annealed	4 00	5 27	5 62	5 545	4 85	5 55	5 27	5 545
No. 10 blue annealed	3 90	5 17	5 52	5 445	4 75	5 45	5 17	5 445
*No. 28 galvanized	6 05	7 57	7 77	7 695	7 15	7 70	7 57	7 695
*No. 26 galvanized	5 75	7 27	7 47	7 395	6 85	7 40	7 27	7 395
No. 24 galvanized	5 60	7 12	7 32	7 245	6 70	7 25	7 12	7 245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25 50–30	$15 00
Cleveland	20 80	15 30
Chicago	16 50	15 00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
⅛, 5/32, ¾, 7/32, ¼ No. 8, ⅝ and No. 10	25.50 to 33.00	⅛ by 12 in. long	14 00
		3/16 by 19 in. long	12 00
⅛ No. 12		¼ by 19 in. long	10 00
⅝, No. 14 and ⅞		¼ by 21 in. long	10 00
No. 18		* Special Welding Wire	
No. 20		⅛	55 00
		3/16	50 00
		¼	50 00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8 00	8 00	7 50
Spring steel (light)	10 00	11 25	11 75
Coppered bessemer rods	9 00	8 00	7 07
Hoop steel	4 77	4 75	4 77
Cold-rolled strip steel	8 02	8 25	8 57
Floor plates	6 27	6 00	6 25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh, basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	47%	20%	⅛ to 1¼	36%	20%
½	51%	32½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25%	⅛ to 1¼	36%	21%
½	46%	33%			
¾ to 1¼	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	43%	27%	43%	26%	41 1%	26 1%
3½ to 6 in. steel lap welded	38%	29%	39%	25%	37 1%	25 1%

Malleable fittings, Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	30 50*	26 00	25 50
Tin in 5-ton lots	72 00	72 00	85 00
Lead	5 75	7 05	6 50
Spelter	7 85	8 60	8 00

ST. LOUIS

Lead	5 45	6 75	6 55
Spelter	7 50	8 25	7 55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	29 00	38 00	31 00	35 00	32 50	32 00	35 00
Copper wire (carload lots)	28 00	35 00	32 00	32 00	28 50	31 00	34 00
Brass sheets	29 00	39 75	30 75	32 50	33 00	29 00	35 00
Brass pipe	37 00	46 00	36 50	38 00	40 00	37 00	41 00
Solder, half and half (case lots)	41 00	55 00	48 00	44 00	43 25	39 00	41.50

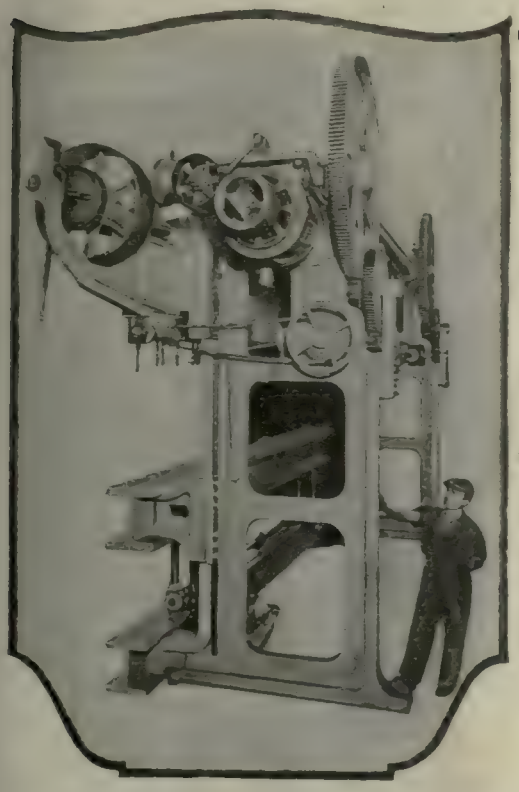
Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz. cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq. ft. extra for 20-oz. widths and under, over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill 100 lb. and over, warehouse 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$26 00	$25 00
New York	27 40	30 00
Cleveland	30 00	34 00
Chicago	28 50	37 00

January 30, 1919 American Machinist Vol. 50, No. 5



The Hill Multiple-Spindle Drilling Machine

EDITORIAL CORRESPONDENCE

The machine described and illustrated herewith has a spindle drive of a design which permits of close spacing of the drilling heads, and yet the mechanism is very simple. The design is such that machines of various sizes may be easily built on order to accommodate the different classes of work they can handle.

THE multiple-spindle drilling machine that is the subject of this article is made by the Hilldrill Co., 2141 North 19th St., Philadelphia, Penn. Several of this type of machine are also being built by the Badenhausen Co., 1425 Chestnut St., Philadelphia. It is intended for multiple drilling of structural-steel members, but it is applicable to practically all multiple-drilling operations on ship and boiler plates, both in the flat and after rolling and forming to shape, and to other work requiring the drilling, cutting or boring of a large number of holes. The construction of the machine is so simple that there is little chance of trouble even when operated by unskilled help. Some of the main features of the machine are that it feeds down the drills automatically; it clamps the work in place, exerting over 20 tons pressure, and thus will straighten out any ordinary sweep or buckles in plates; it lubricates the drills individually and stops this lubricating when the machine is not in operation; it stops automatically when the drilling is done, releases the clamp automatically and is ready for the next cycle of operation, and it is smooth in its running and uses a comparatively small amount of power. The machine shown in Fig. 2 carries 50 drill heads for $1\frac{1}{16}$-in. drills and feeds 0.005 in. per revolution of the spindles. Thirty-two cutter heads for $3\frac{1}{4}$-in. tube holes may be used in the place of the 50 drills. Each drill unit is moved along the rail to any place desired by raising a lever and the units clamped in place by means of the same lever, making spacing as close as $2\frac{3}{4}$ in. in 3 to 5 sec. By raising the same levers a few inches higher than for releasing the clamp the drill unit may be entirely released and taken off to change for larger units. These machines can be built to a length of 40 ft. or more, a size which makes them available for drilling over 100 rivet holes at one operation and at one setting of the work. The one shown weighs about 26 tons and is of about 20 ft. span. At the sides are two cast-iron housings *A*, the bases of which are secured to a concrete foundation. The tops of these housings are tied together by two members *B* made of heavy flanged pipe which are amply stiff and comparatively light in weight. In the front, at the bottom, the housings are held together by a heavy I-beam *C*. On each housing is a slide *D* which carries the table *E* of the machine. In this instance the table is an I-beam, but of course various forms are used to suit the work in hand. The table is raised and lowered by means of four screws *F* 3 in. in diameter and operated by a power worm drive. The cross-rail which carries the drilling heads, or units, is a heavy I-beam section. Between the flanges it is planed from end to end on both sides to form a

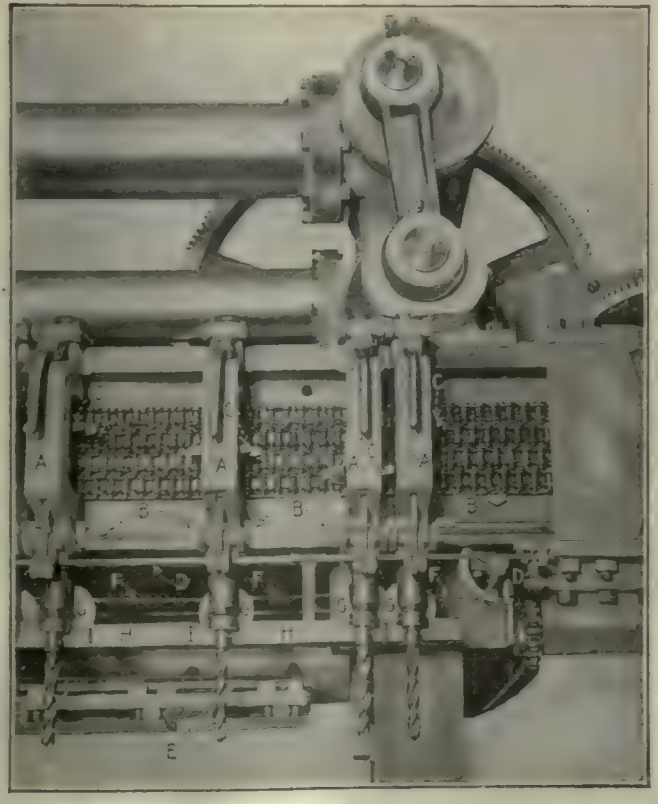


FIG. 1. SOME DETAILS OF THE MECHANISM

runway for the roller chains *G* that drive the drill spindles. These flanges are also planed on their faces, tops and bottoms to form seats for the drilling heads.

The chains that rotate the spindles run over sprockets at each end of the cross-rail. The sprockets at the right-hand end of the rail are keyed to the same shaft as the bevel gear *H*, which is driven by means of a bevel pinion from the pulley *I*. The sprockets at the left-hand end of the rail are idlers. At the lower end of the shaft carrying the bevel gear *H* is a worm *J*, which operates the feed mechanism.

On top at the back of the machine two large spur gears *K* are mounted in the housings. These gears are timed to turn in unison. On the front ends of the shafts on which they are mounted are two disk cranks *L* with rods *M* connecting with the cross-rail. This mechanism is so arranged as to feed the cross-rail and drills down slowly and returns almost instantly to its highest position, when the clutch is tripped and the machine stops. It is now ready for the next operations.

A close-up view of one end of the top of the machine and cross-rail is shown in Fig 1. This shows the clamping levers *A*, by which the drill units may be clamped, loosened to slide along the rail or removed entirely. The units are kept from cocking over as they are slid along the rail by means of keys like *B*, which slide in grooves planed in the cross-rail. There are two grooves and the keys of alternate heads are staggered in order not to interfere with the close setting of the heads. This is also true of the sprockets, as will be seen from those shown at *C*.

When the heads are attached to the rail the clamping mechanism is only partly tightened. A lever placed in the drift hole in the spindle is then used to rack the head to its proper position, the sprocket and chain acting as pinion and rack for this. A steel tape *D* running from end to end of the machine facilitates setting the heads to correct spacing. The setting to position is simply and easily done and the entire set of heads can be placed in about eight minutes. In the machine shown the heads may be set as close as $2\frac{3}{4}$ in. and are more than powerful enough to drive a $1\frac{1}{16}$-in. drill. Larger and stronger heads with larger sprockets capable of driving larger drills can be substituted.

An ingenious work clamp is provided between the front and back of the machine and throughout its entire length a heavy clamping member is pivoted. The upper forward part of this member is connected by links to the under side of the cross-rail. At intervals along the front of the clamping member are clamping fingers like *E* that can be adjusted to clamp the work between the drills. As the clamping member is linked to the cross-rail the weight of the rail in its descent and the thrust of the feed mechanism furnish the clamping power which in the machine shown amounts to approximately 20 tons. Heavy helical springs cushion the clamps and compensate for the change of position of the cross-rail with relation to the work.

Lubrication of the drills is by gravity. A simple mechanism causes the chain *F* to work back and forth. This chain engages teeth to the rear of the disks *G*. The disks are at the back provided with a series of pockets which reach down into the lubricant trough *H*. In their bottom position the pockets fill with the lubricant, and then near the top of their movement the lubricant flows through a central hole into the tubular stem on which the disks are mounted. The front end of this tubular stem is so located that the lubricant passes into a gutter *I* turned around the spindle end and from there passes through holes to the drill. As the lubricating device is integral with each head no adjustment of the lubricating mechanism is necessary when placing or altering the position of the heads on the rail, thus the flow of lubricant ceases when the machine stops.

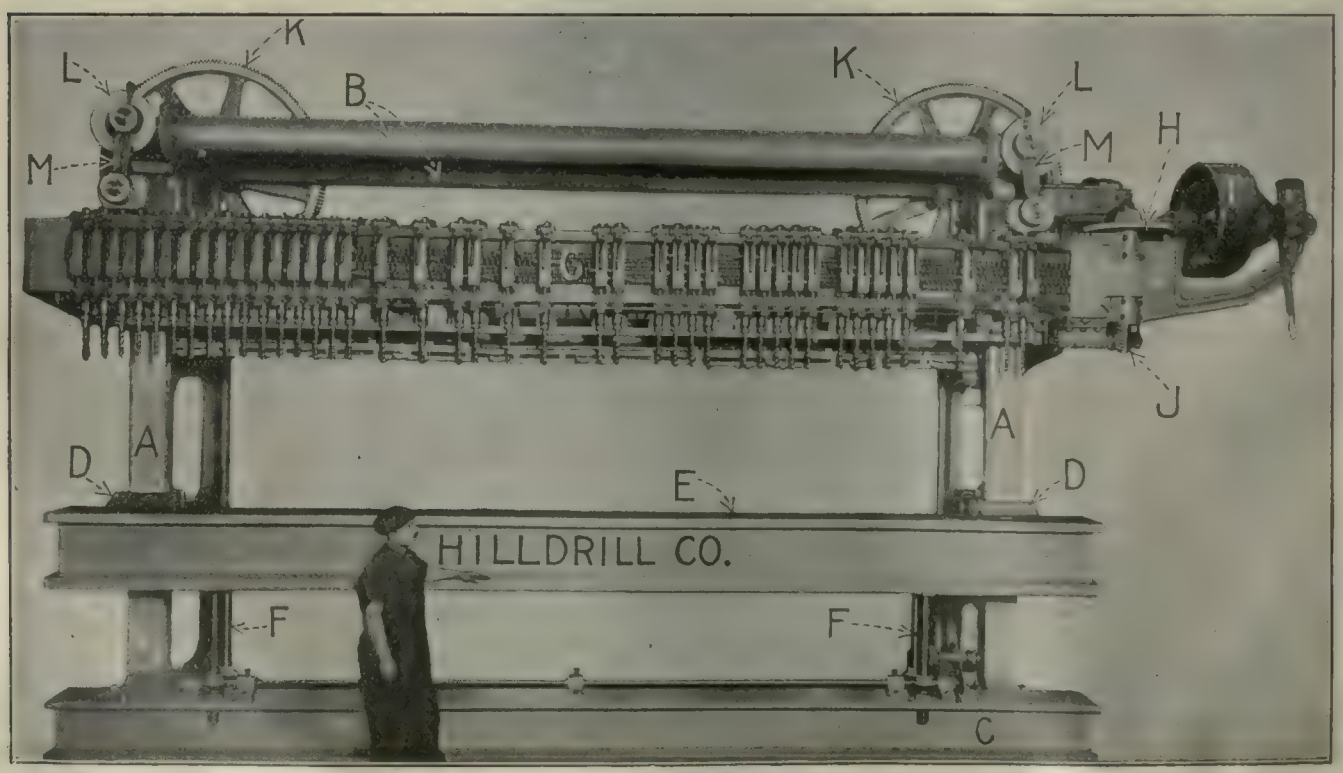


FIG. 2. MULTIPLE-SPINDLE DRILLING MACHINE MADE BY THE HILLDRILL CO.



WAR TIME WORK *at* BALBOA SHOPS

Panama Canal

By R. D. GATEWOOD
Naval Constructor, Mechanical Superintendent of the Canal Zone

Nothing could show better than the illustrations presented with this article the great variety of work being done at the Balboa shops of the Panama Canal. And nothing shows the versatility and practical experience of the men on the job to better advantage. Not to be daunted by a lack of launching facilities they lift boats 120 ft. long and weighing over 200 tons and swing them into the water. We know of nothing in this line that gives a greater feeling of satisfaction than such a record, for it is one which reflects a great deal of credit on the whole personnel of these shops.

IT MAY be doubted if ever in the history of the expenditure of Government funds a wise policy of foresight and preparedness has ever received a more convincing demonstration than that furnished during the war by the Balboa shops of the Panama Canal. In war work alone these shops have several times paid for themselves since our entry into the great struggle, and each day adds to their usefulness as a great national asset.

It would not yet be wise to enter into too many of the details of war work, but it may be mentioned that in addition to the complete overhauling of four good-sized German cargo steamers interned in Colon harbor the shops have performed work, in many cases of an extensive nature, on over one hundred naval vessels and more than five hundred merchant vessels. Nearly all the latter were loaded with valuable and urgently needed war-time cargoes.

It is strange how little even the better informed among the shipping world know of the facilities and possibilities of this splendid repair plant. Agents, owners, masters and insurance men inspecting it for the first time are universally astonished at its capacity and its ability to handle almost any conceivable job of marine repair work.

Probably in no other plant in the world is the variety of work handled greater than at these shops. There are no other large shops for 1500 miles, and as a consequence this Government plant must do not only the maintenance and construction work of the Panama Canal, including the Panama Railroad, but all the work for the Navy, the Army, merchant shipping traversing the canal and a large amount of work for private establishments for mines, mills and other development projects in Central and South America.

A fair idea of this variety of work may best be obtained by glancing at the illustrations. The headpiece and Figs. 1 and 2 show a large repair job being begun on a vessel in the great 1000-ft. drydock. The stern of this vessel had also been severely damaged, but the damage is not shown.

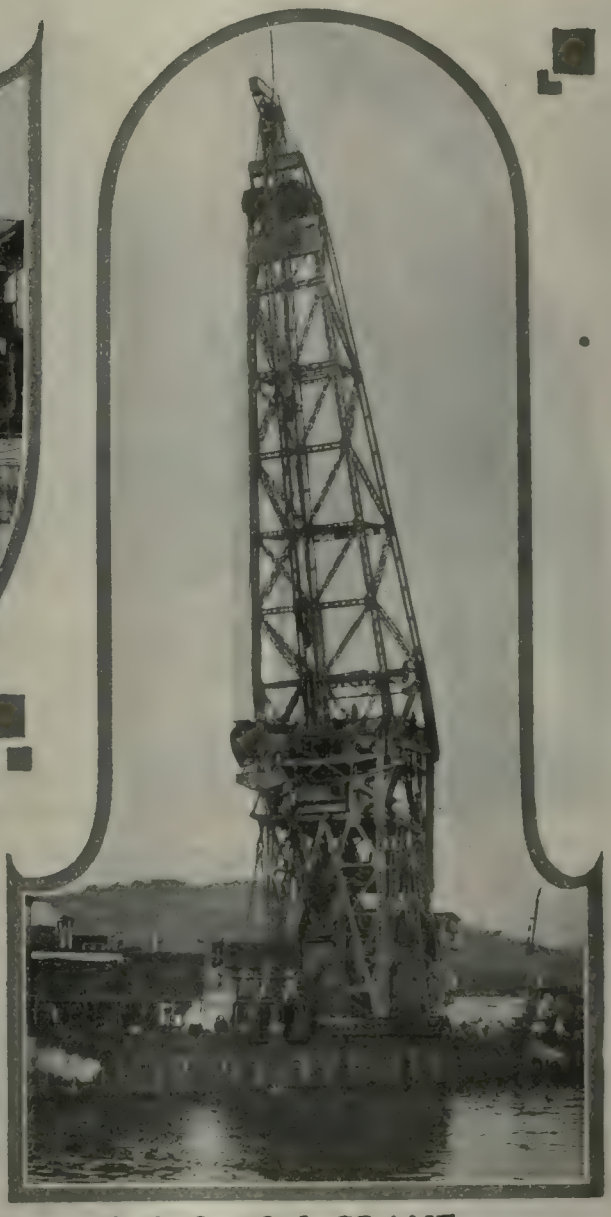
In general the work included a new stem, a new hawse



1. DAMAGED BOW



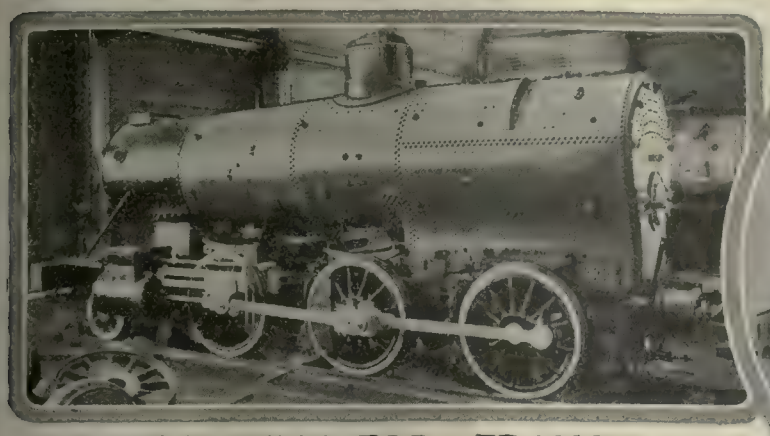
2. COMPLETED BOW



3. 250-TON CRANE



4. HAULING ENGINE



5. AN ENGINE FOR FRANCE



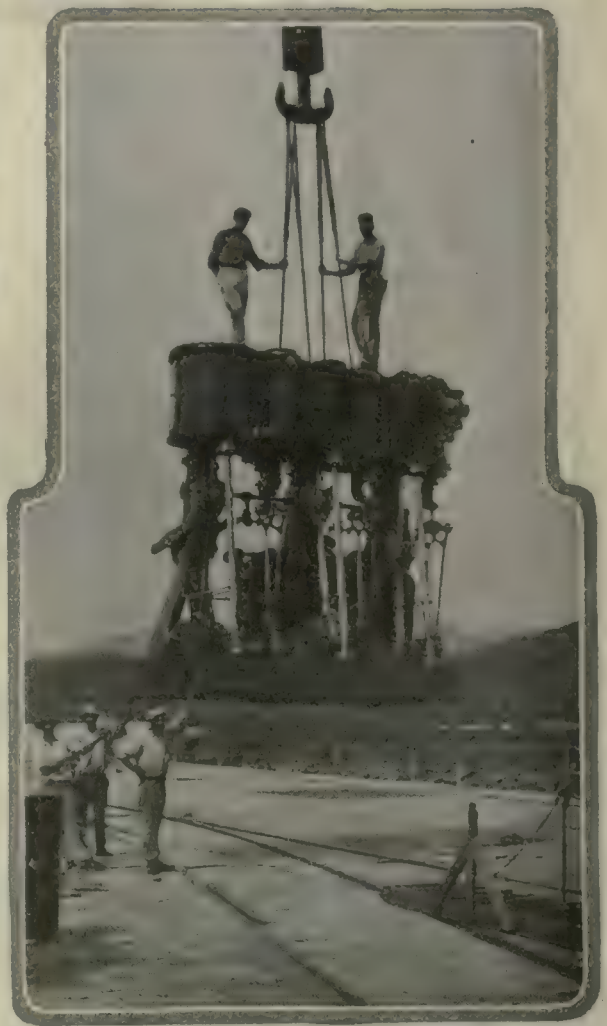
8. LAUNCHING MANHATTAN



6. 120-FT. BARGE



7. COASTGUARD CUTTER



9 ENGINE FOR MANHATTAN

pipe and extensive alterations to increase the coal-carrying capacity of the ship. The repairs to the bow necessitated the renewal of 12 frames from the keel to upper deck on both sides. Four decks had to be renewed from the stem to the collision bulkhead; 27 shell plates were renewed and seven were faired and replaced, these plates being about 22 ft. by 6 ft. by 30 lb. In addition, a new stem 60 ft. long, 14 in. deep and 4 in. thick had to be forged and fitted, and a new hawse pipe, requiring a new pattern, had to be cast, weighing seven and one-half tons.

The total weight of material used in making repairs was over 80 tons, involving in its fitting and erection the work of the following trades: Ship fitters, riveters, calkers, machinists, shipwrights, joiners, electricians, pipe fitters, patternmakers, molders, heavy forgers and riggers. The work had been estimated at over 50 days in a northern drydock. It was completed and the vessel left in just 19 days after her arrival, the men working splendidly all along the line.

Lifting the Main Engines of a Steamer

Fig. 3 shows the large 250-ton floating crane "Ajax" handling one main engine of a 10,000-ton cargo steamer, and Fig. 4 shows this same engine being hauled by a locomotive over rails under the bay of the machine shop, where a 60-ton overhead electric traveling crane will carry it into the erecting floor. The steamship mentioned received a thorough overhauling and renovating, including new boilers, the time required to do the work being only 4½ months. She is now engaged in the important war work of carrying coal to the isthmus and nitrates from Chile to the United States.

In Fig. 5 is one of over one hundred locomotives that have been thoroughly overhauled, retubed, gage changed to standard (the isthmian gage is 5 ft.), and crated and shipped to the United States, many of them for duty in France. During the last few months this work was done at the remarkable rate of 14 locomotives a month, or a little better than one every other working day.

Fig. 6 gives an idea of the launching facilities here. The piece of equipment is simply picked up with the floating crane and there is no further launching troubles. The barge shown is 120 ft. long and was constructed for the use of the Army. It may be seen in process of construction on the dockside in Fig. 4.

The 120-ft. coastguard cutter "Manhattan" being constructed for the Navy is shown in Fig. 7. The launching of this vessel in the same way is shown in Fig. 8. The shops were determined to "do their bit" in ship construction, but were handicapped by lack of launching ways, and hence they could only build a hull capable of being lifted by the crane "Ajax." The weight of the lift shown in Fig. 8 is 210 tons. The vessel is to be used as an ice breaker, hence the peculiar shape of the bow. The engine for this vessel was designed and completed in every detail at Balboa. It is shown in Fig. 9 being lifted by the same crane.

Another Kind of a Job

The shops of the Canal Zone are constantly called upon to do every imaginable sort of job on vessels using the canal. The illustration below shows a large windmill designed and constructed here for use in pumping out the holds of a full-rigged sailing ship, now over 30 years old, on her way to Manila with a cargo of gasoline.

In addition to the interesting engineering problems found in the variety of the work there also arise many phases of the administrative side of the work in dealing, on the one hand, with American, West Indian and Spanish labor, and on the other with captains and chief engineers of almost every nationality, many of them not being able to speak a word of English.



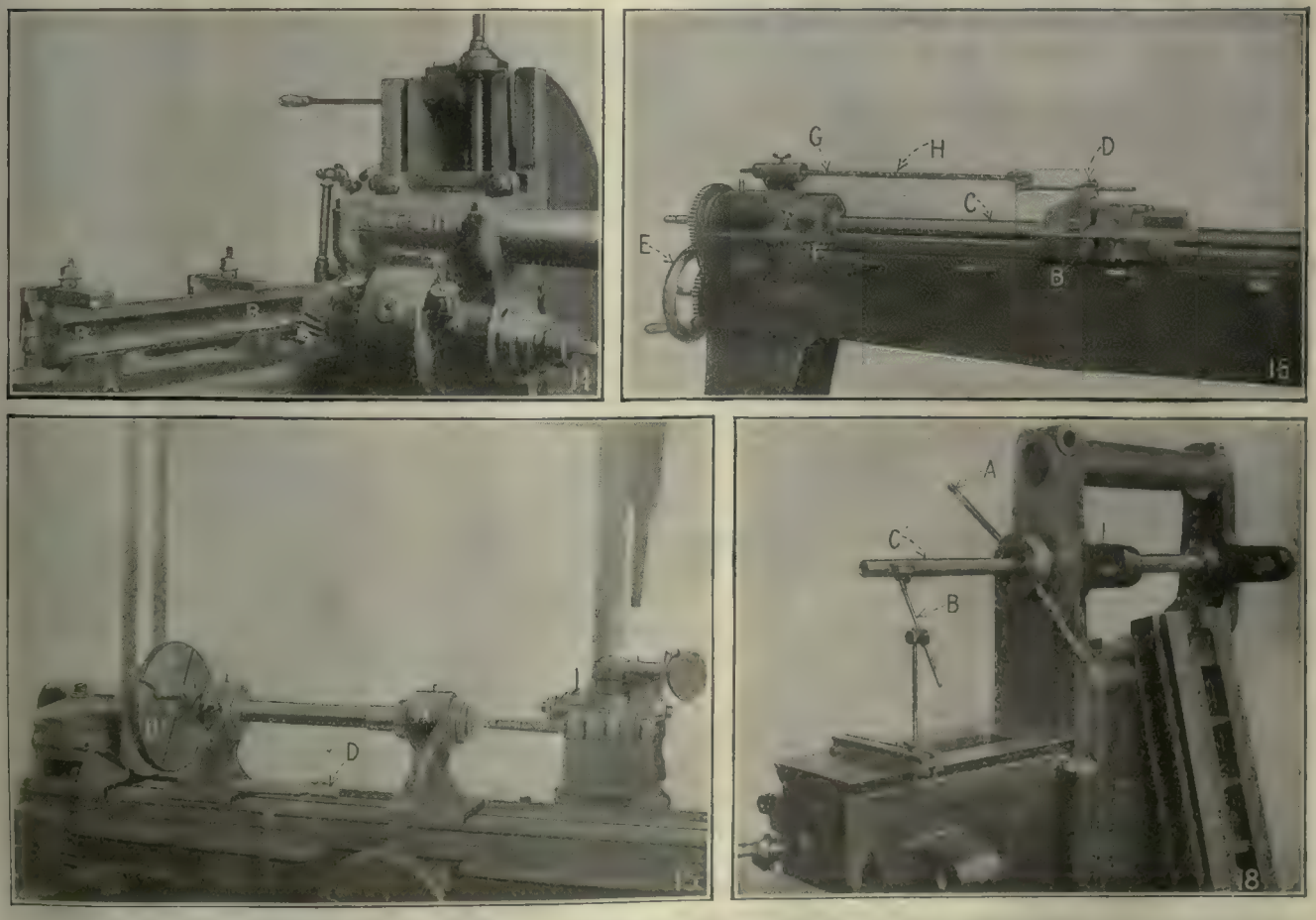
Building the Kempsmith Milling Machine—II

By M. E. HOAG

Further details of the construction of the Kempsmith milling machine, including the grinding of journals, the making and testing of feed screws, etc., are here recorded. For the reason that machines of this nature become in a sense master tools, by which other tools are made, it is essential that in their manufacture the utmost accuracy should be maintained.

WHILE to the casual observer the overarm of a milling-machine may seem an unimportant part of the equipment it really requires a considerable degree of accuracy in its construction if the machine is to give the best results in practice. Recognizing this fact the Kempsmith shops give as much care to the making and testing of this arm as to any other part. A special grade of machinery steel is used. After cutting the pieces to length they are carefully centered, rough-turned and faced, after which they are ground to exact size. The flat for the clamping screw is carefully milled in a No. 33 frame milling machine as shown in Fig. 14. A long, heavy plate *A* tongued to fit the T-slots in the machine table has three V-blocks cast upon it, two of which may be seen at *B*. The cut shows very plainly the manner in which the milling is done. In making the spindle of the machine the operations, including boring the through and taper holes, threading the spindle nose, grinding all over as well as other minor operations, are more complicated. The cones for the spindle journals are first roughed out nearly to size and heat-treated. They are ground inside to gage, which gives a press fit on the spindle. After being pressed on, the cones are ground in place, thus insuring absolute truth. After all other operations on the spindle are completed the taper hole in the nose is ground, and as this is a very important matter special care is used to secure not only correct size and taper, but to insure its running true. This is accomplished with the grinding fixtures shown in Fig. 15. The two heads *A* are fitted with bearings that are exact counterparts of the bearings in which the spindle will run when assembled in the milling machine and are adjusted to the spindle which is to be ground. A dog *B* and stud *C* in the faceplate of the grinding machine head drive the work while the internal grinding atachment grinds the hole to fit the standard taper plug gage *D*.

The feed screws are milled in a Pratt & Whitney thread-milling machine equipped with a special precision screw, which insures very accurate results. If a screw shows any distortion after milling it is carefully



FIGS. 14, 15, 16 AND 18. OPERATIONS IN MACHINING AND TESTING

Fig. 14—Milling flat on the arm. Fig. 15—Grinding taper in spindle. Fig. 16—Testing machine for lead screws. Fig. 18—Testing alignment of spindle

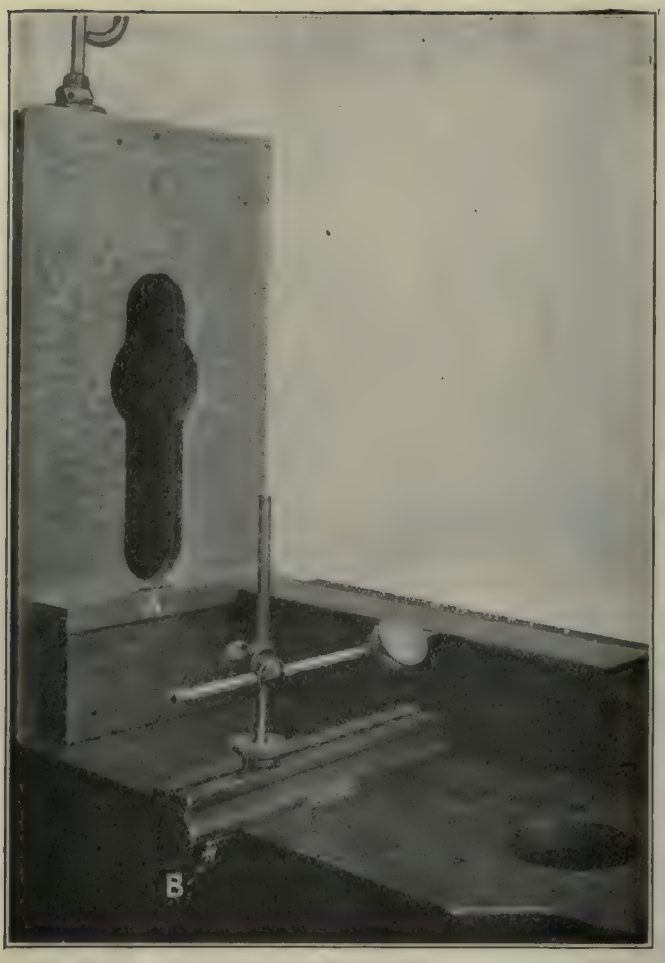


FIG. 17. INDICATING KNEE AND COLUMN

straightened and then tested for lead througout its entire length, in the special machine shown in Fig. 16. The bed of this testing machine is much the same as a lathe bed, except that the ways are flat and the carriage is made a very close fit to insure freedom from vibration, etc. All parts are carefully fitted and scraped. The carriage *A* is fitted with adjustable bronze nuts *B* which receive the screw *C* to be tested. An arm *D* supports a dial indicator directly over the center of the screw. The machine head has a hollow spindle and chuck through which the screw is passed and locked in place. On the outer end of the spindle is a gear that meshes with a second gear through which the machine is turned by means of the handwheel *E*. On the front end of the spindle is a collar, which is graduated to read in inches, and over it the pointer *F*, which is attached to the head of the machine. If the screw is turned by the handwheel until the reading on the collar indicates 3 in. it means that the carriage carrying the dial indicator has been advanced exactly 3 in. from its former position.

The screw *C* is placed in the machine and the carriage *A* advanced until the distance from the indicator finger to the end of the rod *G*, which is supported by a bracket on the head of the machine, is say just 24 in. when measured by a standard end-measuring rod *A*. The collar on the end of the spindle is now set at zero and the handwheel turned until the carriage carrying the dial indicator has been advanced a definite amount as indicated by the graduated collar. By substituting a shorter standard rod in place of the one first used any variations will be disclosed by the difference between the theoretical advance measured by the graduated collar and the actual advance as measured by the rod and dial indicator. These operations are repeated at fixed intervals throughout the entire length of the lead screw *C*, which not only gives the total error but also serves to detect local variations that might occur throughout the length of the screw.

Testing Alignment

When the knee is fitted to the machine column it is tested for alignment in every position. As shown in Fig. 17 the machine column is in a horizontal position with the knee in place and clamped to the ways by the gibs. A steel square *A* is supported at a convenient distance above the column face by wooden blocking. The base of the dial-indicator support rests on the scraped surfaces of the column with the guide block *B* in contact with the V on the column. By holding the stock of the square against the scraped surface of the knee with the edge of the blade in contact with the indicator and sliding the latter back and forth with the block *B* in firm contact with the V it will indicate any variation from square and at the same time detect any high or low points along the V which would not be possible if a wide block *B* were used, as such a block would have too great a bearing on the V. By placing the square in a vertical position any variation from square in the other direction is determined, and by reversing the first test the alignment of the Vs on the knee with the face of the column will be determined. The table

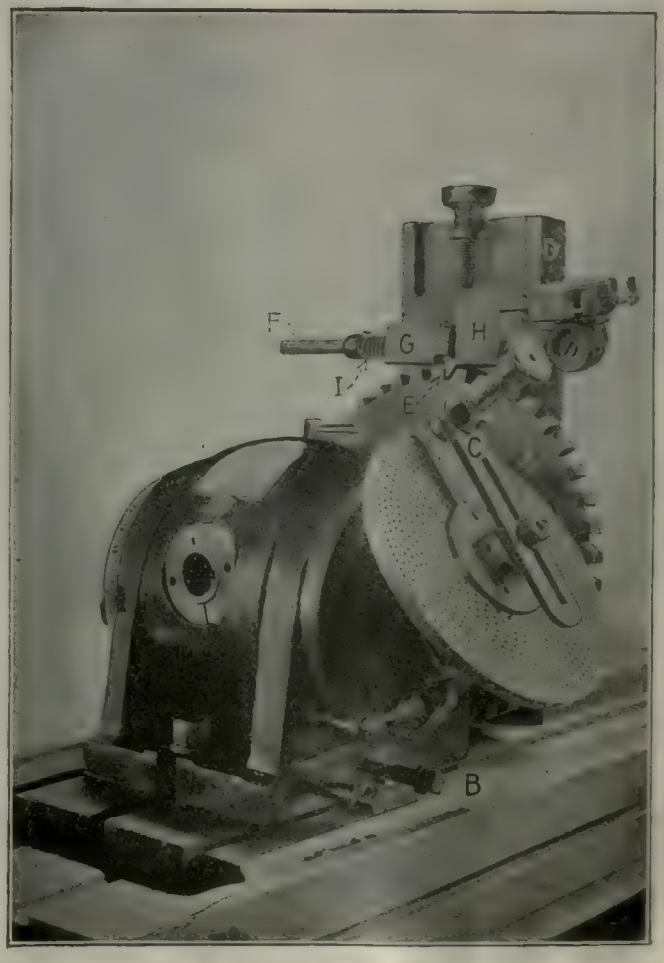
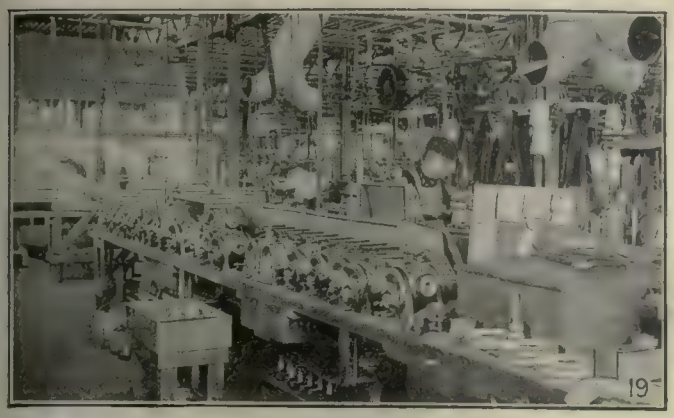
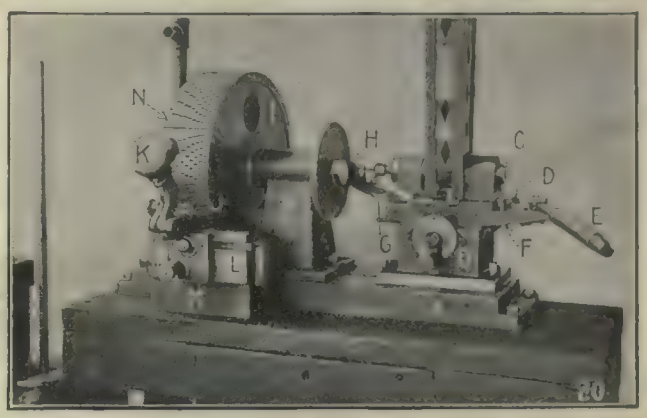
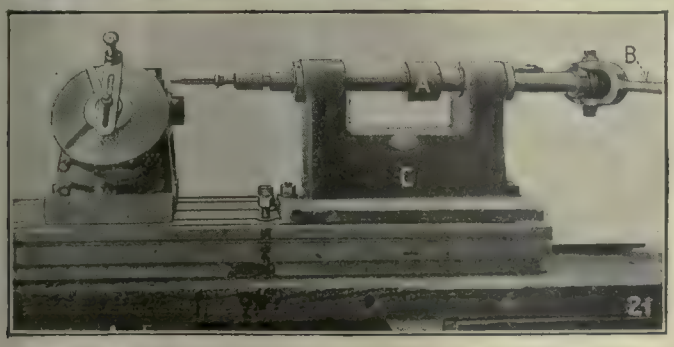


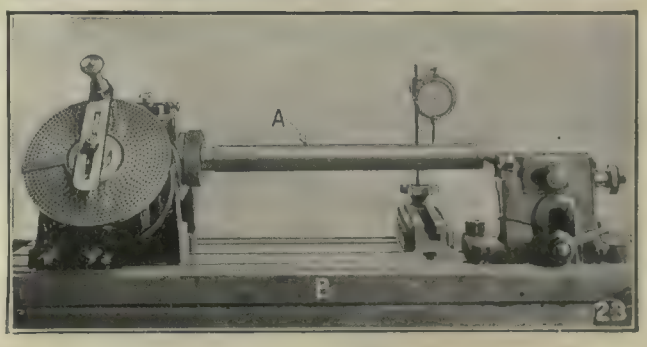
FIG. 22. TESTING INDEX WORM

and saddle are indicated in a similar manner. After assembling and testing the knee and column the spindle bearings are scraped. In testing the spindle a standard hardened and ground taper-shank arbor is placed in the spindle nose and tested in all positions, as shown in Fig. 18, the yoke or wrench *A* being screwed onto the spindle nose in order that it may be easily turned to different positions. By placing the finger of the dial indicator *B* against the under side of the arbor *C* and moving it along its length with the spindle in various positions any variation from parallelism between the spindle and the top of the knee will be shown, and by placing the indicator finger against the side of the arbor and sliding the base along the V the alignment of the spindle with the travel of the saddle is determined. Before making these tests the spindle taper and arbor have been indicated and found true. The testing of the machine arm is handled in practically the same way, which assures perfect alignment of its centers or collars with the machine arbors used in regular work, etc.









FIGS. 19, 20, 21 AND 23. TESTING DIVIDING HEADS AND INDEX PLATES

Fig. 19—Progressive assembling of dividing heads. Fig. 20—Drilling index plates. Fig. 21—Reaming quick index holes. Fig. 23—Indicating head and tail centers

In making the dividing heads the same unit system of assembling is followed out as described for the machines, involving the use of some interesting testing devices and special fixtures. A general view of one of the assembling benches with dividing heads in various stages of completion is shown in Fig. 19. At the lower end of this bench the heads are given the final tests and inspection.

One of several machines for drilling index plates is shown in Fig. 20. These machines are mounted on wooden benches at a convenient height from the floor and are operated by boys still in their apprenticeship.

The base *A* carries the drilling head *B*, which is driven by belt from a countershaft. The spindle *C* carries a drill chuck on its front end and is supported by suitable bearings in the sliding member *D*, which is advanced to and withdrawn from the work by the lever *E*. A second sliding member *F* is operated by the handle and index plate *G*, and by it the drill is shifted to correct positions for the various rows of holes in the index plate being drilled. On the forward end of this member is a support which carries a bushing *H*, which guides the drill.

The index plate is fastened to the end of the spindle that carries the master index plates *I*, of which there are in this particular case 11. These plates are hardened and ground and the index notches are ground, one edge being radial with the axis of the plate and the other edge beveled so that the action of the locking bolt, which is carried in the piece *J*, is to wedge the plate forward and keep the radial edge of the notch in contact with the bolt during the drilling. The index bolt is operated by the padded lever *K* on which the operator rests his forearm while he turns the plates with his left hand. Correct location of the plunger for the several plates is obtained by sliding the bracket along the plate *L* and locating it by means of the pin *M*, which enters one of a row of holes in *L*.

In assembling the master plates on the spindle they are lined up at one point as shown at *N*. With this fixture and a reasonable amount of care by the operator it is practically impossible to make an error.

After the heads are assembled and tested for correct indexing the quick-index holes in the bronze worm-wheel are finish-reamed true with the index pin hole in the fixture shown in Fig. 21. This fixture is quite simple, the entire equipment, including the head to be reamed, being mounted on a machine table and the spindle *A* driven by a belt from a countershaft. The

lever *B* serves to move the spindle back and forth in the bearings carried by the head *C;* the reamer and shank is held in the front end of this spindle and is supported and guided into the work by it.

After being assembled all of the dividing heads are given a careful inspection and various tests, one of the principal ones shown in Fig. 22 being the test for proper indexing. The master plate *A* has 40 notches and is fastened securely to the nose of the head being tested, which in turn is located on the bedplate *B*. As the worm requires 40 turns of the handle *C* to produce one complete revolution each notch in the master plate tests one turn of the handle. The head *D* is also located on the bedplate *B* and in such a position that the flat surface of the finger *E* is held in contact with the flat portion of the notch in the master plate. This is accomplished by the plunger *F* which passes through the two blocks *G* and *H* and is held in position by the spring *I*. One end of this plunger carries the dial indicator *J*, the finger of which rests against the surface of the block *H*, as seen in the illustration.

The plunger and all its parts are free to turn about its supporting axis so that the finger *E* may be moved out of the notch in the master plate while the position of the latter is being changed. By starting at notch No. 1, setting the dial indicator at zero and then indexing the master plate around, each of the 40 positions may be tested and any variations or accumulated error noted. Upon a printed chart each reading is noted as the work proceeds, so that a visible record is obtained showing the exact condition of each head when it leaves the factory. The quick-index holes are also indicated, and if there is any variation between these and the master plate this variation is also noted. This work is held to very close limits which insure satisfactory results in the finished machine.

The truth and alignment of the taper hole in the spindle is tested with a hardened and ground master arbor and dial indicator as shown in Fig. 23, the first test being for parallelism of the arbor *A*, with the baseplate *B*. Then by indexing the head around, any inaccuracy in the taper hole will be indicated by a rise or fall at the end of the arbor. The arbor must also stand true in all positions with the edge of the central slot in the base *B*. If it does not do so suitable alterations are made in the tongues and grooves in the base of the head.

After these tests have been made and the parts found correct the tailstock center is tested by forcing the center into the center hole of the arbor, when if it does not line up with the head it will cause a movement of the arbor which is at once shown by the dial indicator and the proper corrections made to overcome such error.

The Modern Foreman

By W. H. Addis

The principal quality in a foreman must be his ability to command and retain the confidence and respect of both employer and employee. Without this he is a losing proposition.

As a foreman enters his department for the first time he realizes that he stands in the position of a mediator, or an umpire. The company expects him to deliver its finished product in such quality and quantity that its good name shall be maintained and that its stock shall pay a fair dividend on its departmental investment. To achieve these results he must have the friendship, the hearty coöperation and the good-will of his men; he must play the game fair, both for the company and for his men. To the men he stands for the company; to the company he is the mouthpiece and the leader of his men. Every word, every promise made in the name of the company must be faithfully kept, for generally it will be found that it was because of the lack of confidence and coöperation by his associates that his predecessor failed.

Improve working conditions the first thing. Strive to establish better order. For the first few days on the job be a good listener. There will be many stories heard of past grievances. Some will point out grievous errors in the former management. I recall a case of injustice that had been done the men by a foreman who promised them an increase in wages and then let the matter drag for weeks. In this case every man was given all back pay as well as the promised raise. The company's word was made good.

A man must have some incentive besides his pay. He must be made to feel that he is a potential success; that there is an opportunity for him to advance in ratio to the effort he puts forth to increase his efficiency. This brings us to the question of educational supervision and the foreman's duties in the matter.

Opportunity for Mental Improvement

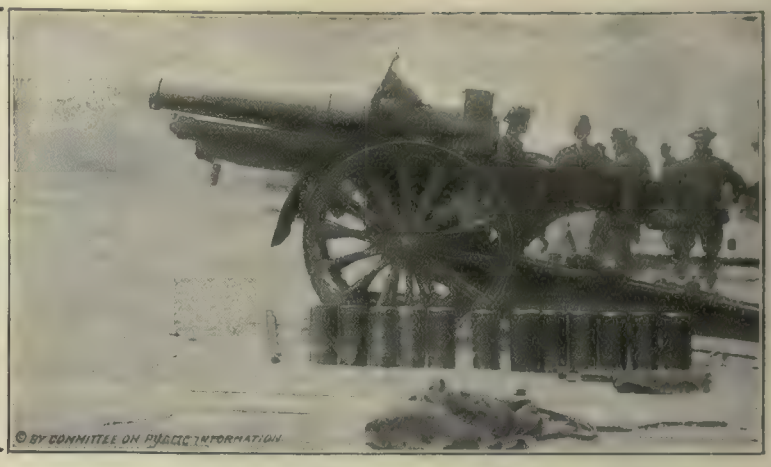
If there is anything that the man in the shop respects it is intelligence. A real leader will lead both in thought and action. He will tactfully ascertain the educational advantages each workman has had, and he will plan to train and instruct him from his particular vantage point. This may be done by means of literature dealing with the trade. In the larger cities night schools offer an opportunity for mental improvement, and the Y. M. C. A. has an educational department that has started many a man on the road to success. The work the correspondence schools are doing ought also to be mentioned. These institutions will gladly coöperate with foremen by informing them of the progress the student is making. Lastly the foreman must constantly strive to devise better methods of production. Tell the boys what it is hoped to achieve in the way of production; ask them to play the game. Set a goal and keep them daily informed as to their progress. Men like to be appreciated. When they make a good record tell them how much their team work is valued.

More than all the other opportunities that come to a foreman is the intimate personal service he may occasionally render to his men. Enter into all the little needs and troubles of your fellows in the shop. If you cannot help them in other ways, sympathy, which is rare, is often highly prized.

Never let a man leave you feeling that you have done him an injustice. When discipline is necessary be sure you are right and that no personal feelings enter into your decision. If you must discharge a man for incompetency, carelessness or disobedience call him into the office, talk it over quietly and ask him what you really ought to do. I have found that in most cases the offender will deliberately punish himself by leaving.

How the 155-Mm. Howitzer Is Made—IV

By J. V. HUNTER
Western Editor *American Machinist*



Machining the breech section of the gun requires great care not only because some very close and accurate work has to be done, but because this work represents the final finishing of the gun body, and any mistakes that might be made would spoil the gun, so that much costly work and material would have to be scrapped.

AFTER the hinge hole has been drilled and reamed there is a further series of operations on the breech end of the body, many of which are gaged from the location of the hinge hole. In connection with the machine operations there are a number of hand-finish operations required from time to time to chip or file corners and other points that cannot readily be reached by the milling cutters.

The further series of operations on Part 3 are:

Operation 27.—Profile angular cut on top of hinge lug. Machine—No. 5119. Type—Beaman & Smith horizontal boring machine fitted with profile arrangement. Tools—Gages, two lip end mills. Coolant—Compound solution occasionally used.

Operation 27A.—Finish right-angle surfaces on hinge lug. Machine—No. 5538. Type—Gould & Eberhardt shaping machine. Tools—Shaping machine; gages. Coolant—None.

Operation 27B.—Mill T-slot. Machine—No. 5122. Type—Beaman & Smith horizontal boring machine. Tools—End mills; holding fixture. Coolant—Seldom used.

Operation 28.—Mill dovetail slot. Machine—No. 5118. Type—Beaman & Smith horizontal boring machine. Tools—Dovetail cutting mills; gages. Coolant—Cutting oil.

Operation 29.—Drill and tap all holes. Machine—Nos. 5107 and 5108. Type—3-ft. Fosdick radial drilling machine. Tools—Drills, drilling fixtures and jigs, taps, locating gages. Coolant—Cutting solution.

Operation 30.—Chase thread. Machine—Nos. 5017 and 5018. Type—36-in. by 18-ft. American lathe. Tools—Lathe tools; thread gages.

Operation 31.—Machine at sides of threaded section for relief in turning. Transformation—Fig. 63. Machine—No. 5432. Type—24 in. by 12 ft. Ingersoll milling machine. Tools—Work-holding fixtures; formed milling cutters; gages. Coolant—1 to 12 solution cutting compound.

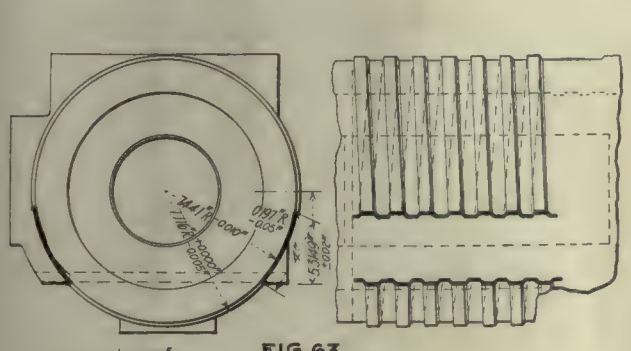
Operation 32.—Finish-turn thread-clearance section and face back of breech.

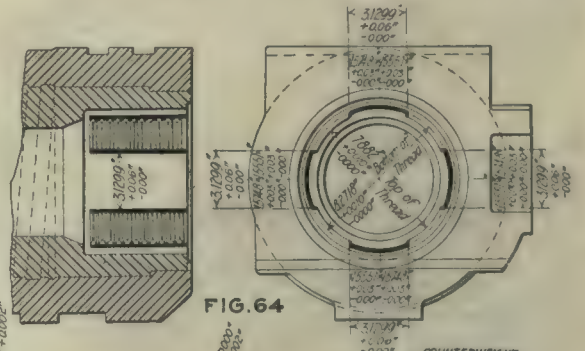
Operation 33.—Slot sectors in breech recess. Transformation—Fig. 64. Machine—No. 5509 Cincinnati shaping machine; Nos. 5525 and 5526 20-in. Gould & Eberhardt shaping machines. Tools—Special work-holding fixture; gages. Coolant—None.

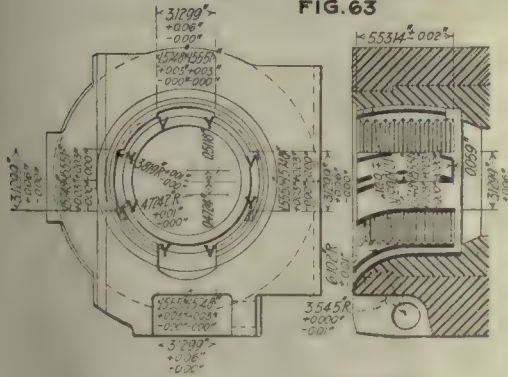
Operation 34.—Machine swing clearance in breech. Transformation—Fig. 65. Machine—No. 5536. Type—Special design of swing shaping machine. Tools—Gages. Coolant—None.

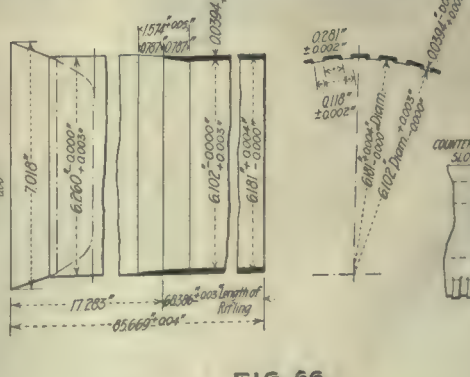
Operation 35.—Rifle gun barrel. Transformation—Fig. 66. Machine—Nos. 5513, 5514, 5515, 5516 and 5517. Type—38 in. by 24 ft. LeBlond rifling machine. Tools—Rifling head and cutters. Coolant—One part lard oil to 5 parts kerosene.

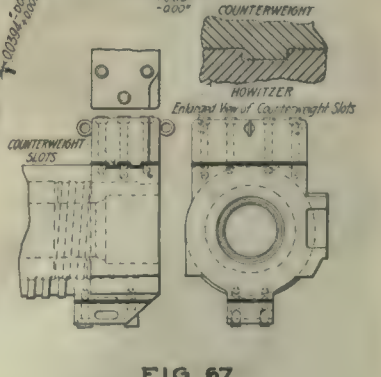
Operation 36.—Cut off and face muzzle end to a length. Machine—No. 5004. Type—27 in. by 14 ft. Reed-Prentice lathe







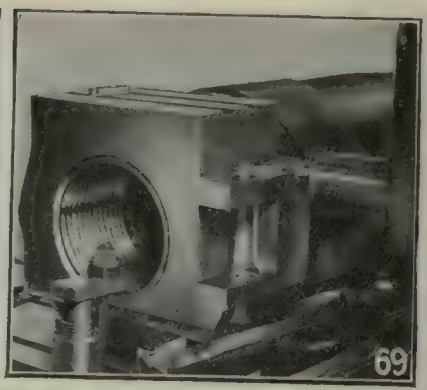


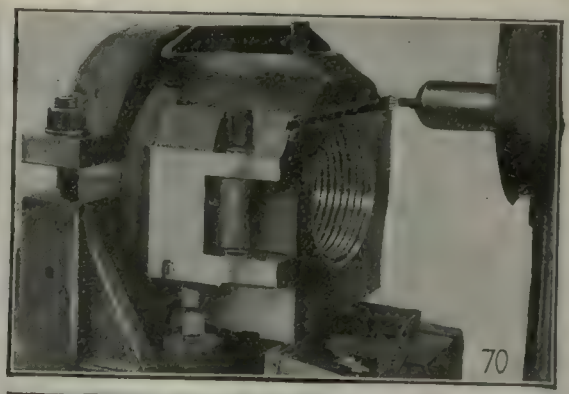


FIGS. 63 TO 67. TRANSFORMATIONS OF VARIOUS OPERATIONS

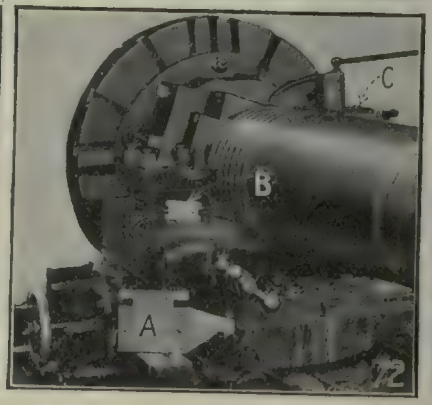
Fig. 63—Transformation for operation 31. Fig. 64—Transformation for operation 33. Fig. 65—Transformation for operation 34. Fig. 66—Transformation for operation 35. Fig. 67—Transformation for operation 38

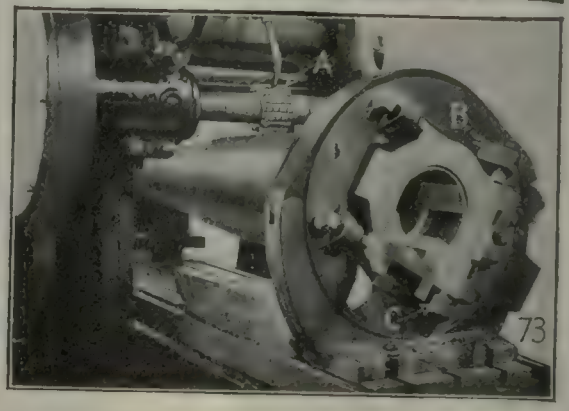






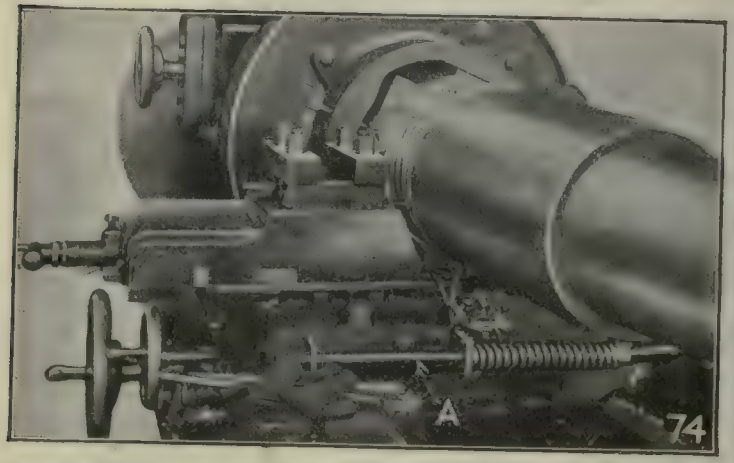


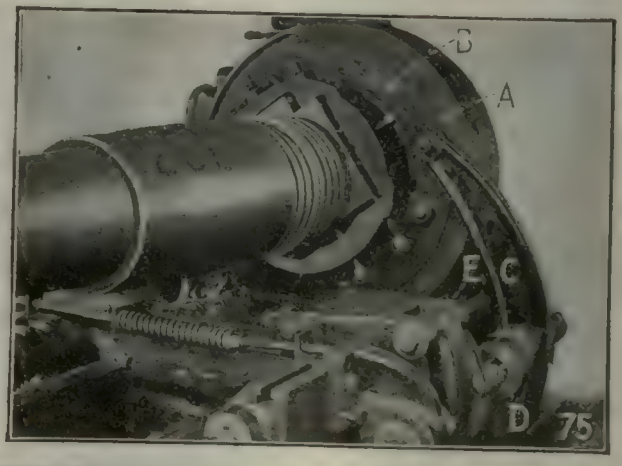


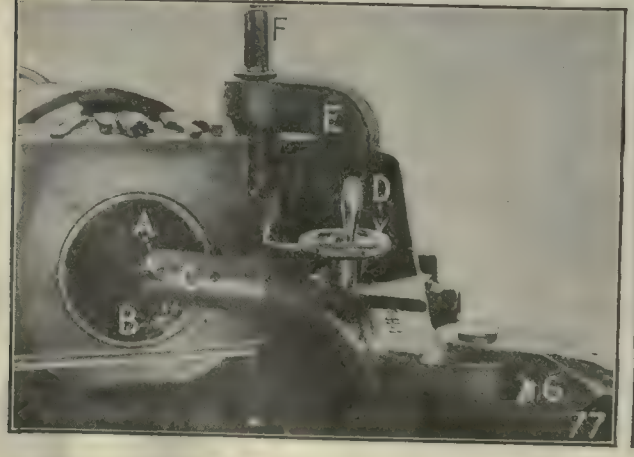


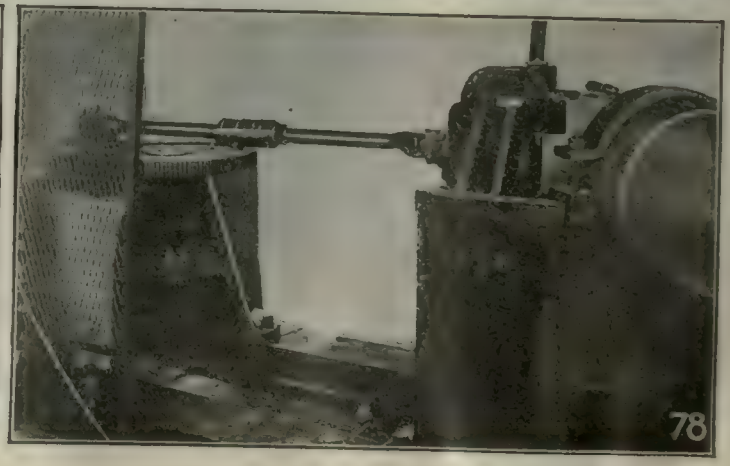
FIGS. 68 TO 73—MILLING AND SHAPING OPERATIONS ON BREECH AND BODY. FIGS. 74 AND 75—SIDE AND REAR VIEWS OF THE JUMP LATHE. FIGS. 77 AND 78—SHAPING SWING CLEARANCE

Fig. 68—Shaping part of hinge pocket. Fig. 69—Milling a T-slot. Fig. 70—Fixture and cutters for milling a dovetail slot. Fig. 71—A counterboring operation. Fig. 72—Cutting threads on the body. Fig. 73—Cutting relief on threaded section. Fig. 74—The tool slide. Fig. 75—The actuating mechanism. Fig. 77—Fixture and tools for cutting the swing clearance. Fig. 78—Driving rig for swing-clearance cutting attachment







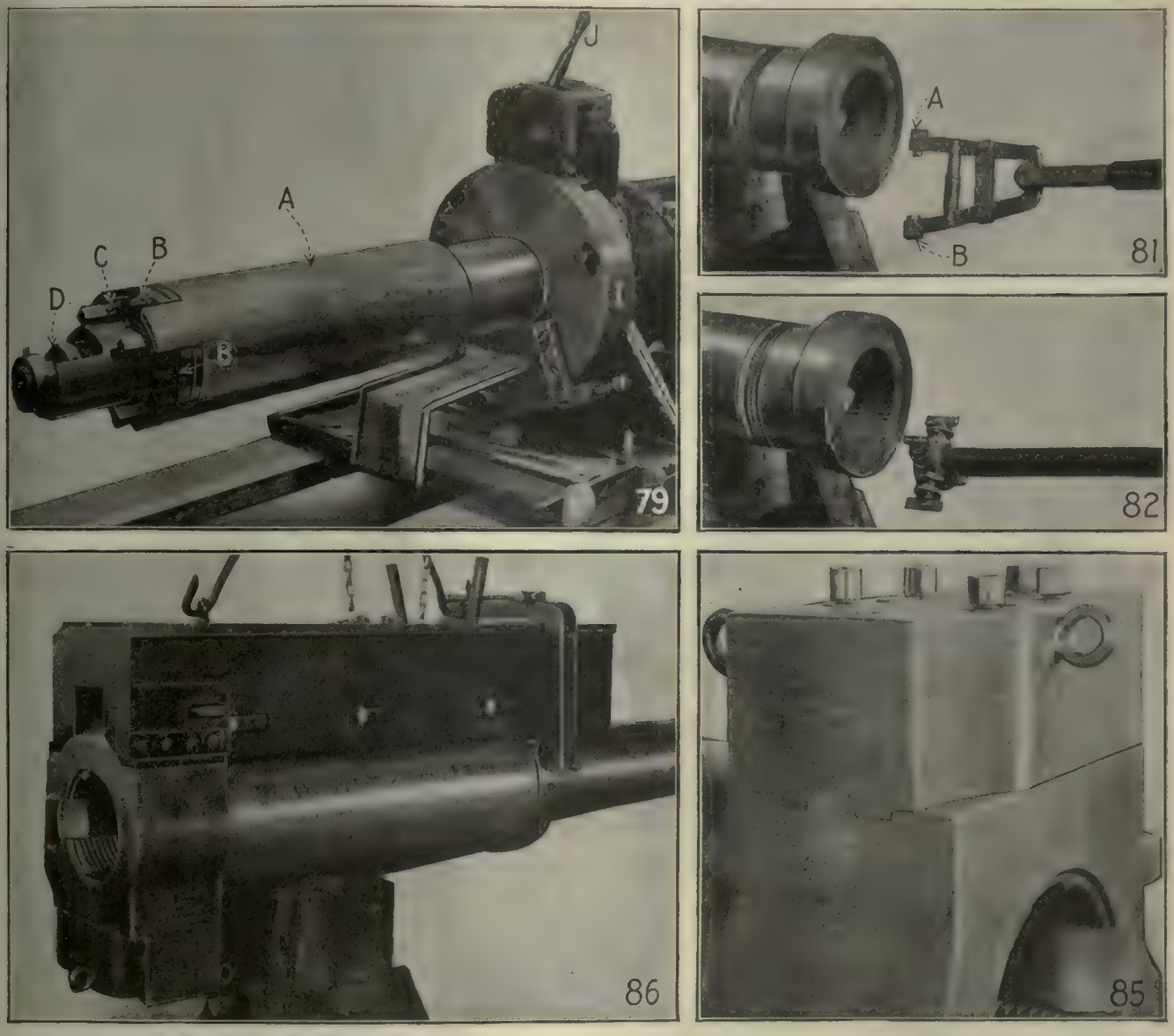


Operation 37.—Mill relief on muzzle end of gun. Machine—No. 5432. Type—24 in. by 12 ft. Ingersoll milling machine. Tools—Special formed cutters.
Operation 38.—Assembling of bridle and counterweight on gun body. Transformation—Fig. 67.
Operation 38A.—Mill screw heads flush. Machine—No. 5138. Type—Beaman & Smith horizontal boring machine. Tools—Milling cutters.
Operation 39.—Hand work; assembling; marking quarter lines; leveling plates and lettering on gun body.
Operation 40.—Final inspection.
Operation 41.—Painting.
Operation 42.—Inspection.
Operation 43.—Boxing.
Operation 44.—Shipping.

The milling cut on the interior of the hinge pocket is a roughing one. This is now followed by a shaping cut on the right angle surfaces, as is illustrated in Fig. 68. Only one side of the dovetail slot is cut at a time, a second cut being made for the opposite side.

All the drilling operations on the breech end are performed on radial drilling machines. One operation—counterboring—is illustrated in Fig. 71, to show the type of jigs that are used for this work. In the drilling operations the body is carefully leveled so that no trouble will result in the alignment of the holes. The tapping arrangements are similarly performed on the same basis by the use of a tapping attachment.

Cutting the thread in operation 30 is performed on a 36 in. by 18 ft. lathe, Fig. 72. The gage for position-



FIGS. 79, 81, 82, 85 AND 86. RIFLING OPERATIONS, COUNTERWEIGHT FITTING AND SURFACE PLATE FOR FITTING CARRIAGE BEARING

Fig. 79—The rifling head. Fig. 81—Tool for filing the grooves. Fig. 82—Lap for polishing the grooves. Fig. 85—How the counterweight is attached. Fig. 86—Surface plate for fitting carriage bearing

In cutting the T-slot the method is shown in Fig. 69, in which at this particular instant the end mill used is making the first cut. This is followed by a T-slotting cutter, which makes the final cut at this point. The milling of the 13-deg. angle on the inside of the hinge lug is performed by the aid of a profile form.

The holding fixture, gages and dovetail milling cutter for operation 28 are easily understood from Fig. 70.

ing the thread on the body is shown at *A*. The thread gage is shown at *B*, and a third gage used in connection with this work is lying on top of the howitzer body at *C*. The thread is cut entirely around the body, but is all later removed with the exception of a strip about 8 in. wide on the lower section, which is used for a rack in connection with adjustment of the gun on the gun carriage.

The removal of the surplus thread is done in a lathe of the "jump" type, but before this is done it is necessary to make clearances for the lathe tool to begin and end the cut. This is done in a milling machine, Fig. 73, using a cutter formed to the radius at the root of the thread as shown at *A*. The fixture for this operation has lugs at *B* and *C* for the alignment of the body in the proper position. The screws *D* are for tightening the body in the fixture.

Turning off the excess thread in the jump lathe, which was especially constructed for this particular operation, is shown in Fig. 74. The jumping feature of the tool carriage is aided by the spring *A* at its base.

bar *C*, which can be turned through the required arc by means of the handwheel *D*. The whole arrangement is attached to the yoke *E* and the cut is made by swinging it about the pin *F* by which it is pivoted to the hinge lugs of the gun. Reciprocating motion is transmitted through the connecting-rod *G* from a power crank shown in Fig. 78 at the left. This view shows the whole machine from the rear.

Rifling the barrel is rather more simple than that required for the large majority of heavy rifles and field guns because the rifling in the howitzer is at a constant degree of twist throughout its entire length; also the shortness of the howitzer in comparison with rifles

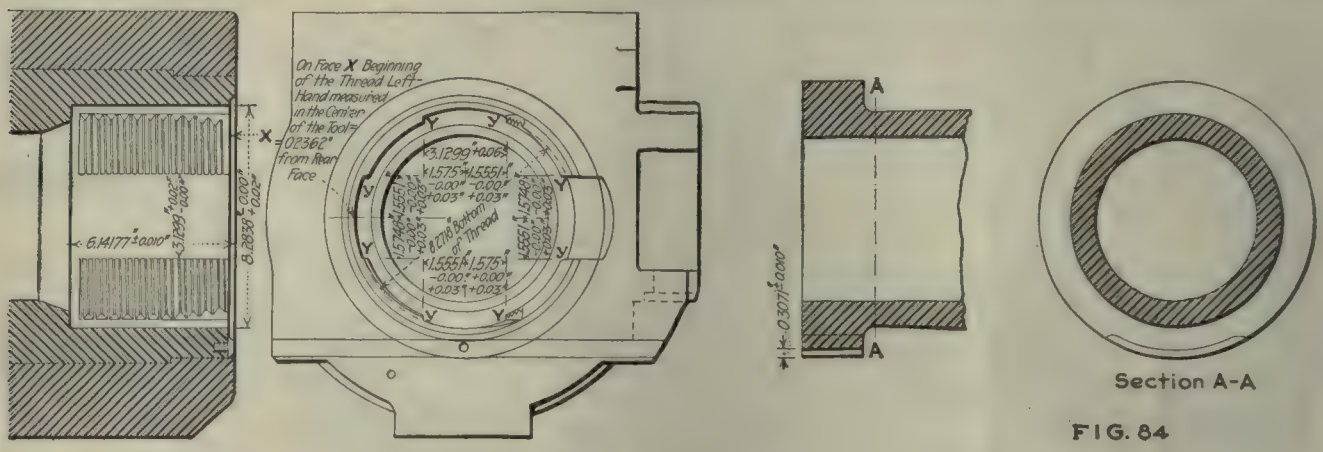


FIG. 76

FIG. 84

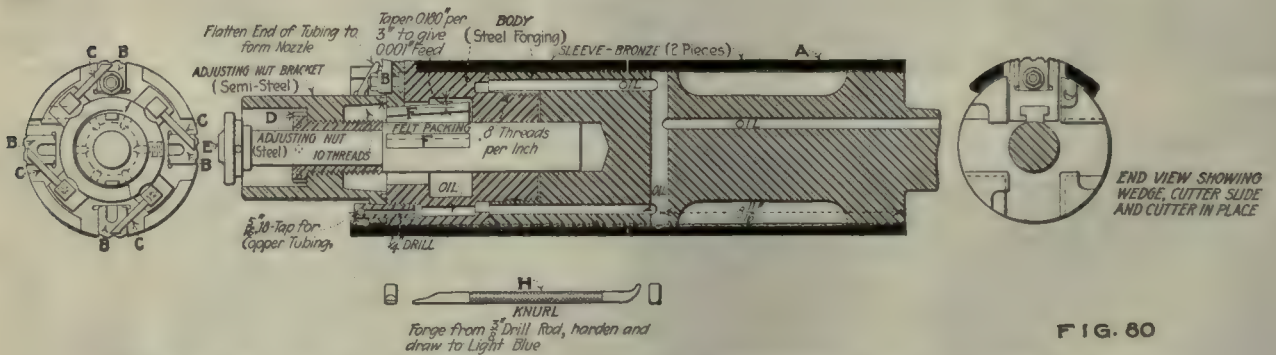


FIG. 80

FIGS. 76, 80 AND 84. INTERRUPTED THREAD, RIFLING HEAD AND RELIEF ON MUZZLE

Fig. 76—Details of interrupted thread. Fig. 80—Details of rifling head. Fig. 84—Relief on the muzzle

This is in turn controlled by lever mechanism at the rear of the lathe bed, which is shown in Fig. 75.

The controlling feature of this device is the cam *A* bolted to the faceplate of the lathe. Running in the groove *B* is a roller on the lever *C*. Motion imparted to this lever by the cam is also imparted to lever *E* through shaft *D*. Lever *E* being pivoted to the tool block gives to it a reciprocating movement timed by the cam.

Interrupting the threads in the breech is done on a shaping machine. Suitable templets are used for laying out the work, and a special work-holding fixture is provided for the necessary partial revolution of the gun body during the removal of each section. Details showing the removal of these sections will be found in the line drawing, Fig. 76.

A machine for cutting the swing clearance in the breech end of the gun is shown in Fig. 77. The cutting tool is seen at *A* being held by the setscrews *B* in the

somewhat lessens the problem of handling this work. A general idea of the rifling head may be obtained from Fig. 79. In cutting position the bar is fed forward or toward the left of the reader. The body portion is covered with a bronze sleeve *A*, which serves the same alignment purposes as does the wood packing on the boring reamers. There are four cutters spaced 90 deg. apart at *B*, each of which cuts two grooves simultaneously, so that the rifling head is actually cutting on eight grooves at each forward stroke. Pipes at *C* feed a constant heavy stream of coolant on the cutter and wash the chips freely from the barrel.

Adjustment of the cutters is made by the capstan nut *D*. The details of the rifling head can be better understood from the drawing Fig. 80. At the end of the head is a plunger *E*. When the head has been pushed through to the further end of the barrel the plunger comes in contact with a fixed stop that pushes it back into the head, causing a release of the cutting

blades for the return stroke. The operation of this release is by the T-shaped tapered keys *F* that are partially let into slots in the inner end of the plunger. The inward movement of the plunger causes the keys to close the cutters together radially. After each return stroke of the rifling head the plunger is pulled out by the small bar *H* and the adjusting nut *D* is set up for the next cut. The flow of coolant is automatically cut off at the end of the cutting stroke, so the operator has not this to contend with while setting his cutting blade. An average of eight cutting strokes is required to complete each set of grooves. The cutting stroke requires one minute, and the return stroke 30 seconds. The coolant used for this work is a mixture of one part of lard oil to five parts of kerosene.

Since the rifling head only works on eight out of the total of 48 grooves in the barrel at each setting it follows that six settings will be required, and these are provided for by the indexing head at *I*, Fig. 79, the control for which is by the lever *J*.

There are always numerous small imperfections and rough spots in the rifling, which have to be later cleared out by hand-finishing operations. One of the devices used for this is the filing device fastened to the end of the pole that is shown in Fig. 81. A special file is clamped on the arm at *A*, of a width to fit the grooves of the rifling, and on the other arm *B* is a corresponding wood block so that no cutting will occur at that point. The device is sprung together in order to insert it into the bore, and a spring across the jaws provides the necessary pressure for the file. By this device the operator is enabled to reach any point in the bore.

The finish required in the grooves is of the highest grade possible, and after filing it is customary to use the lead lap shown in Fig. 82. The device, which is also mounted on the end of a pole, has four lead laps at 90 deg. from each other. By polishing with this device the operator is enabled to bring the grooves to a very high grade of finish. The chalk marks which the workman put on the muzzle indicate the grooves upon which he has completed his work. After the finishing work on the grooves has been completed they are subjected to a very careful inspection, including star-gaging. An inspection of the powder chamber is conducted at the same time. Both of these inspections are recorded on the form shown in Fig. 83, which is similar to the forms which were used for star-gaging the jacket, and also the tube, before and after shrinking. After the muzzle end of the gun has been cut off and faced to the required length the gun is placed in a 24 in. by 12 in. milling machine, and by means of a formed cutter the relief is milled on the muzzle end of the gun. The cut made in this operation is shown in Fig. 84. The gun body is now ready for assembling the bridle and counterweight, which are fastened by means of special screws, the heads of which are afterward cut off. A view of the method of fastening the counterweight is shown in Fig. 85, in which the heads of five of these screws may be seen standing above the top surface of the counterweight. After the heads have been cut off, the part of the bodies in the counterweight are peened in order to insure tightness and then milled flush with the surface of the counterweight and bridle.

LANDS C.-75 **GROOVES**

155 M/M HOWITZER No. 536 MODEL 1918 HEAT No. JACKET B₂ 58 E₂ (S) HEAT No. TUBE M 354 (S)

INCHES FROM MUZZLE	LANDS		MEAN	GROOVES		MEAN	INCHES FROM MUZZLE	LANDS		MEAN	GROOVES		MEAN
Set	6.102			6.181			34	+.002	+.002				
0	+.015	+.0025		+.001	+.0015		35	"	"		+.002	+.002	
1	"	"		"	"		36	"	"		"	"	
2	"	"		+.002	"		37	"	"		"	"	
3	+.002	+.002		"	"		38	"	"		"	"	
4	"	"		"	"		39	"	"		"	"	
5	"	"		+.003	"		40	"	"		+.0015	"	
6	"	"		"	"		41	"	"				
7	"	"		"	"		42	"	"				
8	+.015	"		"	"		43	"	"				
9	+.002	"		"	"		44	"	"				
10	"	"		"	"		45	"	"				
11	"	"		"	"		46	"	"		"	"	
12	"	"		"	"		47	"	"				
13	"	"		"	"		48	"	"				
14	"	"		"	"		49	"	"				
15	"	"		+.0025	+.002		50	"	"		"	"	
16	"	"		"	"		51	"	"				
17	"	"		"	"		52	"	"				
18	"	"		"	"		53	"	"				
19	"	"		"	"		54	"	"		"	"	
20	"	"		"	"		55	"	"				
21	"	"		"	"		56	"	"				
22	"	"		"	"		57	"	"				
23	"	"		"	"		58	"	"		"	"	
24	"	"		"	"		59	"	"				
25	"	"		+.0025	+.0025		60	"	"			+.0025	
26	"	"		"	"		61	"	"				
27	"	"		"	"		62	"	"				
28	"	"		"	"		63	"	"				
29	"	"		"	"		64	"	"				
30	"	"		"	"		65	"	+.0025				
31	"	"		"	"		66	"	"				
32	"	"		"	"		67	+.002	+.0025				
33	"	"		"	"		68				+.001	+.0015	

POWDER CHAMBER

INCHES FROM BREECH			MEAN	INCHES FROM BREECH			MEAN	INCHES FROM BREECH			MEAN		
	6.2596											FORCING CONE	GAS CHECK SEAT
7 +	+.003	+.003		13	+.0005	+.005		19	+.001	+.005			
8	+.002	+.002		14	"	"		20	"	+.001			
9	.0015	+.0015		15	"	"		21	"	+.001			
10	+.0015	"		16	+.001	"		22	+.0015	+.002			
11	+.001	+.001		17	"	"		22 +	+.002	+.002			
12		+.0005		18	"	"							

Bore clear has been tapped

A. B. S. & F. CO. INSPECTION BY ✓

U. S. INSPECTION BY ✓ DATE 6/ /19

A. B. S. & F. CO. FORM F-551

FIG. 83. INSPECTION REPORT OF RIFLING AND BORING POWDER CHAMBER

A great deal of hand work is required in the final finishing of the breech end of the gun and the breech mechanism, such as chipping, filing and polishing. The threads in the breech must have their corners relieved approximately $\frac{1}{4}$ in. in order that there will be no tendency for catching or binding when the breech block is rotated. The gun must be placed on an accurately leveled surface plate, and after it has been carefully leveled thereon the quarter lines indicating the exact center of the bore are marked on both the breech and on the muzzle ends.

On the top of the counterweight are placed two leveling plates made of german silver. These are used in connection with setting the sight on the gun when it goes into service and for adjustment purposes of the sight while the gun is in active service.

The gun body must have a perfect fit on certain portions of the carriage, and for this purpose it is fitted to the gage shown in Fig. 86. The gun is turned upside down across the trestles as shown, and the sleigh gage, which has previously been coated with prussian blue, is laid in position and carefully rapped down with wooden mallets. The bridle pin is also put through in place in order to insure that the bridle-pin hole is perfectly in line and of exact size. After removal of the gage the high spots, as indicated by the prussian-blue marks, must be filed and scraped and the gage refitted until a good bearing is obtained. The holding-down strap, which may be seen at the right end of the gage, is also fitted at the same time in order to insure that its holes will match perfectly those in the gun carriage.

Draftsman or Engineer?

By Harry Senior

E. H. Michaelis, in an article on page 77 of the *American Machinist*, comes dangerously near the truth in his views as to what constitutes an engineer when he says that the requisite knowledge "consists of two essential parts, one the theoretical and scientific and the other the practical shop knowledge." The only thing that saves him from going plumb into the bull's-eye is his later asseveration that "a college education is not necessary—any ambitious man with a little money can become as good a designer as ever graduated." He also says that "any dub can do the work of a so-called draftsman."

It is to the two latter statements that I take exception, for Mr. Michaelis seems to imply that any old "dub" who can become a "so-called" draftsman may also become an engineer as "good as ever graduated," the requirement being a little money and a stock of ambition.

The first part of the first statement means, I think, simply that the same degree of education acquired outside of a college would not be a college education, and with this view I have no quarrel, as it is only a matter of nomenclature. I have always maintained that the items of knowledge possessed by an engineer are to him exactly what the tools in his kit are to a draftsman or a toolmaker, and the manner or place of acquiring them is of no more importance to the former than it is to the latter whether his T-square and compasses were made by Keuffel & Esser or Theo. Alteneder or his micrometers by Brown & Sharpe or Starrett; but the kind of education is as arbitrary and its degree as important (and then some) to the engineer as the nature and extent of his kit is to the worker.

It may be said that a draftsman does not have to have an expensive lot of tools in order to be a skillful draftsman, but nevertheless it cannot be gainsaid that he could not accomplish much in the way of drawings without them; neither could he have become proficient if he had never had them. The engineer and draftsman alike must first acquire tools, and then by practice with them become proficient in using them, the principal difference being that the latter can buy, beg or steal his tools, and in case of temporary hard luck can "hang them up" with "Uncle" and borrow more to do his work with, while the engineer fills his "kit" with the tools of his trade only at the expense of hard work, and once having acquired them can neither lend, sell nor mislay them—he can part with them only by the forgetting process, and he cannot add to them by borrowing.

This brings me to the second point at issue: "Any ambitious man with a little money" and the desire to do so can buy a draftsman's or toolmaker's kit, and the same requisites will supply the candidate for engineer with the necessary education; but right here Mr. Michaelis and I begin to disagree. No dub, even though he owns a year's output of the world's best tool factory, will ever be a draftsman or toolmaker (the chances are, however, that he will never know this); neither will he be an engineer though he absorbs so much academic information that he makes a noise like a football train pulling out of New Haven station.

To attain proficiency in the use of their new possessions both engineer and workman must put them to practical use; they are of no value packed away. Each must become so accustomed to applying the proper tool to its individual purpose that its use becomes second nature; must know just what each will accomplish, and whether or not it is working properly. Each must respect the limitations of his tools and check them with other tools until they respond to the dictates of his brain as subconsciously as the fingers of the violinist follow through the same medium the score.

Years ago there was considerable discussion in the columns of the *American Machinist* anent the relative qualifications of the "born mechanic" and one who just "learned his trade," the advocates of the latter overlooking the fact that not even the born mechanic himself considered himself a finished product until he had passed a little way through the period of evolution that was the sole reliance of the mechanic by education.

I have no wish to reopen this ancient controversy, but it is my personal conviction that to be a successful mechanic, engineer, musician, artist or what not the candidate must bring to the beginning of his educational period, whether the way lies through shop, drafting room, college or studio, that impalpable, inexplicable something called "genius" which if not inherited can never be attained.

Two persons may aspire to play the violin. They may start at the same time and in the same conservatory; may study the same lessons under the same tutors; may devote to their work the same number of hours a day for the same number of years. In the end the one with genius is a violinist, the other a fiddler.



Copper-Pipe Smithing in the Sun Shipyard

By E. A. Suverkrop, Associate Editor, American Machinist

Considerably more steel piping is used in marine work in the United States than in Europe. There are, however, a great number of copper pipes used for marine engine and boiler installations. These require in their production the employment of skilled pipe benders and coppersmiths.

THE smaller pipes for engine work in shipbuilding are usually made from solid-drawn pipe bought in the open market. Before bending, the pipes are filled with rosin, and when the rosin has set the bends are made in the usual way with a bending machine usually equipped with grooved rollers operated by levers. The methods and machines employed in making such bends have been fully covered in previous articles in the *American Machinist*, so there need be no recapitulation of them. In the headpiece is shown a part of the outside storage space for the smaller sizes of copper pipes that have been bent to templet and are ready to have the flanges secured on them. The templets used for this work are made of iron rod, the size of which is determined by the stiffness necessary to retain its form while being handled in the bending shop. It is not intended to go deeply into the art of coppersmithing as practiced in the shipyard copper shop, but a few examples of the procedure when large pipes or abrupt bends are made may be of interest. In Fig. 2 is shown a partly finished main-exhaust pipe 22 in. diameter. This pipe leads from the low-pressure cylinder to the condenser. After the engine and condenser are installed on shipboard the carpenter gets out his templet for the pipe *A*, Fig. 2. This templet is shown at *B* in Fig. 2 and also in Fig. 3. The two wooden flanges *B* are bored for bolt holes and bolted in place on the low-pressure cylinder and condenser respectively. The carpenter then sets in the boards *C*, and at each end the braces *D* are securely fastened to *B* and *C* so that the flanges *B* will retain their position. The bolts securing *B* to the high-pressure cylinder and condenser are now removed, and the templet carefully lifted out and taken to the copper shop. Here the rough wooden platform *E*, Fig. 2, is laid down, and on it with the aid of the templet *B* the two dum-

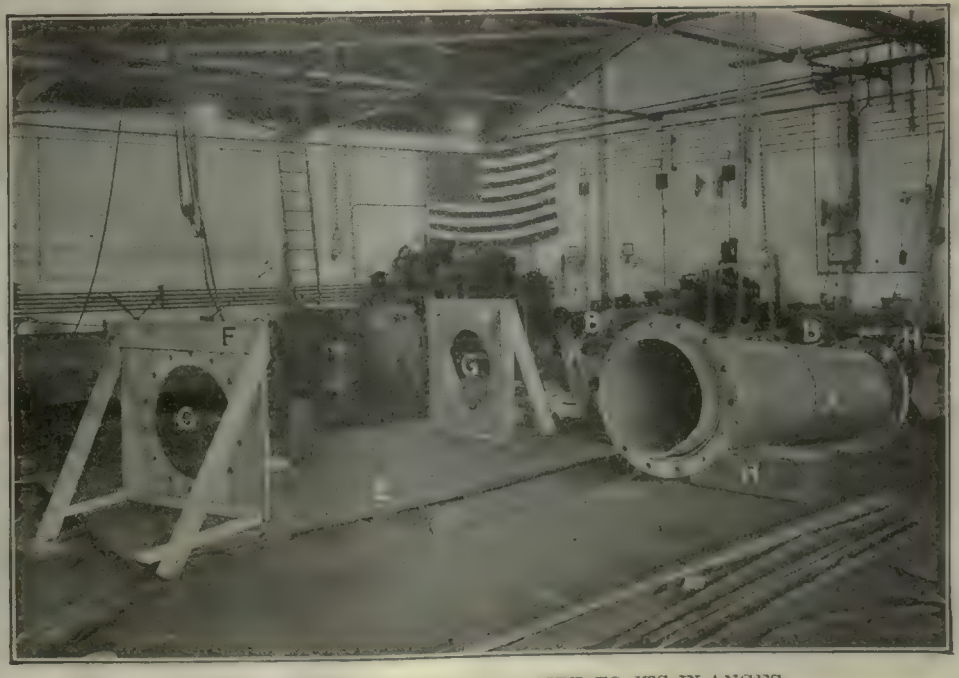


FIG. 2. FITTING AN EXHAUST PIPE TO ITS FLANGES

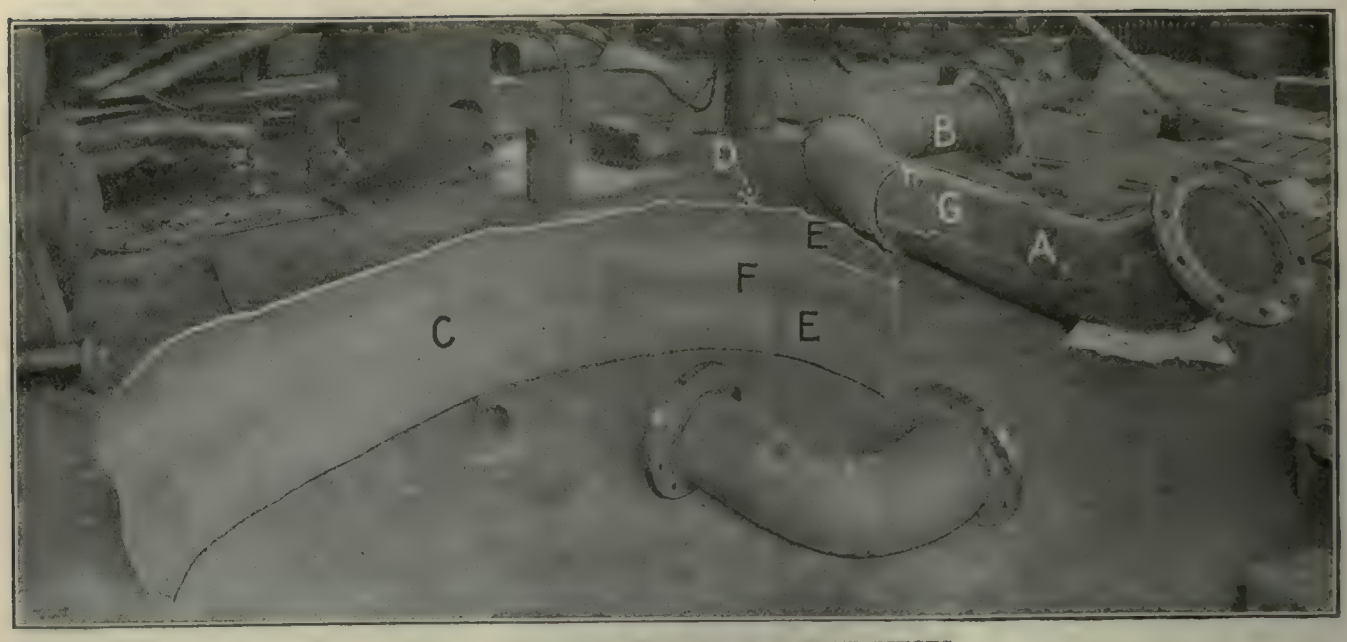


FIG. 4. DISCHARGE PIPE MADE IN FOUR PIECES

my faces *F* are erected and secured in exactly the same relation to each other as those of the low-pressure cylinder and the condenser on the ship. The openings *G* in *F* are a little larger than the size of the pipe *A*.

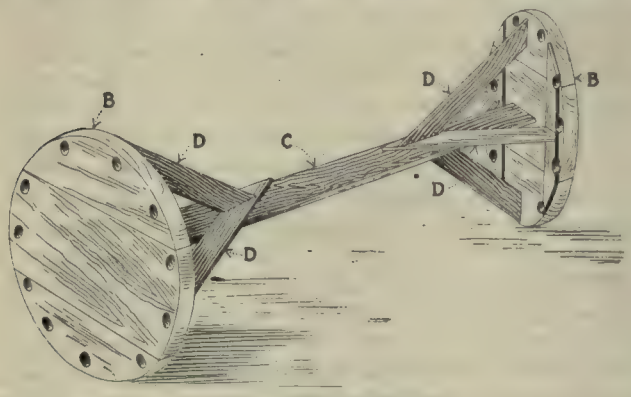


FIG. 3. THE TEMPLET

The bolt holes in *B* are laid off in correct position on the faces *F* and bored. The two flanges *H* are now bolted to the inner faces of *F* and the setup is ready for the coppersmith. His work consists in bending the large pipe *A* to correct shape, passing it through the openings *G* and the affixed flanges *H*.

It will be noticed that there is a groove around the inner edge of the flange *H* next to the pipe. When the pipe has been correctly bent, each end is cut off to length, flanged and peened over into this groove. The depth of the groove is slightly less than the thickness of the copper used in the pipe, so that when it is solidly peened in there is enough metal to finish the face.

Formerly it was thought necessary to braze all flanges in place. This is still done with many of the smaller sizes of pipes, but providing the peening has been properly done it is not necessary when steel flanges such as *H* are used.

Two men work on a job like this main-exhaust pipe and it takes about 380 hours to complete it. The thickness of copper is No. 2 B. W. G. The greatest pressure to which it is subjected is not more than 10 to 15 pounds.

The pipe shown at *AB* in Fig. 4 is in two lengths, which are each made of two pieces. One of the half

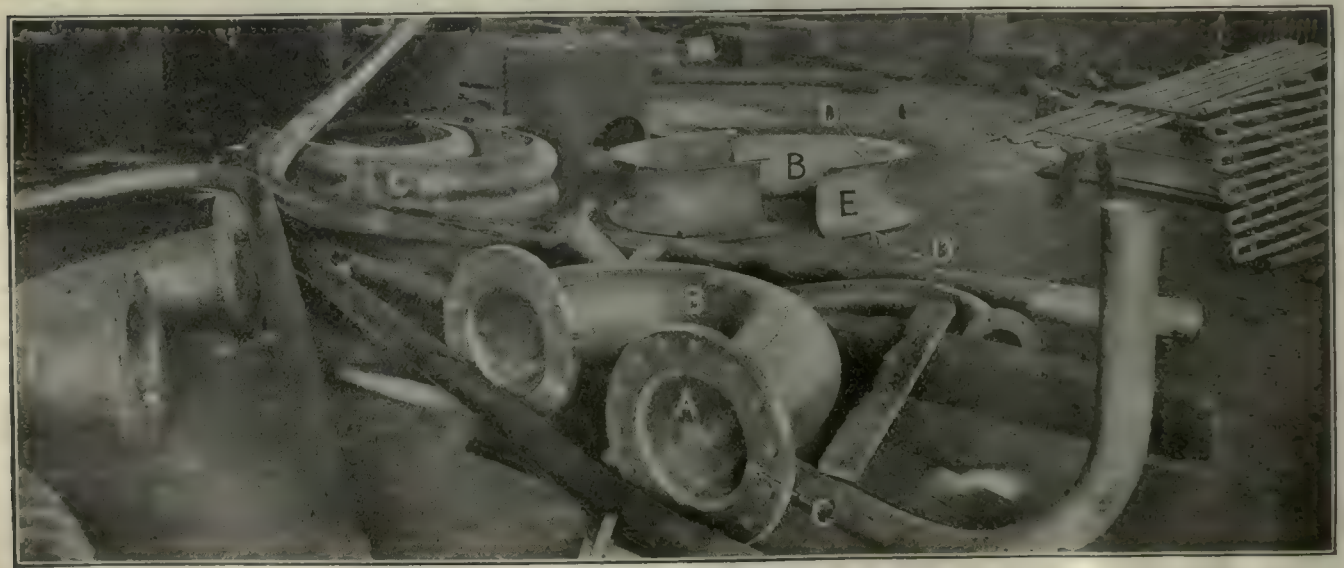


FIG. 5. AN ABRUPT BEND AND ITS COMPONENTS

pieces for the *B* section is shown at *C*. A pipe like this is not difficult to produce, but in Fig. 5 at *A* is shown a bend which requires a skilled coppersmith to produce. Such a pipe is made from two pieces of flat copper sheet, the joint running roughly as indicated by the dotted line on *A*. Obviously when making the inner half *B* from flat stock the edges *D* must be stretched and is therefore thinner than the center *E*, as the original sheet is flat, of uniform thickness and of equal length throughout its width, while edges *D* are longer than the end-to-end distance measured through the center line *E*. The reverse is true of the outer half *C*. In these sections the edges are shorter than the end-to-end measurement on the center line. This means that the edges must be shortened and therefore thickened.

The piece *C*, Fig. 4, will serve to show the way the copper is "humored" into shape.

The flat stock is first cut to length and width, after which the width is divided into thirds, as shown by the white lines on *C*. The plate is then roughly bent in the flat to the approximate shape of the half pipe. It is next crimped along the edges as shown at *D*. The work is as far as possible done hot, as the copper is then more malleable. Judicious hammering with wooden mallets thickens up the edge *D*, and shortens it. The depressions at *E* are also driven outwardly with round-faced mallets. The stretching of the metal here facilitates the thickening of the metal at the edges. As previously stated bent iron rods are used as templets. In this case the rod would be bent to conform to the center line of the bent pipe. When the edges *D* have been formed into the shape of the templet the inwardly projecting ridge *F* is beaten out with mallets till the half pipe is to the correct circle. This end is of course not attained by merely pounding with mallets on the center of the inside of the half pipe. The hammering must be intelligently done and the metal at this point uniformly stretched; the edges must also from time to time receive attention, otherwise the work is apt to be distorted. When cutting the sheet to width allowance is made for the amount the two halves lap each other at the brazed joint. In the case of the pipe shown in Fig. 4, at *A*, allowance is also made in the length for the amount the one pipe enters the other at the joint *G*. The metal on the edges of the joints is thinned down, so the exterior of the pipe will be round. Brazing is done in a coke fire with borax as a flux and yellow brass as hard solder. One of the coppersmiths tells me that boric acid does not give good results in copper brazing.

After brazing, the pipes are pickled to remove the borax and generally to clean them, the joints appearing as in the two pipes shown in Fig. 6.

During fabrication pipes are apt to become dented. Dents are removed by hammering over a ball such as shown at *A*, Fig. 7. The curved pipe in Fig. 7 shown in place over the ball is similar to the pipe shown in Fig. 5. After the dents are removed the flanges are fitted. Copper pipes that are exposed to view in the engine room or elsewhere are planished on the ball. This makes the surface denser and after planishing the copper will take a high polish.



FIG. 6. SUCTION PIPE AFTER BRAZING



FIG. 7. HAMMERING OUT THE DENTS

Surplus Ordnance Scrap

The Ordnance Department will order to be sold or stored, as conditions require, all surplus unused or obsolete construction and manufacturing material, both semifinished and completed parts. This includes miscellaneous supplies, etc., left over at the time of the cancellation or termination of ordnance contracts or any surplus at arsenals and supply depots. This will be handled by a subcommittee on the sale of material of the Salvage Board. The actual sale of this material will be handled by the Materials Branch of the Stores and Scrap Section of the Ordnance Department through the district stores and scrap managers located in each district office.

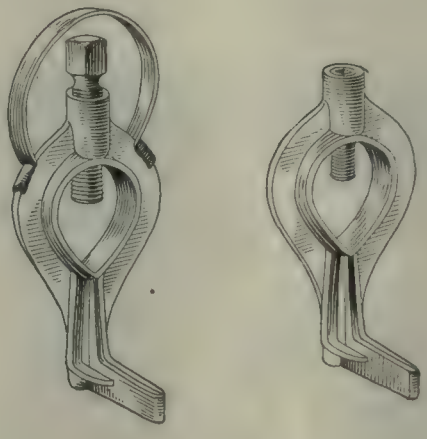
Lists of this material are now being prepared by Capt. Ralph B. Shaw, room 303, section 1 of B Building, Ordnance Department, Seventh and B Sts., Washington. These lists will be completed as promptly as possible after the materials are reported for sale. Any Government agencies or others interested in the purchase of any materials having been ordered sold or to be ordered sold by the Salvage Board should communicate with the Materials Branch.

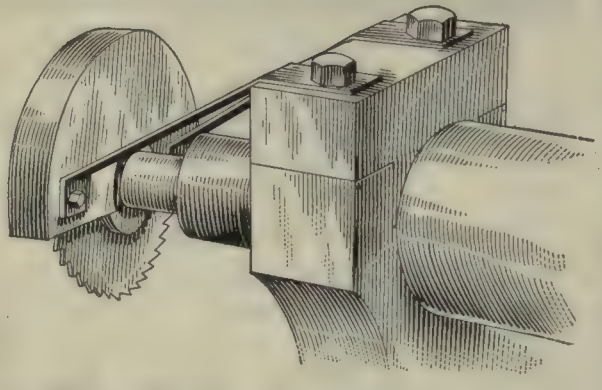
All scraps left over from the operations of ordnance contracts will also be sold. This scrap consists of different kinds of steel in sheets, billets and turnings, scrap-steel parts, cupronickel scrap, antimonial lead dross, silk and cotton waste, burlap, spent acid, etc.

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas













Why Do Ball Bearings Sometimes Fail?

By F. J. JAROSCH

Nothwithstanding the justifiable claims of ball-bearing manufacturers for their product these devices sometimes cause trouble to their users. Seldom, however, are these remissions due to the bearings, but to extraneous conditions, beginning with the improper selection of the types and sizes wanted up to plain mistreatment. The influence of these parts on the life of a machine is so great and the troubles arising from defect so numerous that they demand more than the perfunctory care generally given them, and for this reason this contribution should be of value to all tool builders.

BALL-BEARING manufacturers claim that annular ball bearings as recommended and used for passenger cars, trucks, tractors, airplanes, electric motors and generators, machine tools, line shafting and for all other kind of machines where efficiency is one of the first requirements are a finished piece of work; that their final development has been based upon sound theories and years of practical experience; that they are made of the best material available; that all dimensions are finished to the closest manufacturing tolerances; that all parts have to undergo a number of inspections and must be satisfactory in every respect, and that they are assembled with great care and precision. All this has been proved to be true, but in spite of all these claims ball bearings sometimes fail of expectations, and then the ball-bearing user, not taking the trouble to investigate the cause of the failure, condemns the bearing.

Of course there are cases where the bearing might have been faulty, but in my experience in investigating ball-bearing troubles I seldom found such cases, most of them being caused by the wrong selection of bearing types and sizes, incorrect mounting, improper lubrication and careless treatment. As no mechanic will permit his measuring instruments or other tools to be put to rough use, so also the bearing manufacturer tries to protect his product by issuing instructions, and only when these rules are observed can success be obtained.

Ball Bearings Precision Products

High-class ball bearings are made of the best grades of chrome-alloy steel, heat-treated and hardened. All surfaces are ground, the raceways and balls are highly polished, all dimensions are kept within limits of a few ten-thousandths of an inch, and the balls in each bearing are guaranteed to be spherical and of equal size within one ten-thousandth of an inch. As all these features are not fanciful ideas of the manufacturer, but are necessary, the ball-bearing user will understand that such bearings must be treated like any other precision product.

In selecting ball bearings for a particular purpose it is necessary to determine the maximum load and maximum speed under which they will operate, in what direction the load will be applied on the bearings, if this direction changes, and if vibrations, shocks, sudden changes of load or speed, excessive high or low temperatures and other possible troublemakers are liable to influence the proper operation of the bearings. The direction of the load will help to select the type of bearing, while all other factors, as the amount of load, speed, etc., which influence the carrying capacity, will be needed in selecting the correct size of bearing.

For radial loads—that is a pressure in a direction at right angles to the axis of rotation and where axial-directed load or end thrust is a negligible factor—a single-row annular radial bearing such as that shown in Fig. 1, or a double-row bearing of the same type is recommended.

Another design of annular radial bearing is shown in Fig. 2, where all pressures due to the load are applied through the lines *AA* and *A1 A1*, which meet and pass through the center of the bearing, which point is also the center of the spherical outer race. This type of bearing is capable of automatically adjusting itself to any deflection of the shaft on which it is mounted. For combined radial and axial loads another type of bearing has been developed, Fig. 3, where the load line is in such a position as to form the resultant of both the radial and axial load. To increase the radial carrying capacity and to take up axial loads in either direction a combination of two bearings of the latter type made up into a unit forms the double-row bearing, Fig. 4. A narrow type of bearing of different design of the raceways, but also developed for the purpose of taking up radial loads as well as axial loads in either direction, is shown in Fig. 5.

Axial or Thrust Bearings

For purely axial loads, that is, a pressure in a direction parallel to the axis of rotation, thrust ball bearings of the plain type, Fig. 6, or of the self-aligning type, Fig. 7, are recommended, but these types of bearings are for axial load only and should not be subjected to much radial load. In case axial loads change from one to the opposite direction, for instance in worm-gear drives, a number of different types of double-acting ball thrust bearings are illustrated in the catalogs of the bearing manufacturers. All these types are made in three standard series for light, medium and heavy duty, and the dimensions and carrying capacities will be found in the catalogs. The published carrying capacities of all bearings referred to are usually recommended for steady loads and speeds only, and a safety factor must be considered where detrimental factors might influence their carrying capacity. Whatever the case might be it is always safest to request the manufacturer to select the proper type and size of bearing guaranteed to do the work.

The mounting of ball bearings is an important matter not only in the proper operation and life of the bearing itself, but also for the other parts on the same shaft, which will be affected by an incorrect installation of the bearings. Notwithstanding bearing manufacturers are always ready to recommend and describe the mounting of the bearings in detail, such information usually never reaches the man who mounts the bearings, and mistakes

are made which later cause the bearing to fail. If ball-bearing users would hand over to the men in the assembling shop not only the blueprints showing the general bearing layout but give detailed instructions on how to mount the bearings, and observe carefully how often ball bearings are mistreated bearing failures would soon disappear.

One of the first rules in mounting annular ball bearings is to mount the inner race a tight fit on the shaft and to fit the outer race with a snug sliding fit in the housing. As in most cases the inner race is rotating, while the outer race is stationary, the tight fit of the inner race will prevent it from working itself loose, while the stationary outer race will have a chance to creep slowly and bring all parts of it under the influence of the load.

There are press fits, drive fits, push fits, sliding fits and some other such expressions in use, and one might get confused in following such recommendations. A real press fit will rarely be employed for mounting the inner race, as this might expand the hardened bearing ring more than the material can stand, and render it liable to crack when put under load. Moreover such an expansion of the inner race will likely cause an elastic deformation of the balls and might also expand the outer race. This pressure, in addition to the working load, will often cause an overload on the bearing which will result in noisy operation and short life.

Taking into consideration that annular ball bearings are ground in bore to tolerances of 0.0002 in. plus to 0.0004 in. minus and 0.0006 in. minus for large bearings the table gives some limits for grinding the bearing seat on the shaft which will secure a tight enough fit for most ball-bearing mountings:

OVERSIZE GRINDING LIMITS FOR BEARING SEATS

Inner Race Diameter in Mm.	Bearing Numbers			Addition to Shaft Diameter in Inches	
				Min.	Max.
10 to 20	200 to 204	300 to 304	403 to 404	0	0.0003
22 to 40	205 to 208	305 to 308	405 to 408	0	0.0004
45 to 75	209 to 215	309 to 315	409 to 415	0	0.0006
80 to 110	216 to 222	316 to 322	415 to 420	0	0.0008

To facilitate the mounting of the inner race the bearing should be dipped into oil heated to about 110 deg. F., thus temporarily expanding the inner race. When driving the bearing on the shaft care should be taken not to strike hammer blows against the outer race, as such blows are transmitted to the balls and may produce flat spots on them, and, still more important, the retainer should not be struck as this will damage the bearing. The best way to drive the inner race on the shaft is to slip a tube, Fig. 8, over the shaft, lay a piece of wood across the free end and strike light hammer blows on the wood, producing an all-around equal pressure against the inner race. If the location of the bearing does not permit the use of such a tube it will pay to make a special tool of such shape as required by the space available. Such tools should be made of soft steel, bronze, brass, etc., but never use hardened steel or strike with the hammer direct on the bearing rings, as such blows always produce a one-sided pressure, and even the best mechanic in the shop is not clever enough to hit always the exact spot he aims at.

The bearing seat on the shaft must be cylindrical, and should be ground and inspected to make sure that it is not oval or tapered. Taking into consideration the high carrying capacity of ball bearings and the small surface of the bearing seat on the shaft, the pressure per unit area on the shaft, produced by the loaded bearing, will be very high. Now if the inner race touches its seat only at a few points this pressure may become excessive, the hardened inner race may press itself into the soft material of the shaft, work itself loose and tear off the material of the shaft. A loose bearing will move edgewise and bring all parts mounted on the shaft out of alignment, besides setting up vibrations.

It often happens that a formation of rust between the bore of the inner race and the bearing seat makes it difficult to dismount the bearing after it has been in service. In order to prevent this rust the bore of the bearing and the seat on the shaft should be cleaned with gasoline to remove all finger marks and moisture, and then apply a coat of pure, filtered mineral oil previous to mounting the bearing. If the bearing seat on the shaft is turned only or rough-ground, finely pulverized graphite or graphite grease may be rubbed into the surface.

Proper Mounting Important

Referring to the mounting of the outer race the bore of the housing must be cylindrical and must not be oval or tapered. If tapered the outer race will not have sufficient seat and might be pressed out of shape by the action of the load, at the same time producing an overload on the balls in some sections of the bearing. Special attention should be paid to split housings, as sometimes the parts of such housings do not match up exactly to form a cylindrical seat for the bearing.

It also cannot be called good practice to mount bearings directly in soft-metal housings, such as aluminum or other soft compositions, for under the influence of vibrations the outer race will pound its seat and become loose in a short time. For such cases a steel sleeve should be forced into the soft-metal housing and the bearing mounted into this sleeve. Before slipping the bearing into place inspect carefully to see that the inside of the housing is clean and that there is no sand, filings or other foreign matter sticking in the corners, which later will get into the bearing and act as an abrasive between the balls and raceways.

In assembling gear boxes and other machine parts very often files, emery cloth and other abrasives are used for smoothing rough edges on the shaft, gears or housing parts, and the residue of this operation adheres to these parts and is left there. This foreign matter will later be carried by the lubricant into the bearings and will cause trouble in a short time. Ball bearings must be kept clean, and therefore they should not be taken out of the boxes until they are needed. Do not let them lie about on the work bench or near a vise. Once in the bearing dust will settle in the pockets of the ball retainer, which cannot be easily washed out. Keep in mind that the proper working of the gears and all parts on the shaft depends to a great extent upon the correct mounting and good service of the bearings.

If possible, the inner race should always be locked laterally against a shoulder sufficiently high to give it good support. The fillet at the shoulder on the shaft should be the same or smaller than the standardized chamfer or radius of the bearing ring. If the radius of the fillet is larger than the chamfer of the inner race

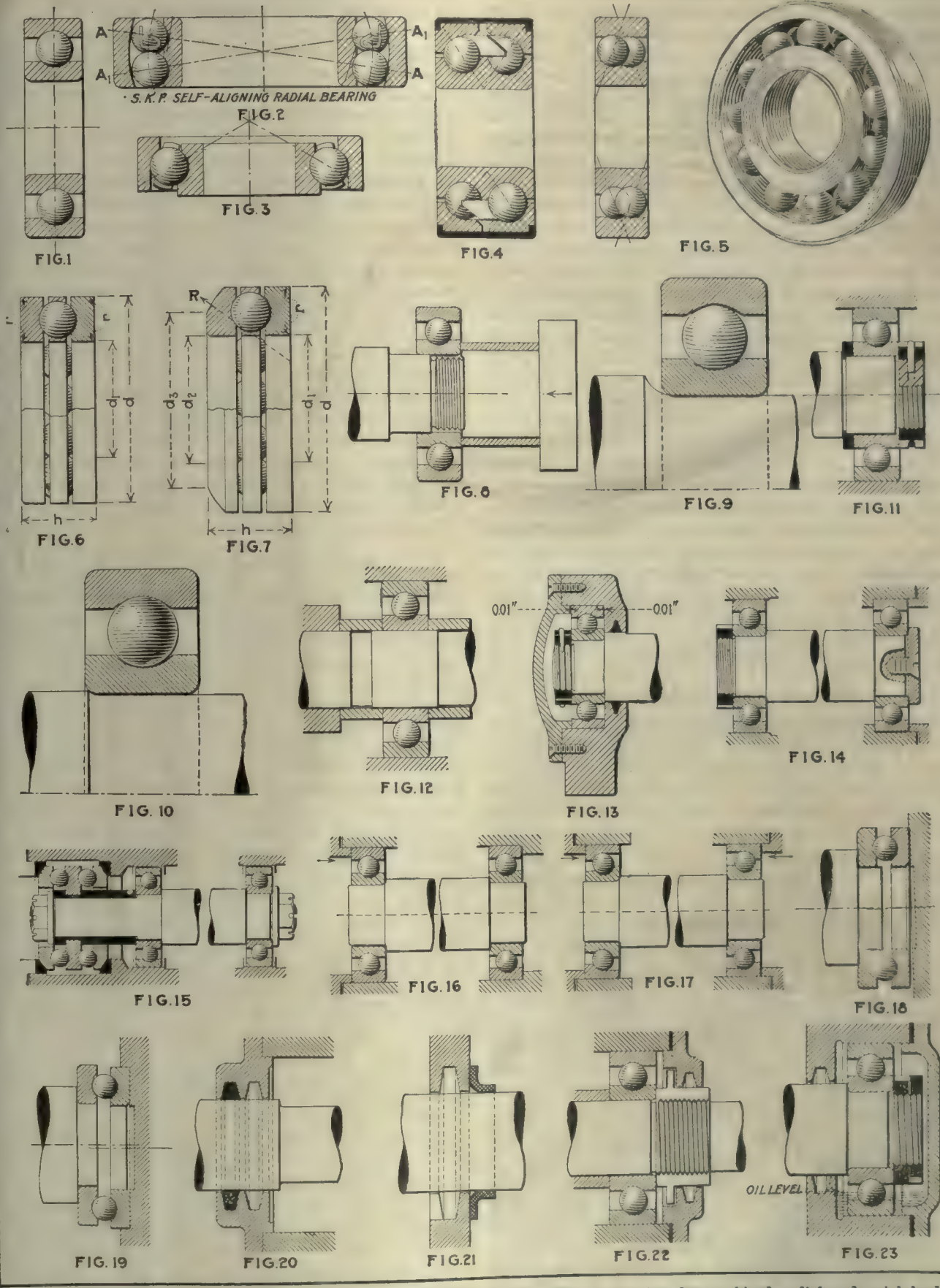


Fig. 1—Bearing for radial loads. Fig. 2—Self-aligning radial bearing. Fig. 3—Bearing for combined radial and axial loads. Fig. 4—Combined axial and radial bearing to take loads from either direction. Fig. 5—Bearing for same purpose, but of different design. Fig. 6—Thrust bearing for axial loads. Fig. 7—Self-aligning type. Fig. 8—Way to drive on a bearing. Fig. 9—Result of too large a radius. Fig. 10—Result of too low shoulder. Fig. 11—Suggested method of fitting. Fig. 12—Bearing locked between sleeves. Fig. 13—Indicating lateral play. Fig. 14—Two radial bearings on same shaft. Fig. 15—A case where one bearing should be laterally free. Fig. 16—An incorrect mounting. Fig. 17—Combined radial and thrust bearing. Fig. 18—Another mounting. Fig. 19—Washers held eccentric to each other. Fig. 20—Method of closing housing openings. Fig. 21—Application of a leather washer. Fig. 22—An overlapping housing. Fig. 23—The proper oil level

the latter will not rest against the shoulder, but will be wedged upon the fillet as shown in Fig. 9. If the shoulder is too low the inner race will slip over this shoulder as shown in Fig.10, and if the side pressure is excessive it will expand the bearing ring and possibly crack it. This can be prevented by turning a sharp corner at the fillet and by slipping a washer over the shaft, illustrated in Fig. 11, thus providing a sufficiently high shoulder for the inner race. Should it be impossible to provide such shoulders on the shaft itself the inner race should be locked between sleeves which might be made to rest against other parts on the same shaft as shown in Fig. 12. For annular radial bearings which are subject to axial loads, or are to fix the location of the shaft in lateral direction, the outer race will be mounted between shoulders in the housings, but it should not be clamped tight, like the inner race, but should be given on either side a lateral play of about 0.01 in. as shown in Fig. 13, so that it can creep and bring all parts of it under the influence of the load.

Where ball bearings are subject to the influence of high temperature, as for instance crankshaft bearings for gasoline engines, bearings must be assembled with a slight end shake; that is, the balls must have a slight radial and axial play in their grooves. As the soft material of the shaft and the housings will expand more than the dense, hardened steel of the ball bearings, the rings and balls must have sufficient space to meet especially the lateral expansion of the shaft, otherwise the immense pressure produced by this expansion will press the ball tightly between the races and cause an overload and noisy operation of the bearing.

Mounting Groups of Bearings

If two or more radial bearings are located on the same shaft, Fig. 14, and the housings are locally stationary, that is, cannot adjust themselves to the bearings, only one of the bearings should be locked laterally in both races, while of the other bearings, only one of the races —preferably the rotating one—should be locked sidewise. The other races must be laterally free, so that these bearings can automatically adjust themselves to the bearing locked in both races. As the bearing locally fixed in both races will prevent a lateral movement of the shaft and will have to take up all axial pressures it will be of advantage to lock that bearing which will receive the least amount of radial load compared to its carrying capacity. Where single or double acting thrust ball bearings are provided to take care of the axial loads one race of each radial bearing must be laterally free, Fig. 15, so that the entire axial load can be received by the thrust bearing.

An incorrect mounting often used for the countershaft in transmission gears is shown in Fig. 16, as here, when tightening the housing caps in the direction of the indicated arrow, the diagonal pressure upon the bearing will wedge the balls tightly between the races and quick wear will result. This method is recommended for ball bearings of the combined radial and thrust type, Fig. 17, as they are designed for taking axial as well as radial loads, and in this arrangement one bearing must counteract the other. There are instances where the outer race is rotating and the inner race is stationary, for example in wheel hubs, idler pulleys, etc., but in such cases it is not necessary to mount the outer race a tight fit; a good push fit will be sufficient, as likely it will be locked laterally.

In regard to thrust ball bearings the manufacturer does his part and carefully inspects the washers to make sure that the surface is parallel with the bottom of the groove and that the grooves are concentric with the bore and outside of the washers. Obviously he expects that the bearing users also do their part, mount the thrust washers between parallel shoulders and observe that the seat on the shaft and the recess in the housing are concentric. Fig. 18 shows a ball-bearing mounting where the stationary washer touches the housing only with a small part of its back surface; the bearing will rock and very likely will be overloaded at that point. In Fig. 19 the washers are held eccentric to each other, the balls will be pressed out of the grooves and will be twisted around, and if the shaft has some radial play it will be pressed out of alignment. In either case the bearing will wear quickly and will have a short life, thus producing more and more play which finally will influence all other parts mounted on the same shaft.

A number of locking devices are recommended and used for fastening the bearing races to the shaft and housing, but their construction largely rests on the available space.

Dust Protection and Lubrication

Bearing housings must be closed in order to protect the bearings against water, dust and other detrimental matter and also to hold the lubricant in place. This part of bearing mountings often does not receive the proper attention, although it is as important as other things. The construction of the bearing housing depends to some extent on the general construction of all other parts connected with it, but no matter what its shape there will always be some way of closing it. Housing openings provided for the passage of the shaft are usually closed by turning lips and one or more grooves in the housing lids, as shown in Fig. 20, and to leave a clearance of about 0.01 in. between these lips and the shaft. The old practice of pressing felt washers into these grooves will close the opening tightly enough, but when saturated with oil the felt becomes a dust catcher, the dust gradually working into the bearing housing. It is better to fill these grooves with a stiff grease or, if two grooves are provided, to leave the inside groove empty so that if any foreign matter gets thus far it can be deposited into this groove. In flour mills, farm tractors, etc., it will be advisable to slip a leather washer tightly over the shaft, Fig. 21, which, on account of its elasticity, will press itself against the housing lid. There are other good ways, like overlapping housing parts, Fig. 22, or pressed sheet-metal caps, and their construction and shape will depend on the space available for them.

Some investigators of ball-bearing theories claim that inasmuch as there is a true rolling motion of the balls in the grooves there can be no friction or wear, and consequently ball bearings do not need lubrication. This theory is based on the assumed fact that the balls have a point contact with their raceways; but in reality the conditions are somewhat different from the theory. A point is an imaginary thing, having no area, but as

loads cannot find support on imaginary things they must have areas to rest upon.

In a loaded bearing the load is pressing upon the balls, and as they are made of an elastic material they will undergo slight elastic deformation, whereby areas of contact are produced conforming to the curvature of the raceways. As these areas of contact are extremely small the pressure per unit area will be extremely high, and much care must be taken in selecting a lubricant that under such condition will prevent a metal-to-metal contact. The lubricant must have such viscosity as to form an unbroken film and at the same time must have enough body to adhere to the surface, and must not be squeezed out by the high pressure between the surfaces. The lubricant must not materially change its viscosity by a change in temperature caused by the weather conditions of summer and winter or by the climatic conditions of the North and South.

Suitable Lubricants Few in Number

There are a multitude of lubricants on the market, but only a few of them are suitable for ball-bearing lubrication. Lubricants used for transmission, bevel, differential and worm gear drives, cylinders and pistons in engines, and wherever a number of driving machine parts are assembled and inclosed in one casing also have to serve for the ball bearings mounted in the same casing. From the standpoint of the ball-bearing manufacturer such lubricants need watching, for while some oils or greases might in the opinion of shopmen and lubrication salesmen be good enough for the gears, they are liable to harm ball bearings.

It cannot be repeated too often that ball-bearing lubricants must not contain water, acids, alkali, free carbon, grit or other kinds of impurities which might effect the highly finished surfaces. Water will oxidize the steel and produce rust which will flake off and leave pits, thereby gradually destroying the smooth surfaces of ball and raceways. Rust flakes will mix with the lubricant and act as an abrasive, thus causing a quick wear of the bearing. Animal fats and oils, besides containing fatty acids, will become rancid, while vegetable oils will become gummy and dry up. Some mineral oils and greases contain acids or alkali either as a necessary component of their composition or as a part of some filler used to adulterate the oil or to alter its viscosity and sometimes as a residue of some of the processes of purifying when refining from the crude product. Free acids and alkali will cause an etching of the steel and, like rust, will also destroy the smooth surfaces of ball bearings.

The only kind of lubrication which will meet the requirements for ball bearing is a pure, filtered petroleum oil and petroleum jelly or vaseline, as they have the highest lubricating qualities and contain practically no impurities. The quality of these lubricants depends upon the quality of the crude oil and the thoroughness of refining and compounding, and the purchaser must depend upon the reputation of the manufacturer to some degree.

It is usually recommended to use a thin oil for high speeds and light loads, an oil of medium thickness for speeds from 500 to 2000 r.p.m., and grease of moderate thickness for low speeds and heavy loads. It will be sufficient to have the oil level reach to about the center of the lowest ball as shown in Fig. 23. Excessive lubrication in the bearing housing will not benefit the bearing, but will cause a rise in temperature produced by the resistance of the lubricant against the fast-rotating parts of the bearing and by the friction of the lubricant in itself. An all-around good lubricant for all bearings will be a slush made up of pure vaseline and a lighter mineral oil. When slightly heated this mixture will readily penetrate all parts of the bearing and after being cooled off it will stay there and will not run out like lighter oils. For high speeds provision must be made to hold the thin oil in the housing and for renewing it. Beware of lubricants mixed with ground mica, cork, wood, asbestos, and other such substances, which are used sometimes for eliminating the noises in worm gears, as this mixture will clog up the bearing, will wedge between raceways and balls, and will force the latter to slide. Cases are known where emery powder mixed with grease was used for running in new gears in already assembled transmissions. This mixture also got into the bearings, and as it was impossible to clean out bearings already mounted it caused wear and started trouble in a very short time.

The proper operation of gears and other running parts on a shaft depends principally on the bearings. In the automotive field—passenger cars, trucks, tractors, airplanes, motor boats, etc.—and in the use of high-class machines where efficiency plays an important part plain bearings have been replaced by ball bearings in order to save fuel and power by reducing the friction to a minimum, but this can be fully accomplished only if the ball bearings are mounted and treated in the right way.

It will be to the benefit of every ball-bearing user in any branch of industry to pay close attention to the instructions freely given out by the ball-bearing manufacturer as only then full success can be obtained. If there are any signs of trouble consult the ball-bearing man and do not wait until the damage is done.

The Next Move—Human Interest

By John R. Godfrey

It doesn't matter much what the game is the fellow who can keep three jumps ahead of the crowd has every advantage. But it takes a live wire to know when the next move is due.

Those who watch the signs and symptoms of the times are convinced that now is the right time to move, and incidentally to be sure and move in the right direction. They realize that peace parleys and the principle of self-determination of little nations also apply to industry right here at home as well as to Liberia or East Africa and other places which are such a long ways off. It means that the little fellow, whether the small manufacturer or the workman, has got to be guaranteed a square deal and not be shut out by any "balance of power" that may be worked against him.

We've been throwing away a lot of good material during these past four years—thousands of tons of steel and the coal it took to make it, thousands of tons of explosives, and nitrates which ought to have gone to fertilize our acres, and other things almost without number. And just as with the individual who has blown in his money without rhyme or reason, who has

spent many times more than he can earn in the same time, we must make more and spend less in the years to come. We must increase our production; we must waste less material and be more frugal in every way.

Greater production, and at a lower cost per unit of production, is the watchword of every good manager; more wheat per dollar, both for our own use and the use of the rest of the world, and other things to match. This, however, does not mean more system or less wages, at least at present. It means the increasing of production by newer and better methods.

Many who have studied the question carefully believe that much greater production may be secured by getting back some of the human interest in the work which our scientific-management friends have taken away from it. It means a getting back to really human relations instead of thinking of men as numbers and forgetting that they have feelings and aspirations like our own.

We have devoted so much time to putting in systems and purely mechanical devices for running our businesses that we have for the most part quite overlooked the most vital part of industry—the human element which is behind it all and without which there would be no industry and no need for it. We have in too many cases considered the man as part of the machine and so entirely devoid of human attributes that we have failed to get his coöperation, and in so doing we have also failed to get nearly as much out of our expensive machine equipment as we might have done.

We have made time studies and motion studies to try and save seconds when we might have saved minutes and hours by getting the coöperation of the men themselves. We have assumed that all the brains of the establishment were tied up in the craniums of a few men, some of whom knew almost nothing about our shops, or any shops for that matter, and have failed to avail ourselves of the intelligence which lay within our grasp in the brains of the workers themselves.

We have paid efficiency experts a hundred dollars a day to come into our plants and try to tell us what ailed them, when as a matter of fact many of them never had any practical experience in shops of any kind. And then we have grudgingly paid a foreman or a worker five dollars for an idea from the suggestion box which saved us dollars every day in the year. We have spent all kinds of money for cards and files and systems brought to us by outsiders and have confiscated without remuneration devices which grew in the brains of our own men on the plea that their weekly salary gave us a right to all that they might evolve. And then we have wondered why we did not get loyalty and devotion.

The next move is due now. It is time to prepare for those three jumps ahead of the crowd. Some have jumped already and are reaping their reward in the absence of labor turnover, in the reduction of costs and in the genuine loyalty and coöperation from every man in the plant. It is time to study men rather than methods; to study the reasons that the old shop could count on the coöperation of every man in the plant, to have the best that was in every man both as to brains and muscle. It is time to study ways and means of reviving the old family spirit, to make men feel that they really belong and are not mere appendages to a machine or mere numbers on the payroll. It can be done and it is being done in a number of shops. These shops are paying big dividends, not only in goodwill but in cash, and a goodly share of it is going to the men who have helped to produce it.

This is a new problem to many, but there are fortunately new physicians in the field to help us diagnose the cases and apply the proper remedies. Some of these men have been pioneers and have had wide and successful experience during the past few years. Fakers will also spring up, just as they did in the scientific-management field, and they will do even more harm than they did before, because this is a more serious problem. But the beginning in each case must come from within. There must be a genuine desire to improve conditions and the relations with the men.

It is time for the first jump. And it is well to be sure that it is in the right direction. Reaction, the attempt to reëstablish the old prewar conditions, is a step backward and can only bring disaster. Prewar conditions will never return. The new era will be different, and it is up to us to make it better. Let us study men more closely and we shall find it pleasant and profitable.

Preservation of Productive Equipment Used During the War

By Luther D. Burlingame

Two reasons why the vast equipment provided for producing war material should be preserved by the Government are: First, as a matter of preparedness and as a guarantee for future peace; and second, that the market may not be flooded with second-hand machines and tools that will demoralize industry.

If this equipment is scrapped or turned over to the second-hand market it will bring the Government but a fraction of its original cost, and the time might come when its having been preserved under Government control would be of incalculable value in preserving peace or in meeting the aggressions of an enemy.

While applying particularly to special machines and equipment, the utilization of which in the industries of peace would tend to lower the standard of efficiency because ill adapted to their needs, it also applies to standard machinery and tools, the supply of which during the war was shown to be so inadequate. While it is not suggested that factories should be maintained with machines belted up ready for war work it is believed that adequate storehouses already in existence should be retained with a complete equipment of tools, gages and machines kept in them which would be available at short notice.

If it be urged that such equipment would soon become obsolete, it might be answered that with the coming of a world league to enforce peace the stimulus for producing new and more destructive agents of war will be largely removed, and therefore the existing munitions will be sufficient for any eventualities.

Such a policy would pay for itself many times over not only in the matter of preparedness but also in avoiding the loading of manufacture with equipment that would be a handicap in world trade and that would tend to glut the machinery market during the transition period when business stagnation or collapse would be disastrous.

Inspection of Metallic Electrode Arc Welds

By O. S. ESCHOLZ
Research Engineer Westinghouse Electric and Manufacturing Co.

The inspection of welds is very important, and unless properly done serious trouble may occur. This article outlines the best methods for satisfactory inspection tests.

DETERMINING the character of welded joints is of prime importance, and the lack of a satisfactory method, more than any other factor, has been responsible for the hesitancy among engineers of the extensive adoption of arc welding. To overcome this prejudice it is desirable to shape our rapidly accumulating knowledge of operation into an acceptable method of inspection.

Manufactured apparatus is practically all accepted on the basis of complying with a process specification

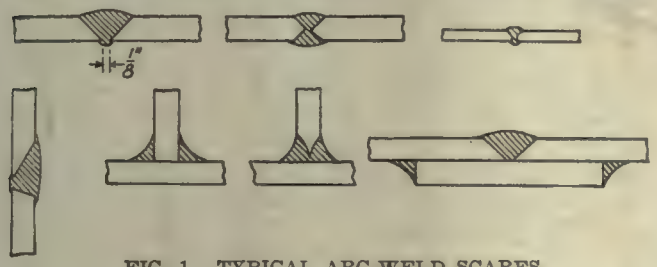


FIG. 1. TYPICAL ARC-WELD SCARFS

rigidly enforced in conjunction with the successful reaction to certain tests applied to the finished product. Riveting impairs the strength of the joined plates, yet with a proper layout and intelligent inspection the completed structure possesses certain definite characteristics which do not require further verification. The inspector of a finished concrete structure is practically helpless, and the weakest sort of construction may be concealed by a sound surface. With careful supervision, however, the physical properties of the completed structure can be reliably gaged to the extent that the use of concrete is justified even in ship construction. With this in view, electric arc welding is susceptible to even better control than obtain in either of these structural operations.

The four factors which determine the physical characteristics of the metallic electrode arc welds are: Fusion, slag content, porosity and crystal structure.

Some of the other important methods that have been suggested and used for indicating these characteristics are:

1. Examination of the weld by visual means to determine (a) finish of the surface as an index to workmanship; (b) length of deposits, which indicates the frequency of breaking arc, and therefore the ability to control the arc; (c) uniformity of the deposits, as an indication of the faithfulness with which the filler metal is placed in position; (d) fusion of deposited metal to bottom of weld scrap as shown by appearance of under side of welded joint; (e) predominance of surface porosity and slag.

2. The edges of the deposited layers chipped with a cold chisel or calking tool to determine the relative adhesion of deposit.

3. Penetration tests to indicate the linked unfused zones, slag pockets and porosity by (a) X-ray penetration; (b) rate of gas penetration; (c) rate of liquid penetration.

4. Electrical tests (as a result of incomplete fusion, slag inclusions and porosity) showing variations in (a) electrical conductivity; (b) magnetic induction.

These tests if used to the best advantage would involve their application to each layer of deposited metal as well as to the finished weld. This, except in unusual instances, would not be required by commercial practice in which a prescribing welding process is carried out.

Of the above methods the visual examination is of more importance than generally admitted. Together with it the chipping and calking tests are particularly useful, the latter test serving to indicate gross neglect by the operator of the cardinal welding principles, due to the fact that only a very poor joint will respond to the tests.

The most reliable indication of the soundness of the weld is offered by the penetration tests. Obviously the presence of unfused oxide surfaces, slag deposits and blowholes will offer a varying degree of penetration. Excellent results in the testing of small samples are made possible by the use of the X-ray. However, due to the nature of the apparatus, the amount of time required and the difficulty of manipulating and interpreting results, it can hardly be considered at the present

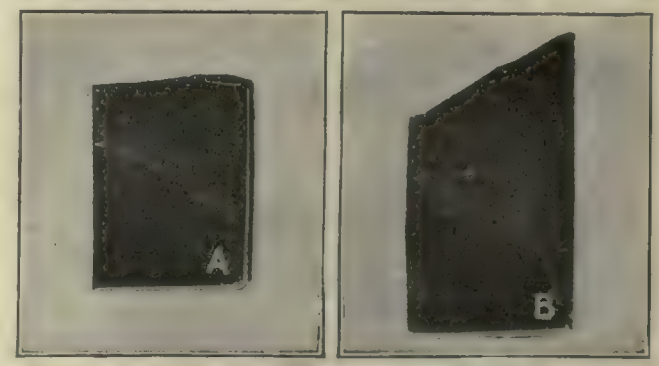


FIG. 2. GOOD AND BAD WELDS

time as a successful means to be used on large-scale production.

The rate that hydrogen or air leaks through a joint from pressure above atmospheric to atmospheric, or from atmospheric to partial vacuum, can readily be determined by equipment that would be quite cumbersome, and the slight advantage over liquid penetration in time reduction is not of sufficient importance to warrant consideration for most welds.

Of the various liquids that may be applied kerosene has marked advantages because of its availability, low volatility and high surface tension. Due to the latter characteristics kerosene sprayed on a weld surface is rapidly drawn into any capillaries produced by incom-

plete fusion between deposited metal and weld scarf, or between succeeding deposits, slag inclusions, gas pockets, etc., penetrating through the weld and showing the existence of an unsatisfactory structure by a stain on the emerging side. A bright-red stain can be produced by dissolving suitable oil-soluble dyes in the kerosene. By this means the presence of faults have been found that could not be detected with hydraulic pressure or other methods.

By the kerosene penetration a sequence of imperfect structure linked through the weld, which presents the greatest hazard in welded joints, could be immediately located, but it should be borne in mind that this

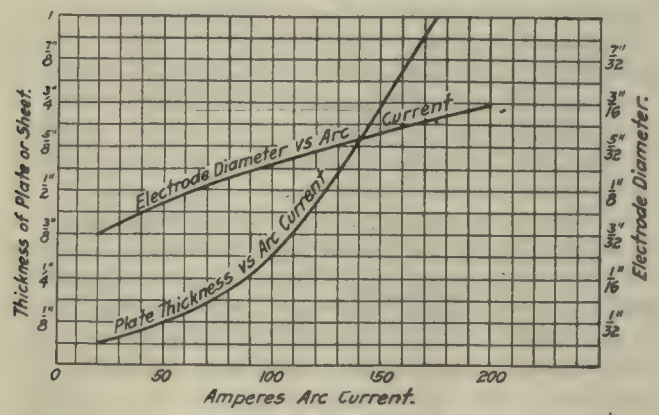


FIG. 3. DIAMETERS FOR WELDING STEEL PLATE

method is not applicable to the detection of isolated slag or gas pockets nor small, disconnected unfused areas. It has been shown by various tests, however, that a weld may contain a considerable amount of distributed small imperfections, without affecting to a great extent its characteristics.

If a bad fault is betrayed by the kerosene test it is advisable to burn out the metal with a carbon arc before rewelding under proper supervision. By the means of sandblast, steam or gasoline large quantities of kerosene are preferably removed. No difficulty has been encountered on welding over a thin film of the liquid.

Electrical tests, by which the homogeneity of welds is determined, are still in the evolutionary stages, and many difficulties are yet to be overcome before this test becomes feasible. Some of these difficulties are the elimination of the effect of contact differences, the influence of neighboring paths and fields, and the lack of practicable, portable instruments of sufficient sensibility for the detection of slight variations in conductivity or magnetic field intensity. No simple tests are plausible, excepting those which involve subjecting the metal to excessive stresses for determining the crystal structure. Control of this phase must be determined by the experience obtained from following a prescribed process.

The inspector of metallic arc electrode welds may consider that through the proper use of visual, chipping and penetrating tests a more definite appraisal of the finished joint may be obtained than by either riveting or concrete construction. The operation may be still further safeguarded by requiring rigid adherence to a specified process.

Good results are assured if correct procedure is followed.

Haphazard welding can no sooner produce an acceptable product than hit-or-miss weaving will make a marketable cloth. It is only logical that all the steps in a manufacturing operation should be regulated to obtain the best results. As it is most welders consider themselves pioneers in an unknown art that requires the exercise of a peculiar temperament for its successful evolution, and as a result welding operators enshroud themselves in the halo of an expert and do their work with a mystery bewildering to the untutored. Once in a while, due we might say to coincidences, these "experts" obtain a good weld, but more often the good weld may be attributed to the friction between slightly fused, plastered deposits.

In common with all other operations metallic electrode arc welding is really susceptible to analysis. Regardless of the metal welded with the arc the cardinal steps are: (1) Preparation of weld; (2) electrode

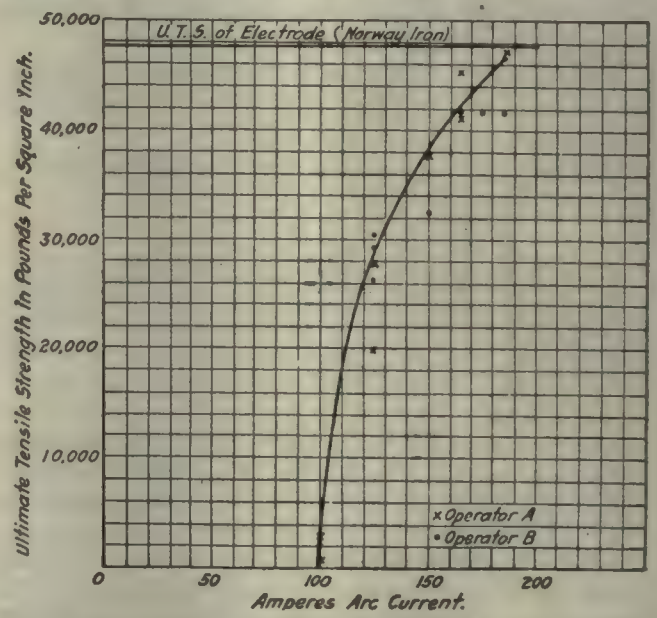


FIG. 4. VARIATION IN WELD STRENGTH WITH CHANGE IN ARC CURRENT

selection; (3) arc-current adjustment; (4) arc-length maintenance, and (5) heat treatment.

Sufficient scarfing is involved in the preparation of the weld, as well as the separation of the weld slants, so that the entire surface is accessible to the operator with a minimum amount of filling required. When necessary to avoid distortion and internal stresses, owing to unequal expansion and contraction strains, the metal is preheated or placed so as to permit the necessary movement to occur. Various types of scarfs in common use are shown in Fig. 1.

The electrode selection is determined by the mass, thickness and constitution of the material to be welded. An electrode free from impurities and containing about 17 per cent. carbon and 5 per cent. manganese has been found generally satisfactory for welding low and high carbon as well as alloy steels. This electrode can also be used for cast-iron and malleable-iron welding, although more dependable results, having a higher degree of consistency and permitting machining of welded sections, can be obtained by brazing, using a copper-aluminum-iron-alloy electrode and some simple flux. Successful results are obtained by brazing copper and

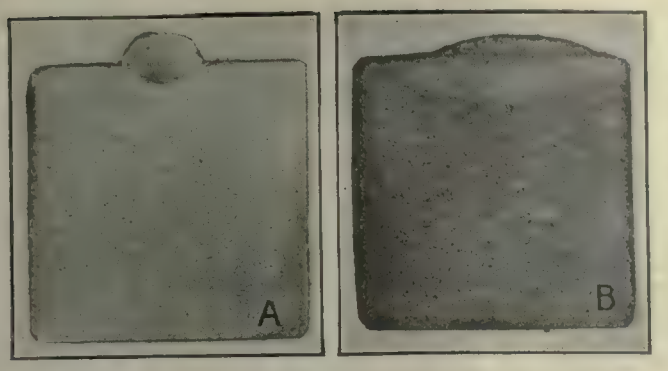


FIG. 5. SECTIONAL VIEWS OF SHORT AND LONG ARC DEPOSITS

brass with this electrode. The diameter of the electrode should be chosen with reference to the arc current used.

A great many concerns have attempted welding with too low an arc current and the result has been a poorly fused deposit. This is due largely to the overheating characteristics of most electrode holders, or using current value, and thus leading the operator to conclude that the current used is in excess of the amount that is needed.

A, Fig. 2, shows a section through one-half of an exposed joint welded with the proper current, and *B* the effects of too low a current. The homogeneity and the good fusion of the one may be contrasted with the porosity and poor fusion of the latter. These surfaces have been etched to show the character of the metal and the welded zone.

The approximate values of arc current to be used for a given thickness of mild-steel plate, as well as the electrode diameter for a given arc current, may be taken from the curve in Fig. 3. The variation in the strength of 1-in. square welded joints as the welding current is increased is shown in Fig. 4.

Notwithstanding that the electrode development is still in its infancy the electrodes available are giving satisfactory results, but considerable strides can yet be made in the ductility of welds, consistency in results and ease of utilizing the process.

The maintenance of a short arc length is imperative. A nonporous, compact, homogeneous, fused deposit on a 1-in. square bar from a short arc is shown in Fig. 5, *A*, and in *B* is shown a porous, diffused deposit from a long arc. Top views of these welds are shown in Fig. 6. A short arc is usually maintained by a skillful operator, as the work is thereby expedited, less electrode material wasted and a better weld obtained because of improved fusion, decreased slag content and porosity. On observing the arc current and arc voltage by meter deflection or from the trace of recording instruments, the inspector has a continuous record of the most important factors which affect weld strength, ductility, fusion, porosity, etc. The use of a fixed series resistance and an automatic time-lag reset switch across the arc to definitely fix both the arc current and the arc voltage places these important factors entirely beyond the control of the welder and under the direction of the more competent supervisor.

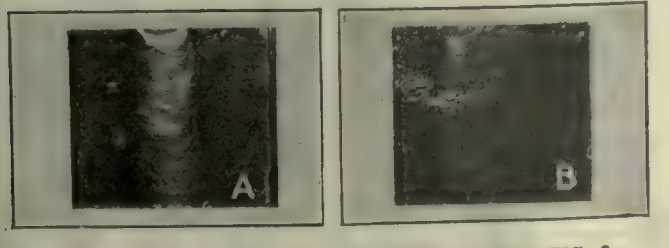


FIG. 6. TOP VIEWS OF WELDS SHOWN IN FIG. 5

Heat Treatment and Inspection

The method of placing the deposited layers plays an important part on the internal strains and distortion obtained on contraction. It is possible that part of these strains could be relieved by preheating and annealing as well as by the allowance made in preparation for the movement of the metal.

The heat treatment of a completed weld is not a necessity, particularly if it has been preheated for preparation and then subjected to partial annealing. A uniform annealing of the structure is desirable, even in the welding of the small sections of alloy and high-carbon steels, if it is to be machined or subjected to heavy vibratory stresses.

The inspector, in addition to applying the above tests to the completed joint and effectively supervising the process, can readily assure himself of the competency of any operator by the submission of sample welds to ductility and tensile tests or by simply observing the surface exposed on cutting through the fused zone, grinding its face and etching with a solution of 1 part concentrated nitric acid in 10 parts water.

It is confidently assumed, in view of the many resources at the disposal of the welding inspector, that this method of obtaining joints will rapidly attain successful recognition as a dependable operation to be used in structural engineering.

Calculations for Roll Feeds

By S. B. Royal

A method of making roll-feed calculations which may be of interest is here described. The way to obtain the number of teeth required in the ratchet, the number to feed and size to grind the roll to give an exact feed to within 0.001 in., which is often necessary on small work, is as follows:

Suppose we have a standard roll feed with 2½-in. hardened and ground rolls and are required to feed exactly 0.625 in. at each stroke of the punching machine $3.1416 \times 2\frac{1}{2}$ in. $= 7.854$ in. $=$ circumference of rolls; $7.854 \div 0.625$ in. (the amount to feed) $= 12.56$; therefore $\frac{1}{12.56}$ = the part of a revolution necessary to feed the metal 0.625 in. with a 2½-in. diameter roll.

But as a ratchet cannot be cut with 12.56 teeth, to find the proper number to cut we multiply the fraction $\frac{1}{12.56}$ by some number that will nearest remove the decimal part of the denominator and still not bring the total number of teeth too high. This will depend upon the diameter of ratchet the roll feed is equipped to take. In small roll feeds of this type this diameter is generally between 3 and 4 in. and 50 to 70 teeth is about the limit.

In this case we can use 2 as a multiplier $\left(\frac{1}{12.56} \times 2\right.$

$= \frac{2}{25.12}$), which will leave a smaller decimal part in the denominator than any other number that will keep the number of teeth within the maximum.

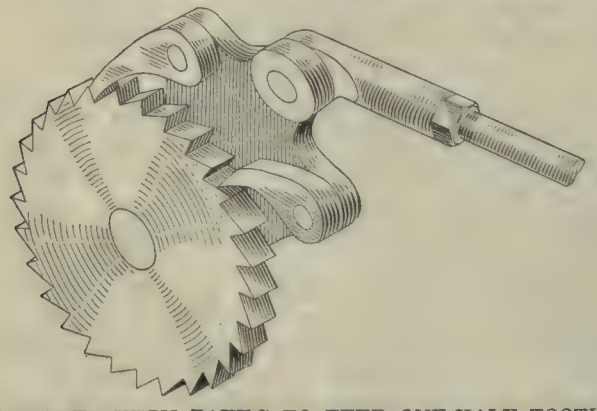
As the whole number of the denominator of the fraction is the number of teeth to cut in the ratchet and the numerator the number of teeth to feed at each stroke, we should cut 25 teeth in the ratchet and adjust the stroke of the lever so that the pawl will feed two teeth at each revolution.

It is evident that with a two-tooth feed on a 25-tooth ratchet the stock will be fed 0.628 in. or 0.003 too much, as $\frac{2}{25}$ of 7.854 (circumference of 2½-in. roll) = 0.628 in., or 0.003 too much. In many cases this 0.003 would be of no disadvantage, but there are cases where the feed must be within 0.001.

To accomplish this it is necessary to grind a small amount off the diameter of the rolls which can be calculated as follows:—$\frac{2}{25}$ of new circumference must equal 0.625 in., therefore 0.625 in. $\times \frac{25}{2}$ = circumference = 7.812 in. and 7.812 in. ÷ 3.1416 = 2.4867 in. = diameter of rolls to feed 0.625 in.

Therefore 0.0133 in. should be ground off the diameter of the rolls, making them 2.4867 in. to obtain the exact feed required.

If the feed required had been 0.632 in. instead of 0.625 in. the fraction would be $\frac{1}{12.43}$ instead of $\frac{1}{12.56}$, and this multiplied by 2 would give $\frac{1}{12.43} \times 2 = \frac{2}{24.86}$, which would be all right if the feed did not have to be exact to the thousandth. A 25-tooth ratchet (the



RATCHET WITH PAWLS TO FEED ONE-HALF TOOTH

nearest number to 24.86) and feeding two teeth would give a feed of 0.628 in. If the feed were required to be exact the figuring would be slightly different from before, as we cannot very well add several thousandths to the diameter of the rolls. If we use a 24-tooth ratchet 0.086 in. would have to be ground off the diameter of the rolls, which is too much, as their gears would not mesh properly.

We would therefore multiply the fraction by 5 $\left(\frac{1}{12.43} \times 5 = \frac{5}{62.15}\right)$, meaning a 62-tooth ratchet and a feed of five teeth with the grinding of 0.0055 in. off the diameter of the rolls, making them 2.4945 inches.

Sometimes when the feed is very small another complication is met. Say a feed of 0.310 in. was required. In this case the fraction would be $\frac{1}{25.34}$, which cannot be multiplied by any number that will keep the number of teeth within the limit without considerable grinding. There are still two alternatives, first to increase the diameter of the ratchet and make the necessary new arm for carrying the pawl. If this causes interference or is not desired, two pawls can be used spaced a distance apart equal to any number of teeth plus one-half of a tooth, as shown in the diagram. In doing this the ratchet is figured for twice the number of teeth that are actually cut, and the number to feed is in half teeth as $\frac{1}{25.34} \times 3 = \frac{3}{76.02}$. Here the ratchet would have 38 teeth and 1½ would be fed at each revolution.

Three pawls can also be used if they are spaced one-third of a tooth apart; in this way any feed can be had to within 0.001.

We generally cut the teeth with a 60-deg. cutter with the straight side set in line with the center. It is always best to leave a small flat at the top of the tooth rather than a sharp point. This will to a certain extent regulate the depth to cut. As a rule $\frac{1}{16}$ in. to $\frac{3}{32}$ in. is sufficient for the depth of tooth and a ratchet with a small number of teeth may have flats of $\frac{3}{8}$ in. or more, but this is no disadvantage.

Hand Versus Power Feed in Surface Grinding

By Christian Dahlerup

The lack of knowledge of the proper grain and grades of grinding wheels is not confined to toolmakers but is observed even in well-organized shops where production is an important factor and where it becomes a serious time-wasting proposition, as pointed out by Donald Baker on page 901, Vol. 49, of the *American Machinist*. This might also be said about any milling or shaping machine, etc., which is not operated at its proper speed and feed.

I presume the machine here discussed is one of the surface-grinding type generally used in toolrooms for all-round work and which is not so handy for gage-grinding and the lighter class of work.

I am in agreement with Mr. Baker that for such work nothing will give as satisfactory results as light cuts with coarse hand feeding, to which any toolmaker will soon get accustomed as well as to the "feel" of the wheel, which compares to the "feel" one should have on a sensitive drilling machine.

No doubt a small surface-grinding machine adaptable for light tool work and gage grinding, without power feed, would be an ideal and very handy tool for the toolroom, but so far as I know no such machine is on the market.

If it is not Mr. Baker's idea to recommend to the owners of surface-grinding machines to remove all power feeds from them, why does he not tell us where machines can be obtained that are not equipped with such feeds? I am certain many read of the *American Machinist* would appreciate this information.

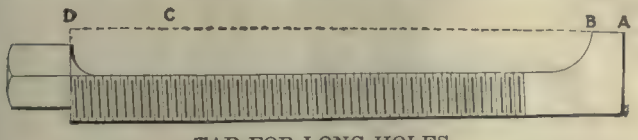


Handy Tap for Long Holes

By Miles Smith

In the sketch I have given an idea of a tap which will be of advantage in tapping long holes either by hand or machine. The principal advantage is that the tap cannot clog with chips, and thus broken taps are rare.

The method of its making can best be explained by sticking to the details of the sketch. First turn up a



TAP FOR LONG HOLES

blank, making the diameter *A* the diameter of the tap drill. Carry this diameter to *B*, or from ¾ to 1 in., according to your own views of the necessary length of a pilot. Next turn the opposite end or from *C* to *D* to the outside diameter of the tap required, making the distance *C* to *D* from 2 to 2½ in., according to the length of hole to be tapped. Then turn the length *CB*, carrying the taper necessary to reduce from the diameter *C* to the diameter *B*, the length to be determined to suit the work in hand, being mindful that the longer the tap the easier the work will be done, especially if a machine is used. Next thread the entire length from *B*. Do not flute, but after the blank is threaded mill away half of the tap from *B* to *C;* machine whatever head is desired and harden. The greatest care should be taken to insure milling the blank exactly to the center line.

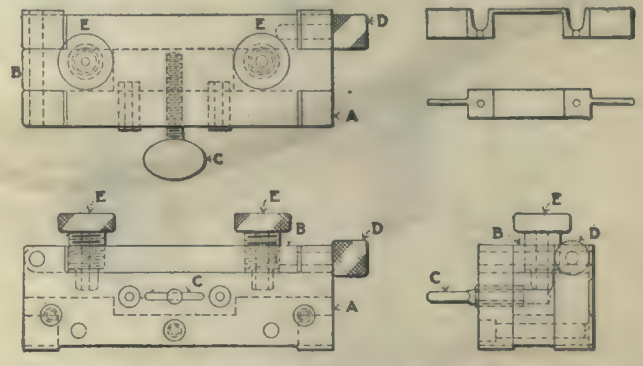
If these instructions are followed you will find a tool which will do its work easily and speedily with the most inexperienced operator.

A Built-Up Drill Jig for Small Castings

By M. H. Chase

We had several thousand small bronze castings, such as shown in the sketch, to drill, this being the only machining required, but the holes were required to be accurately spaced with relation to each other to make them interchangeable. The job had to be got out in a hurry, so we built up the jig from some machinery steel we had in stock instead of waiting for patterns and castings.

The jig consists of the built-up body *A* to which is fastened the hinged cover *B*. The casting is put in the jig and the thumbscrew *C* screwed up, clamping the web of the casting against the back wall inside the jig. The cover *B* is then closed and locked in place by means of the knurled-headed pin *D*. The threaded clamping bushings *E*, having the proper sized holes for drilling, are then screwed down clamping the pro-



A SIMPLE DRILL JIG

jecting feet against the nest of the jig, acting as drill bushings and clamps at the same time.

In the front of the jig are two plain bushings for drilling the 0.116 in. holes, which are drilled by turning the jig on its side. The cost, including material, is $24.

Punch and Die for Stamping Balls for Sheet Metal

By S. B. Royal

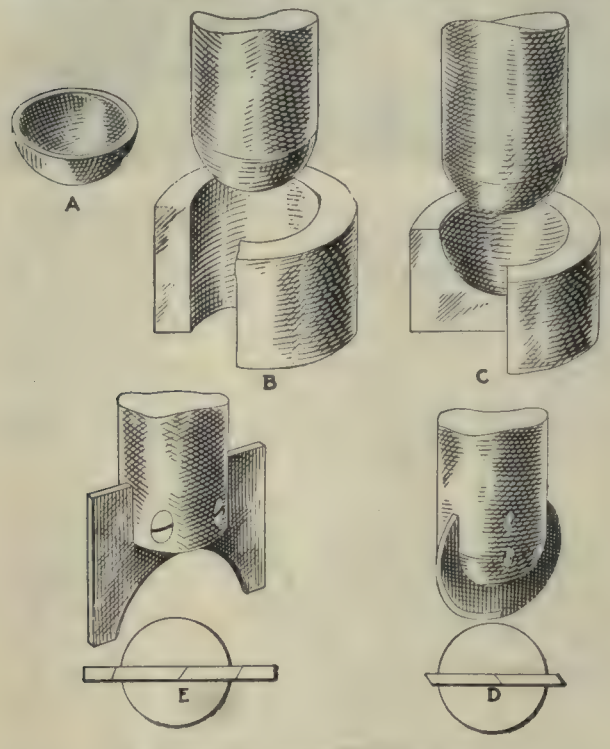
In drawing a half ball, as shown at *A* in the cut, of thin gold-plate stock the die must conform to the contour of the punch in order to iron out the stock and produce a surface capable of taking a fine finish. If a ball-shaped punch is used with a plain die, as shown at *B* the same shape will be produced, but the metal will have a rough, pitted surface. By using a punch and die as shown at *C* the metal will be ironed out smooth and will take a mirror-like polish.

Ordinarily to make a punch and die of this type requires a toolmaker of above average skill, as both punch and die must be perfect hemispheres and differ in radius by the thickness of the metal to be used. For this reason they cannot be fitted by the usual process.

A method which will enable anyone of ordinary skill to make them is here described. A bar of tool steel is turned to the exact radius of the die. A disk is then cut off this about $\frac{1}{16}$ in. thick and mounted in a holder as shown at *D*. The edges are beveled both ways, making an end mill which has a truly semicircular cutting edge. In beveling care must be taken not to file so far as to destroy the contour.

The mill for the punch is made, as shown at *E*, by boring a hole equal in radius to the required punch in a thin piece of steel, and after filing proper clearance on the edge mounting the piece in the holder.

These mills are accurate, are easily made, and will stand up for making several punches and dies. If a large quantity is required it is advisable to make a



TOOLS FOR STAMPING BALLS

master convex mill in the same manner for producing a number of working concave mills, and likewise a master concave mill to make the working convex mils.

[We are under the impression that tools made in this manner would not produce a "truly semicircular" contour unless the cutting edges were filed back so that both would lie on the center line. In this condition the cutter would be infinitely thin at the center and difficulty would be experienced in making this point conform to the desired contour.—EDITOR]

A Double Blanking and Drawing Die

BY G. R. SMITH

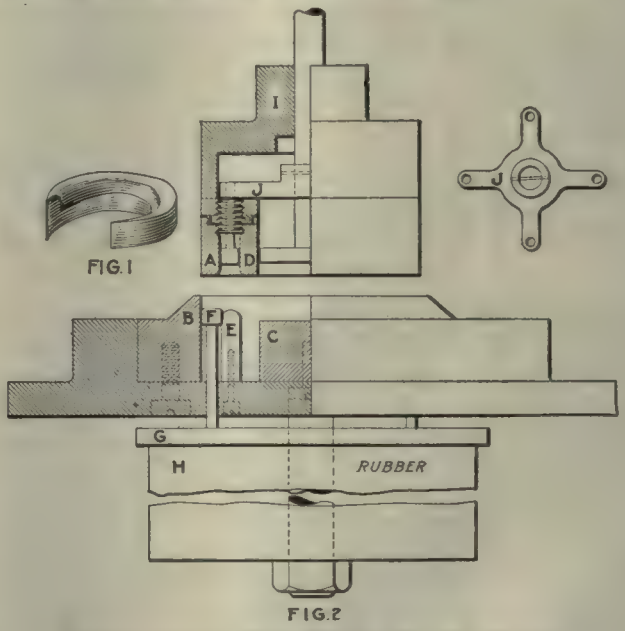
The press tools used in the manufacture of the cap shown in Fig. 1 may be of interest to the readers of the *American Machinist* inasmuch as it is rather an unusual and difficult form to produce in one operation. This shell was formerly made in two operations, but with the present tools it is made in one operation on a single-action press from strip stock in rolls, the production being about 2000 an hour. The tools are shown in Fig. 2.

The shell is blanked with the tool-steel ring *A* set in the punch and the tool-steel ring *B* in the die. After the blank is cut from the stock and held, slightly bent, in the die the center is cut out by the punch *C* and die ring *D*. The draw then takes place over ring *E*, the top of which is the same radius as the finished shell.

The pressure ring *F*, which also acts as a stripper, rides on four pins which pass down through the die block and rest on the machine-steel plate *G* on top of the rubber bumper *H*.

The pressure supplied by the bumper is regulated to suit conditions by a nut in the center bolt that holds the bumper in place. The punch *C* is held in position by fillister-head machine screws sunk in the die block.

The punch *I* is made of cast iron, with the tool-steel rings *A* and *D* screwed into position and held by blind setscrews. The radius on ring *A* draws the outside, and the radius on ring *D* the inside of the shell. The knockout shown at *J* is a steel spider having four arms, from the ends of which pins pass to the knockout ring. These pins are shouldered and screw into both the knockout ring and the end of the spider arms. The spider is pinned in position to the central knockout rod which carries at its bottom end a steel plate which serves to knockout the scrap cut from the center of the shell at the same time the shell itself is removed.



FIGS. 1 AND 2. THE WORK AND THE TOOLS

In shops where compressed air is available it may be used to separate these scrap centers from the finished shells. At the top end of the central knockout rod is a small nut which engages the knockout bar of the press, relieving the rod of wear.

These shells are made from 0.015-in. stock, both brass and steel. The press used is a single-action 2-in. stroke Bliss No. 21 straight drive, with back knockout.

A Two-Position Milling Fixture

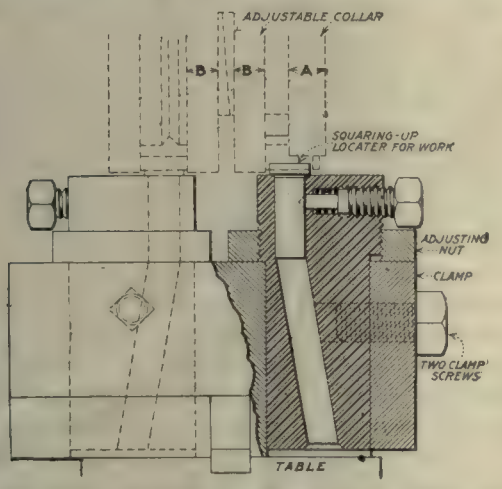
BY G. R. RICHARDS

According to the article entitled "A Two-Position Milling Fixture" on page 772, Vol. 49, of the *American Machinist* Mr. Fenaux would seem to be wasting a perfectly good milling machine, probably a 5-in. automatic, judging by the size of the work.

The table T-slot in this machine is $\frac{5}{8}$ in. wide and if the drawing is in proportion the head of the work being milled is about $\frac{7}{8}$ in. and the shank about $\frac{1}{2}$ in. in diameter. It is these approximate dimensions which make me think the smallest machine, a 5 in., is used.

If the fixture was designed as in the sketch here shown to hold two pieces it would be unnecessary to run the machine two complete cycles to complete one piece as one would be sufficient.

For the benefit of those who are unfamiliar with this machine it may be said that the table is operated and fed by a barrel cam which makes one complete revolution for each forward and return movement of the table, and,



IMPROVED TWO-POSITION MILLING FIXTURE

as Mr. Fenaux says, it is necessary to trip the starting lever twice for each piece, as the table, after completing the cut, returns to the starting point and stops automatically.

A fixture designed as shown would be also more rigid because closer to the table and because every movable and sliding part is clamped tight.

The adjustment for height on the right-hand side makes it unnecessary to grind cutter *A* to an exact diameter and would also prolong the life of the center side mills *B* used for squaring the head, as the single cutter shown by Mr. Fenaux does double duty and any reduction in width due to grinding makes it worthless.

Incidentally it would be interesting to know what the material is, as a 3-in.-per-minute feed is faster than is ordinarily taken.—[The suggestion in the foregoing letter is a good one inasmuch as by its provisions each machine would turn out nearly twice the amount of work as it would with the fixture described by Mr. Fenaux, but it apparently does away with the indexing feature of the former and is not therefore a just criticism of it.—EDITOR.]

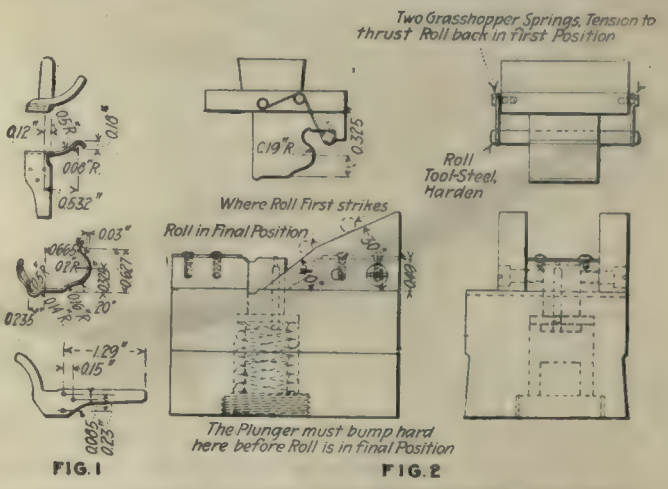
Die for Forming Small Blanks

BY JOHN TECKEER

A set of dies to form the piece shown in Fig. 1 was required to be used in the usual type of small jewelry-manufacturing press. Limited space prevented using the usual type of die with sliding plunger to form the upper bend, so a novel and original scheme shown in Fig. 2 was used effectively on the second bending die. This consisted of a roll attached with springs to the punch and operated by inclined planes attached to the die. In order that this roll should not be subject to too great stress the die was made to strike hard on the bottom at the time the roll reached its proper location, therefore the die bottom takes the shock of impact and the roll simply finishes looping in position the radius on the upper end of the blank.

On the second-operation die it will be noticed that one side is cut away tangent to the side of the plunger, thus the end already formed in the first operation is allowed to bend at right angles without interference.

The distance 0.325 in. from the center of the 0.19 in. radius to the bottom of the punch necessarily means that the corresponding distance on the die would be 0.365 as the stock is 0.04 in. thick. We then make the depth of the die 0.490, as shown, which leaves 0.125 in. above the center line and which is sufficient for a $\frac{1}{16}$-in. radius



FIGS. 1 AND 2. BLANK AND SECOND FORMING DIE

over which the metal must draw, and a $\frac{1}{16}$-in. straight. At this moment the roll, traveling down the inclined planes, picks up the end of the the blank and curls in the 0.100-in. radius, reaching its final position as the plunger bottoms hard on the surface below it.

The method used in laying out the die may be new to some. The punch is first carefully finished and the die laid out from it by using a scriber made of drill rod the diameter of which is twice the thickness of the blank. This is pointed central and rolled over the outline of the already finished punch.

Daily Time Card for Small Shops

BY V. C. BOWSER

I have used the style of daily time card shown in a small jobbing and repair shop. It has proved the most satisfactory of any I have used. With a minute's study it explains itself.

DAILY TIME CARD

Wm Smith
EMPLOYEE'S NAME

DATE Oct 10 - 1918.

NAME OR NO OF JOB	START	STOP	START	STOP	START	STOP	TOTAL
Jones Truck Transmission	6 30	10 00	10 45	11. 30	12 00	3 45	7.45
William's Tire change	10 00	10 45					.45
Brown Valve Grinding	3 30	5 00					1.30

10 00

TIME CARD FOR SMALL SHOPS

Editorials

Concerning Informal War Contracts

READERS of the *American Machinist* who are vitally concerned in the validation of informal war contracts will be interested in the statement of Joseph H. Defrees, chairman of the war-service executive committee of American industries.

Mr. Defrees' statement was called forth by the delay in Congress in getting the proposed legislation through, and more especially by the insertion by the Senate Military Affairs Committee of a provision giving the Government the right of appeal through the Department of Justice from the War Department's decisions respecting the contracts. Mr. Defrees' statement follows:

A Substitute for the Dent Bill

"The Senate Committee on Military Affairs has reported out as an amendment and substitute for the Dent Bill (H. R. 13,274), the War Industries Board bill, to which was added a section giving the right of appeal from the decisions of the War Department to both the contractor interested and to the Department of Justice to a commission to be composed of one representative of the War Department, one representative of the Department of Justice and one representative of the business interests of the country.

"There is also included in the substitute bill a section providing that in all instances where no affidavit is obtained from the officers of the War Department who had to do with the making of the contract stating that they were not interested directly or indirectly on the side of the contractor in respect to the contract such contracts cannot be settled by the Secretary of War, but that they shall go at once to be settled by the Appeals Commission.

Substitute Bill the Best So Far

"This substitute bill would be of all the bills proposed the best bill, from the standpoint of both the public and the industrial interests whose patriotism caused them to proceed with necessary war work without awaiting formal contracts, if the provision giving appeal by the Department of Justice from the War Department's decisions were eliminated. It affords to the War Department the necessary powers to enable it to carry out its engagements with industry and would permit it to do that speedily except for the right of appeal of the Department of Justice.

"Speed in payment of the industries which did war work is absolutely vital in order that the industries may have use of their capital and thus employ the labor of the country and assist in preventing a bread line. Already the newspapers are carrying stories of unemployment, and it is clear that the situation will grow worse unless the industries which have been doing war work can receive payment from the Government so that they can immediately go back to peace production.

"The appeals clause referred to opens the way not only to delay payment on informal contracts, but on formal contracts as well, of which the War Department now has full jurisdiction and which are being settled.

"The right of one department of the Government to appeal from the decisions of another is an anomaly in the history of legislation. Such a provision, if it were incorporated in the legislation as finally passed, would prevent the expeditious relief essential. The Department of Justice would feel that the right cast upon it would be a duty, and it would have to organize forces to enable it to become advised and to pass judgment upon all the details in respect to each contract up for settlement that it might be able to ascertain which decisions of the War Department it should appeal. This could mean nothing other than intolerable and endless delay and disaster, because in few cases could it make such investigation in the 30 days allowed for appeal, and it would feel constrained to appeal every case in order that sufficient time could be allowed for it to make its investigation.

Appeal by Department of Justice Unnecessary

"There can be no reason for retaining the right of appeal in the bill except the feeling that there might be some cases in which some of the civilians who have been operating as officers of the War Department may at the time of letting the contract or at the time of settlement have been interested in some manner with the contractor. This reason is not substantial, however, because under section 3 of the bill there must be definite evidence that no such interest on the part of the office making or settling the contract exists before the War Department has the right to proceed. The section requiring this evidence provides that if the evidence is not forthcoming all such contracts must go immediately to the Appeals Commission to be disposed of. This affords adequate protection to the Government and to the public, and it is not just that tens of thousands of contracts should be held up indefinitely in their settlement in order to afford this supplementary and entirely unnecessary protection as provided in the clause giving the right of appeal to the Department of Justice, especially when it is recognized that the need for such protection, even if it existed at all, could be made necessary only in a minor fraction of the great body of contracts.

Contractors Should Have Right to Appeal

"Contractors should be given the right of appeal, however, because there could arise cases in which a manufacturer who went ahead on war work without a formal contract could be done a great injustice by some careless officer of the War Department. But to give the Department of Justice the right of appeal from the decisions of another Government department is absurd when the Government already is protected.

"The committee which I represent represents in turn, through the War Service Committees of the industries, substantially 90 per cent. of the industries of the United States, and it is convinced that this feature of the bill as set forth must be eliminated in order not to defeat the purpose of the legislation, which everyone agrees is necessary and which must be so phrased as to give relief at the earliest possible day."

We Need a Strong Ordnance Organization as Peace Insurance

It is not necessary for us to comment upon Mr. Defrees' remarks further than to state that reciprocity is a sound model by which to be guided and that our Government should give relief to its contractors and endeavor to act with the same celerity that these contractors exhibited in giving relief to the Government.

The New Ordnance Organization

THE reorganization of the Ordnance Department, which is now taking place, is designed to give the United States a permanent organization of a kind in keeping with both our nonmilitary aims and our possible military necessities.

The fact that we are and will continue to be a peace-loving nation is one of the strongest reasons for a proper ordnance organization. We were peace loving before the war, and the handful of officers that we considered sufficient to take care of our very limited expenditures for target practice and maneuvers, while high in quality, were sadly lacking in quantity—when the emergency came.

This condition had to be, for in the prewar days the American public had no conception of the size and complexity of an adequate ordnance organization, nor would it have been possible to obtain from Congress the necessary funds for the maintenance of such an organization.

Now we know how ordnance requirements in war time tax to the utmost the energies of engineers and industries. And, like Clemenceau of France, while all of us desire the abolition of war and wish the best of luck to the League of Nations most of us will be reluctant to relax into a comfortable state of unpreparedness until it is demonstrated that this League of Nations is actually going to work.

Soldiers Can Be Obtained Quickly But Ordnance Takes Time

That part of preparedness which is hardest to develop in a hurry when needed is the part to set in order first. Experience has proved that you can produce good fighting soldiers in two or three months, but that it takes a long time to produce good fighting ordnance. It is not so much due to the complexity of the individual articles of ordnance, although in many cases these things are complex enough, but the delay lies in the establishment of human relations—in the building up of personnel adequate to handle the complexities and ramifications of ordnance in war times. A dozen ordnance officers cannot be familiar with the scope and capabilities of 5000 manufacturing plants. And this acquaintance—in fact more than acquaintance, a perfect familiarity between the manufacturer and his engineers and the ordnance engineers—is requisite for efficiency in bending a nation's industries to war.

This new organization contemplates the development of an intimate knowledge on the part of ordnance engineers of the capabilities of American shops on one hand and on the other an equally thorough knowledge on the part of American shops of the requirements of American ordnance. It provides sufficient personnel for the obtainment of these ends and is built for speed as well as power—something that perhaps cannat be said of the old organization.

New Organization Fractional, Not Functional

This new organization divides ordnance material into a number of fractional parts, such as artillery; trench-warfare material automatic arms and small arms; aircraft armament; tank, tractor and trailers; artillery ammunition, metal components; explosives, chemicals and loading. Each of these divisions is in charge of one man who is responsible not only for the design and development of his material but for its procurement, production and inspection. These division heads report directly to a chief of manufacture, who has not yet been named but who is directly responsible to the Chief of Ordnance. Each division chief is specifically held responsible for the final obtainment of material within a specified period as to kind, quality, quantity, time and place of delivery.

Administrative District Offices and Field Service Cared For

In addition to the group of divisions under the Chief of Manufacture this new organization forms three parallel groups. The Chief of Administration has charge of the Administration Division, which, as its name implies, performs administrative functions for the various other divisions. The Chief of Districts has charge of all matters relating to the organization, location and operation of the ordnance district officers. The Chief of the Technical Staff approves all drawings and specifications, all changes and passes upon all proof tests of material. The Chief of Field Service is in charge of three divisions. The first of these has to do with the depots, dumps, rail heads, trains and other facilities for the handling, storage and delivery of ammunition. The second, the Maintenance Division, is in charge of base, advance and other shops and of the repair and maintenance of equipment in the field. The third, the Supply Division, has charge of the base and advance depots, rail heads, trains and storage for all ordnance material other than ammunition.

Gage Obtainment Needs Special Attention

This organization appears to be very admirably planned, combining as it does the possibilities for rapid expansion of personnel if needed, with a logical subdivision of duties, each of which is performed by a man who is provided with all necessary authority and held accountable for results. The one suggestion that it seems advisable to make for the improvement of this organization is the similar centralization of gage work under one division chief. The obtainment of gages for war work is of such primary importance that it should not be classified as a minor function of several divisions.

Work of War Committee of Technical Societies

The invaluable advisory work of the War Committee of Technical Societies, just dissolved, is little realized by the country at large. Some idea of what was accomplished may be gleaned from the statement that the committee passed on more than 110,000 ideas, suggestions and inventions. The work of the committee is to be carried on by the various engineering societies individually.

THE War Committee of Technical Societies, which has been operating in close coöperation with the Naval Consulting Board and with the General Staff of the Army, has had its work brought to an end by the termination of the war and ceased to exist on Dec. 31. To understand fully the history of this committee it is necessary to go back to the creation of the Engineering Council by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the United Engineering Society, which is described in the bylaws of the United Engineering Society as follows:

In order to provide for convenient coöperation between the four Founder Societies, for the proper consideration of questions of general interest to engineers and to the public, and to provide the means of united action upon questions of common concern to engineers, the United Engineering Society shall, in addition to its other activities and entirely separate therefrom, establish and maintain a department to be known as the Engineering Council . . . (Par. 116).

The council may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers, unless objection be made by a majority of the representatives present of one of the Founder Societies or by one-fourth of the representatives present and voting.

When war was declared the engineering and technical men of this country who by reason of age or business restrictions were unable to go to the front began to insist that some means be offered by which they could assist the Government in the study and prosecution of war problems. This feeling, after considerable agitation, resulted in the organization by the Engineering Council of the War Committee of Technical Societies at meetings held on June 27 and July 13, 1917. The functions of this committee, as defined by the officers of the Council in their published announcement, were as follows:

To assist any organization in Washington, such as, for instance, the Council of National Defense, the National Research Council, and the Naval Consulting Board, in any way in which it can bring to the attention of the engineers of the country the necessity for thought and help in the numerous problems that arise in the prosecution of the war.

Membership Not Restricted to the Four Great Societies

That the War Committee should cover as broad a field as possible and afford full facilities to the technical men of this country to utilize their inventive talent for the benefit of the Government membership in this committee was not restricted to the four great national societies, but other technical organizations were invited to join, with the result that the committee now consists of two members from each of the following societies: The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Electro-Chemical Society, the Mining and Metallurgical Society of America, the Illuminating Engineering Society, the American Gas Institute, the American Society of Refrigerating Engineers, the American Institute of Chemical Engineers, the Society of Automotive Engineers and the American Society of Heating and Ventilating Engineers. The American Chemical Society also coöperated, and the officials of the committee were as follows: Chairman, D. W. Brunton; vice chairman, Edmund B. Kirby; secretary, Capt. Lloyd N. Scott; treasurer, Preston S. Millar.

Chairman's Report

The chairman's report of the activities of the committee states that when the War Committee was first organized on June 27, 1917, its membership consisted of two delegates from each of the four Founder Societies. Harold W. Buck was chosen as its chairman, and remained in office until pressure of private business compelled him to resign on Sept. 24, 1917. The present chairman was then elected, and as he was anxious to "do his bit" and was too old to go to the front he has devoted his entire time and attention to the work of the committee since that date.

Finding that the appropriations from the Engineering Council were too small to enable us to work efficiently, continues the chairman, we accepted an offer from the Naval Consulting Board on Oct. 2, 1917, by which we agreed to coöperate with officials of the board, they to provide us with an office, telephone service and postal privileges. This arrangement has operated most satisfactorily, and under it the two bodies were able to put out a bulletin on "The Enemy Submarine" and later one on "Problems of Aeroplane Improvement." The printing, mailing and other expenses incidental to the sending out of these bulletins were provided for by the Naval Consulting Board appropriation and approved by the Navy Department.

Value of the Bulletin

These bulletins in a measure achieved the desired results, as they placed before the engineers of this country in concrete form some of the requirements in both the submarine and aircraft branches of the service and brought to the War Committee and the Naval Consulting Board a much better class of suggestions, ideas and inventions than they had before been receiving. During the prosecution of the war new problems of all kinds were constantly coming up in both the Army and Navy, but it was found extremely difficult for us to obtain these at long range.

With the erection and occupancy of the new Navy Building space was provided for the office of the Naval Consulting Board, consisting of the resident member, who is also chairman of the War Committee, and a staff of examiners, which office was directly connected with the office of the Secretary of the Navy. In this office space was also provided for the work of the War Committee

of Technical Societies. This has resulted in the concentration of all work in connection with the Navy Department and has brought the committee in much closer touch with service officials.

The first necessity in successfully maintaining an office at Washington was a capable secretary, but owing to the high cost of living in that city we were unable to find anyone with the necessary qualifications for this important office who was willing to volunteer his services. At this juncture the General Staff of the Army offered to aid us by appointing a liaison officer who should be free to devote half his time to War Committee work.

After due consultation with the chairman and the secretary of the Engineering Council this offer was accepted, and Capt Lloyd N. Scott of the Inventions Section of the General Staff was appointed liaison officer to the War Committee, and at a meeting of the board held in New York on Sept. 10 he was elected secretary. This arrangement has proved most satisfactory to the Army, the Naval Consulting Board, and the War Committee, as Captain Scott is a staff officer with a wide experience in engineering and business undertakings, which, combined with forcefulness and tact, has made it possible for him to achieve wonderful results under conditions such as now exist in Washington.

War Problems Classified

The war problems received from the Army and Navy may be grouped into three classes: (a) Those which are suitable for general distribution to our members by means of bulletins and letters; (b) semiconfidential problems which are sent to selected individuals and groups of inventors who are known to be interested in that particular class of work; (c) strictly confidential problems, the solution of which requires the highest order of technical information and which can be sent only to carefully selected scientists and prominent inventors whose life study has fitted them for the work in hand.

These problems are always mailed in double envelopes, the outer one giving no trace of its contents, and the inner envelope marked "private and confidential." At present the outstanding problems in Class C relate principally to submarine detection devices, aeroplane instruments, especially those required in cloud and night flying, and liaison devices for communication between the advancing front of an army and the artillery protecting them at the rear.

The War Committee, in sending out both bulletins and letters, requested our members to forward all ideas, suggestions and inventions on naval warfare to the Naval Consulting Board, and on land warfare to the inventions section of the General Staff. The material received in response to our bulletins and letters ranged from aeroplane supercharges and fuel for high-altitude flying, down to submarine detectors and depth bombs; from long range guns to trench knives; from observation balloons to tunneling machines, and from caterpillar tanks to radium sights.

Up to date more than 110,000 ideas, suggestions and inventions have been received and passed upon by the Navy Department and the Naval Consulting Board, either separately or conjointly, and the Inventions Section of the General Staff, which is a much younger organization, has already handled over 25,000. The crest of the inventions wave for the Navy Department and the Naval Consulting Board was reached in the early months of the war when the receipts amounted to as high as 600 a day, and that of the Inventions Section of the Army in July last when they received 124 a day. All the material received by both organizations is subjected to careful study and consideration by specialists, and those inventions deemed to have merit are immediately sent to the department of the Army or Navy where they can be most readily utilized.

Classes of Inventions

Inventions as received by the Naval Consulting Board and Inventions Section of the Army may be roughly divided into four classes: (1) Those which have no intrinsic or suggestive value; (2) those which, though having no real value in themselves, suggest new lines of thought and investigation; (3) inventions which have considerable promise, but are not yet developed to a point where it is possible to pass judgment on them, and (4) inventions which are sufficiently perfected so that they can be investigated and tested.

Ample facilities for testing inventions of the fourth class are now provided by the Bureau of Standards and Bureau of Mines in Washington. The ideas, suggestions and inventions belonging to classes 2 and 3 are, of course, much more numerous than those of Class 4, and the necessity of providing some means of solving problems and developing inventions has long been apparent. In many instances the inventors have neither the funds, scientific knowledge nor mechanical skill to perfect their own inventions, hence aid in each of these directions is necessary so that the country may reap the full benefit of the originality of its citizens.

In its financial relations the committee has been singularly fortunate, as owing to the generous support given by the Navy Department, the Naval Consulting Board and the Inventions Section of the General Staff it has expended only $1843 of the $4700 appropriated by the Engineering Council, and all of the funds contributed by organizations not included in the four Founder Societies are still intact in the hands of the treasurer.

Danger of Lack of Engineer Officers

The Great War, which has just been brought to such a glorious conclusion, has given us all a realization of the dangers of inadequate preparation for national defense. In no department has this been felt so severely as in the scarcity of engineering officers and the ignorance of military affairs on the part of those that were obtainable. To benefit by past experience we must insist that in every engineering school the students are given thorough military training. The last war and the wars in future will be engineers' wars, and it is to the engineers that the country must look for officers to supplement the efficient, highly trained but numerically inadequate supply graduated from West Point and Annapolis.

Now that the war is over the Government can scarcely expect continuous volunteer service from our members, and after consultation with all of the parties at interest it has been decided that though the engineers

of this country still maintain their readiness to assist the Government in every possible way it will be more economical and convenient for the Army and Navy to function with the members of the societies which united to form the War Committee of Technical Societies through the secretaries of these organizations. For this reason the Engineering Council has asked that the committee be dissolved on Dec. 31, at which time our appropriations will cease.

Lists of the officials and membership of the societies included in the War Committee have been filed with the War and Navy departments, and their officials have been requested to continue the work which has heretofore been carried on by the War Committee of Technical Societies through the secretaries of these different organizations, an arrangement which I have no doubt will prove extremely satisfactory to all concerned.

Pipe Dreams of a Tramp Machinist—Why the Super Drove Slowly

By Glenn Quharity

Tom was master mechanic of a fair-sized manufacturing plant in a small Middle-Western town located about 30 miles distant from the Great City.

Tom was a thrifty fellow—owned his own little home where he, the wife and kiddies lived "happily ever after" and where he spent many contented hours when his day's work was done puttering around the house, putting a few bricks on the chimney where the old mortar had worked loose or new boards in the veranda flooring where Jr. had chopped a hole with his Christmas hatchet, and doing all such necessary and unnecessary jobs as fall to the lot of men who have a house of their own and enjoy living in it.

Just at the season of which I write Tom was engaged during his spare time in putting a new window in the living room to let in more of the morning sun. Late one Saturday afternoon he might have been seen coming out of the principal hardware store of the distant city and heading up the street in the direction of the railroad station, carrying gingerly under his arm a long, flat package wrapped up in brown paper.

As Tom was nearing the station a "long, low, rakish craft" came droning up behind and stopped abreast of him. It was Mr. Williams' new 1920 model twin-six Jacquard with Mr. Williams—Tom's superintendent—himself at the wheel.

"Goin' home, Tom?" called Mr. Williams.

"Sure thing," replied Tom.

"Climb in," and Mr. Williams opened the door for Tom to get in beside him.

Tom deposited his bundle tenderly on the seat, got in and closed the door. Mr. Williams turned on the gas and they began to fade quietly out of the city and onto the 30-mile stretch of not too good pike that led homeward.

Mr. Williams was an enthusiastic motorist and his cars always ran like well-oiled sewing machines—Tom personally saw to that—consequently when they had cleared the city traffic and Mr. Williams had "widened 'er out" a little, long rows of telegraph poles began to flash by on either side with astonishing rapidity and the ordinarily widely separated houses along the way took on an aspect of being quite friendly and close together. There also seemed to be an unconscionable number of vehicles bound toward the city.

About half way home, after they had described a narrow radius arc around a 5-ton truck loaded with 7 tons of pig-iron which was headed in the same direction as they were, Mr. Williams noticed that Tom was cringing away from the place where a telegraph pole had recently threatened to come aboard (everybody knows that a Jacquard 1920 is a left-hand drive and that Tom was therefore on the off side) and that he was hugging his bundle jealously under the arm next to the driver.

"Scared, Tom?" queried Mr. Williams.

"No-o-o," said Tom.

Mr. Williams gave his attention for a fraction of a second to gaging the approximate number of sixty-fourths between him and a passing touring car and then, turning to Tom who was nursing his bundle even more tenderly than before, inquired: "Afraid of smashing something in your bundle?"

"It might bust up some if I got too brash with it," admitted Tom. "You see it's a half dozen sticks of dynamite that I hope to use to blow out that ledge outcrop in my back yard."

The humming motor commenced to lower its high-pitched pur until it had become a hoarse growl. The car glided sedately along the smoothest part of the roadbed, carefully avoiding passing vehicles by generous margins, and once upon approaching a farm wagon pulled by a pair of mild-eyed oxen the aristocratic appearing automobile drew carefully to one side of the road and stopped while the team went by.

Eight miles an hour was the limit for the rest of the journey, and when the buzz wagon finally drew up to Tom's gate Tom was lolling back comfortably on the seat with his bundle on his knees while Mr. Williams sat erect, looking as if he were worried about something.

As Tom rose to get out, the bundle tilted sidewise. There was a sound of tearing paper, and a long sinister-looking cylindrical object started endwise toward the floor of the car at the same moment that Mr. Williams with a yell like a wild Indian started to climb over the wheel.

Too late! The cylindrical object caught Mr. Williams' foot just before he got fairly started on his sky ward flight.

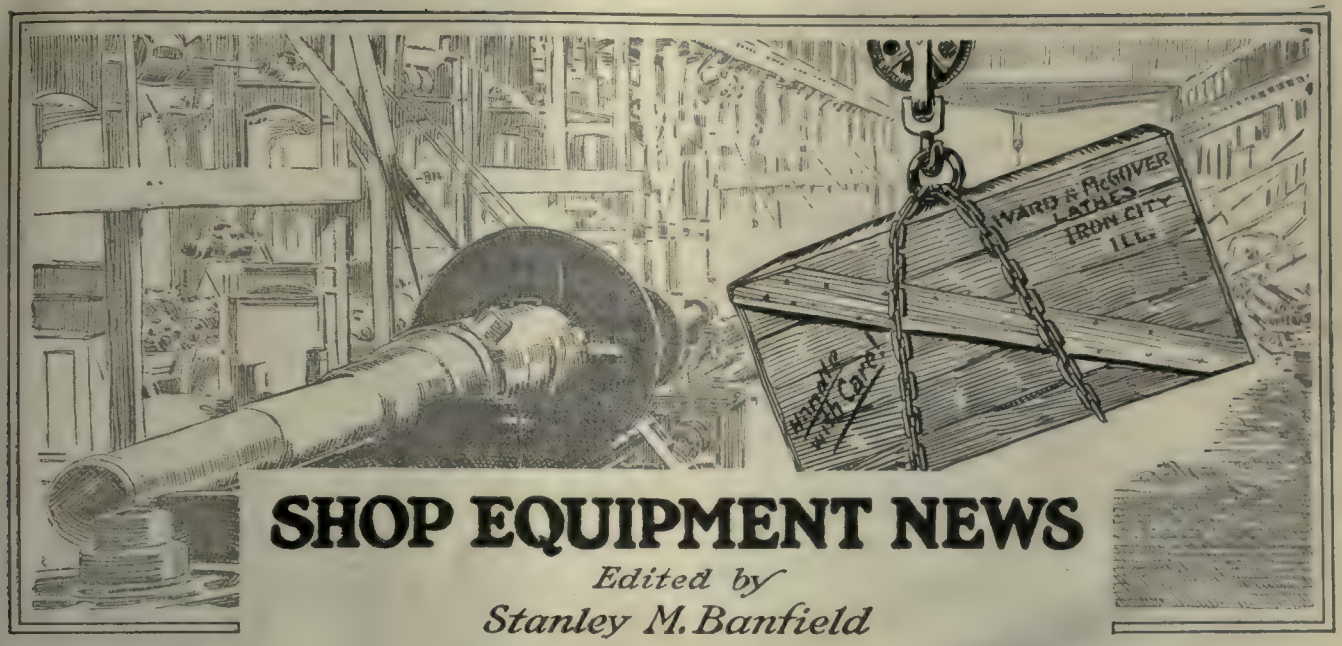
The trouble is not entirely patched up yet.

The sinister-looking object was a window weight.

Value of Training Employees

Since the beginning of the new year the Department of Labor has received requests from 12 large plants in New York State for assistance and advice in directing the establishment of training rooms that will embody all the best ideas for the careful conditioning of employees for better service. As a preliminary, plant surveys will be made by experts of the Training Service, and this work will be started at once.

The extent to which employers are awakening to the value of training is shown in the fact that a transcontinental railway has asked that a survey be made of its great shops and extensive lines with a view to making provisions for the training of its personnel, which includes thousands of employees.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Saphil Electric Grinding Machine

The illustrations show a new portable electric tool, cutter and surface grinding machine that has recently been placed on the market by the Saphil Manufacturing Corporation, 149 West Austin Ave., Chicago, Ill. Fig. 1 shows the complete motor-driven grinding attachment. It is designed to be placed over the toolpost on the lathe, and is held in place by means of the regular toolpost screw which is tightened down upon a bar slipped through the hole in the toolpost. An adjustment is provided which permits the grinding spindle to be raised or lowered to any necessary position, this adjustment being accomplished by means of a micrometer screw. The motor is supported on two vertical bars, making it possible to raise or lower it as desired to adjust the belt tension. The spindle is driven from the motor by means of a flat belt. The spindle runs on double self-aligning ball bearings. The machine is ordinarily equipped with either a $\frac{1}{10}$-hp., 110-volt, direct-current, compound-wound, 3500-r.p.m. motor, or a 110-volt, alternating-current, single-phase, 60-cycle motor with an operating speed of 3400 r.p.m. The machine can also be equipped with a $\frac{1}{8}$-hp., 110- or 220-volt motor if this is desired. Fig. 2 shows the machine attached to a cutter and surface grinding outfit with a 12 x 12-in. surface plate, the cutter being in use for grinding a milling-machine product. Milling attachments can also be furnished if these are desired. The machine complete weighs 26 pounds.

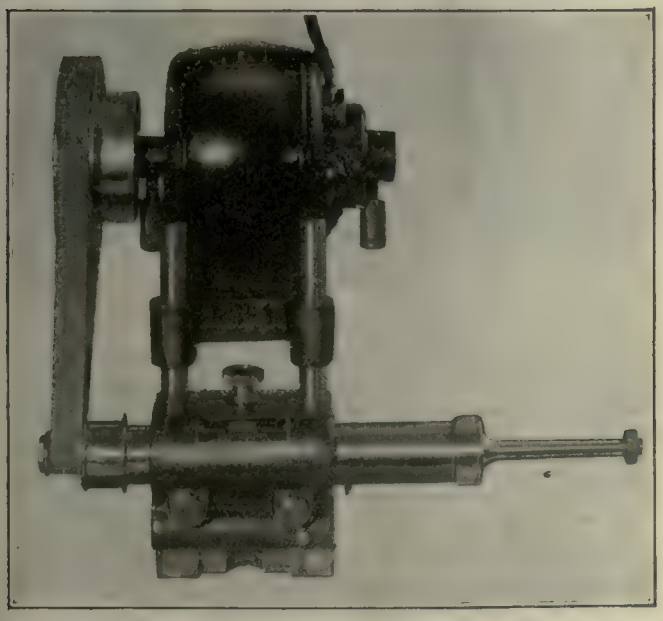


FIG. 1. A FRONT VIEW OF THE SAPHIL MOTOR-DRIVEN GRINDING ATTACHMENT

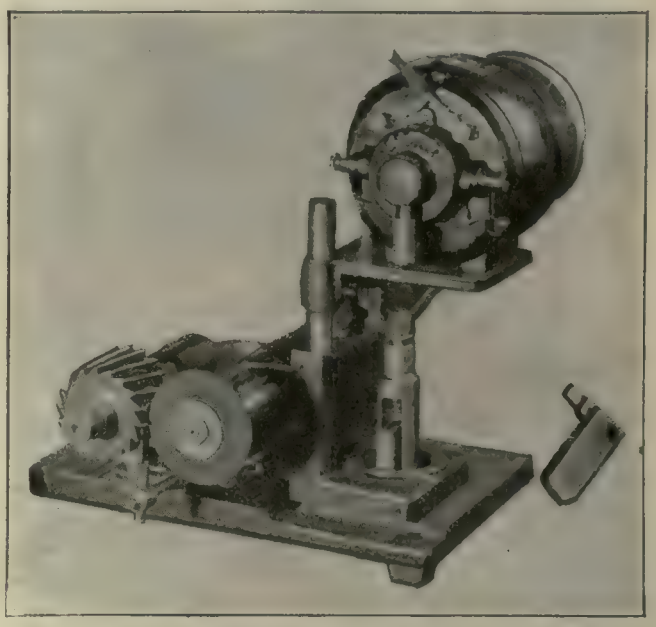


FIG. 2. THE GRINDING ATTACHMENT MOUNTED ON THE SPECIAL SURFACE PLATE

Harris Thread-Gage Lapping Machine

The H. E. Harris Engineering Co., 1047 Broad St., Bridgeport, Conn., has recently placed on the market the thread-gage lapping machine shown in the illustra-

tion. The drive to the spindle is from either of the two grooved pulleys through the double cone-shaped spider. In designing the machine it has been the intention to include such features as would be conducive to the comfort of the operator. His left hand and arm rest upon the bench and a slight pressure with either the thumb or index finger will cause the lapping spindle to drive in the desired direction. In lapping female gages the lap is held in the chuck and the gage in the operator's right hand. His right elbow rests on a pad on the bench, thus taking the weight of his body and leaving the muscles of his hand, fingers and wrist free for the



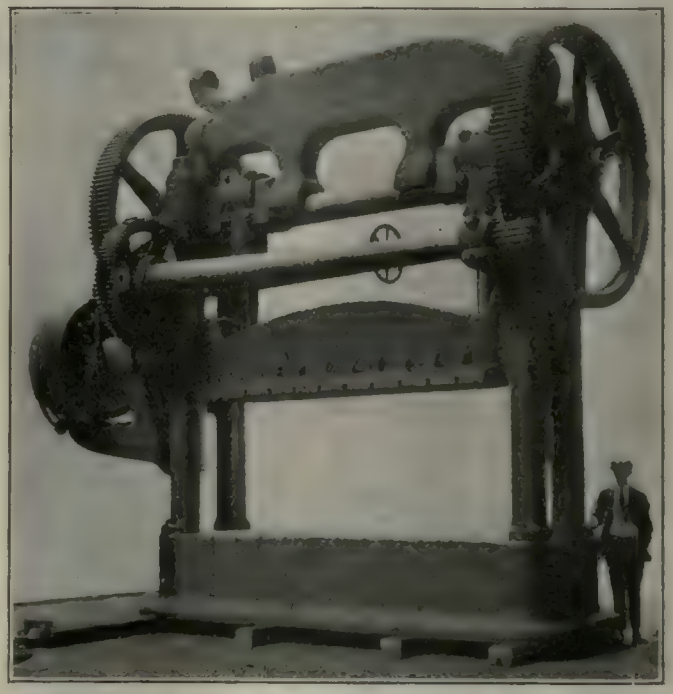
HARRIS THREAD-GAGE LAPPING MACHINE

lapping operation. In lapping male gages the gage is held in the chuck and the lap is in the operator's hand. The drive is at high speed, and is communicated from the groove pulleys by the spider which is fastened directly to the spindle, the friction surfaces being leather faced. It is said that the drive is so smooth that the reverse cannot be detected by the eye and that there is no shock in reversing. The reversing mechanism requires a very slight movement of the spindle, probably 0.01 in., this being obtained by pressing on the vertical lever shown at the left. The upper end of the lever carries a yoke and a ball thrust bearing in order to overcome friction at this point. When there is no pressure on the lever the ball weight at the lower end holds it in vertical position, which is the neutral point in its motion, the spindle remaining at rest. It is stated that the spindle is reversed in one-quarter of a revolution.

500-Ton Ferracute Press

The Ferracute Machine Co. Bridgeton, N. J., has recently built the large press shown, which is known as press S-507, designed for pressures up to 500 tons. The tensile stresses are taken by four 5½-in. steel rods that are shrunk in the cast-iron columns. The ram has a vertical motion of 18 in. and makes between 5 and 6 strokes per minute. The distance between columns, right to left, is 148 in., and from bed to ram at top of stroke and adjustment, 60 in. Power is applied through the medium of a combined friction clutch and brake, by means of which the operator is given complete control of the action, it being possible to start or stop the press at any part of the stroke, or to run continuously, or to have the ram stop automatically at the top of the stroke each time.

Attention is called to the tapered back shaft, a construction which is said to be unique. The reason for having this shaft a larger diameter at its driven end is to equalize the torsion so that both the large gears will



500-TON FERRACUTE PRESS

be driven with equal pressure tangentially on their teeth. This is accomplished by the short part of the shaft being elastically twisted only to the same degree of rotation as is the long part, which, if the shaft were parallel the whole length, would of course twist much more on account of its length than would the short section. As the torsional deflection of a shaft under stress is inversely as the fourth power of its diameter the proper amount of taper required to produce the desired result is easily calculated.

A method formerly used to insure equal pressures at the ends of the back shaft was to place the driving gear in the middle of the shaft, but this involved a somewhat unwieldy outrigger or bracket to carry the journal box of the clutch shaft and also required great care in the mechanical operations when the press was under construction, since it was essential that all the journals of the clutch shaft should be exactly aligned. Placing the gear at one end and giving scientific proportions to the shaft obviate the objections mentioned, and also enable the clutch shaft to be much shorter than by the old design and uniformly of standard length. The total weight of the press is about 137,000 pounds.

Connecticut Universal Grinding Machine

The machine shown in Figs. 1 and 2 is made by the Middlesex Machine Co., Inc., Middletown, Conn. Fig. 1 shows the machine set for cylindrical grinding, and Fig. 2 fitted with a magnetic chuck and set for surface grinding. The machine is rigidly built and has ample bearing surfaces and substantial column and head construction, which insure rigidity and freedom from vibration. It is very efficient on light, extremely accurate work, as well as on the general run of work. Its range includes rapid and accurate production of straight or taper work between centers, surface grinding, internal grinding, cutter and reamer grinding and all general toolroom grinding. The wheel head carrying the main grinding spindle is a heavy casting bolted to the column which is solid with the base. The spindle is of tool steel hardened, ground and lapped. It is mounted in SKF ball bearings and fitted with special adjustable bronze bushings which effectually eliminate all end play. The spindle has a 15-deg. taper on each end. Flanged bushings fitting these tapers are furnished, making it possible to change the wheels and maintain their true relation to the work without the necessity of retruing the wheels.

The internal grinding attachment is bolted to the spindle head and is made adjustable to give the proper tension to the belt.

The column construction allows the table to be swung completely around the head, yet the table is supported by a knee slide similar to that of a milling machine. The top platen rests for its full length on the main table casting. It is made to swivel and has a knurled-head thumbscrew for accurate adjustment. The table is operated by rack and pinion and is furnished with automatic feed. The cross-feed screw has micrometer adjustment. The water supply is piped direct from the pump to the wheel hood, doing away with the leaky hose connection.

The regular equipment furnished with this machine includes one machine countershaft, one drum countershaft, one universal attachment, one 4-in. three-jaw chuck with wrench, one gear cutter-grinding attachment, one internal grinding attachment with driving pulley, belt and one spindle extension, one universal headstock fitted with drawback attachment, one headstock bushing with pulley fitted to carry either chuck or faceplate, one tailstock with center, one faceplate with taper shank, one expansion collet for faceplate, one wrench for ½-in. nut, three T-slot bolts and six dogs, assorted sizes.



FIG. 1. CONNECTICUT UNIVERSAL GRINDING MACHINE

Specifications—Spindle, 1¼ in. in diameter; front bearing, 4½ in. long; rear bearing, 3¼ in. long; longitudinal movement of table, 19 in.; vertical movement of table, 13 in.; transverse movement of table 8½ in.; centers swing work up to 12 in. in diameter; centers swing work up to 24 in. long; working surface of table, 5¾ x 34 in.; maximum distance spindle to table, 9 in.; height, floor to center of spindle, 45 in.; column, 7 in. in diameter; spindle belt giving increased power and no slipping, 2½ in. wide; universal attachment swings cutters 12 in. in diameter; chuck, 4 in. in diameter; faceplate with expansion drawback, 6 in. in diameter; headstock has No. 10 B. & S. taper; headstock, dead center, has No. 6 Jarno taper; net weight complete with attachments and countershaft, 1700 lb.; net weight complete with attachments boxed for foreign shipment, 2000 pounds.

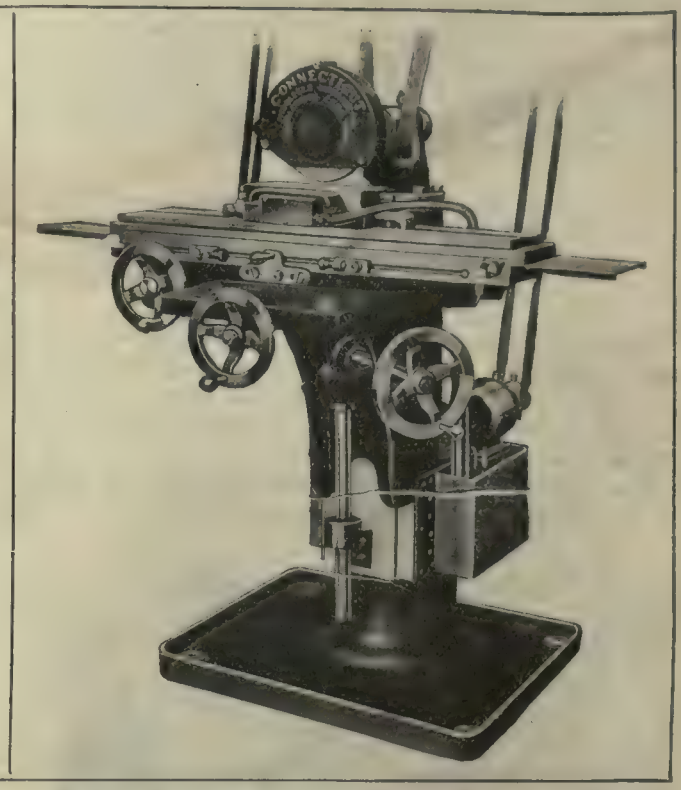
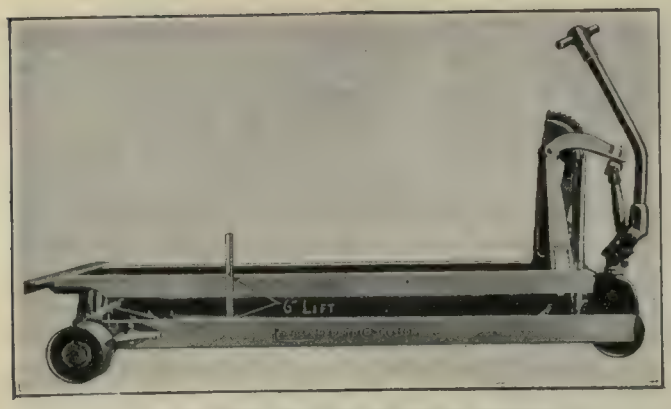


FIG. 2. MACHINE FITTED FOR SURFACE GRINDING

"Jacklift" Type G Elevating Truck

The Louis Sheppard Co., 48 Binford St., Boston, Mass., has recently placed on the market a jacklift elevating truck, which is known as type G. The particular feature of the truck is that the load may be elevated 6 in., and it is claimed that it is the only elevating truck in the market that lifts the load over 3½ in. It is also claimed that the 6-in. lift is very handy where the load must be trucked over steep inclines and that it may be



THE "JACKLIFT" ELEVATING TRUCK

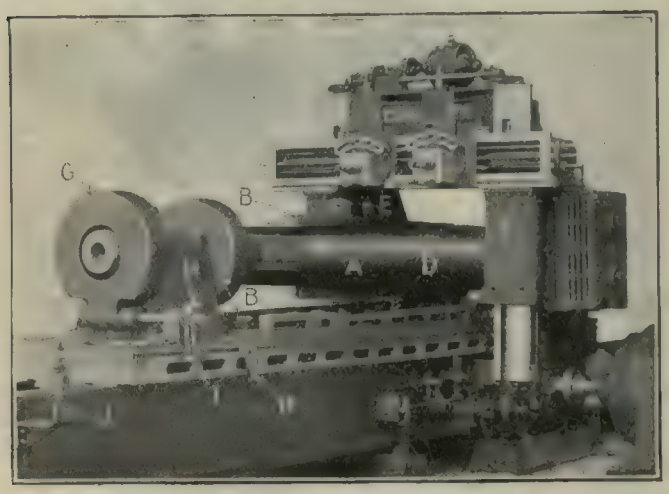
used to great advantage in taking battery cradles, with the battery intact, from an electric truck. This truck contains the usual features of the jacklift line, principal among which are easy lift, vertical lift and free lifting handle. The type G truck is made in 10 models and five different lengths. Each may be equipped with either 8- or 10-in. wheels as desired.

Cam Rails Used in Planing Howitzer Jackets

By E. A. Thanton

Owing to the recoil ways for the 9.2-in. howitzer being made solid with the tapered jacket it is impossible to turn off the surplus metal. For this reason the Cincinnati Planer Co. fitted up one of its big planing machines to do the work as shown.

The howitzer jacket held on special centers is shown at *A*, the two recoil ways being indicated at *B*. In order to cause the tool to follow the taper of the jacket cam rails *C* and *D*, which are exactly alike, are placed one on each side of the table. Bolted to each end of the cross-slide are brackets *E* and *F*. These brackets carry rollers which ride on the cam rails and give the cross-rail the necessary vertical movement for the tool to follow the work. The jacket is automatically rotated for the feed by means of a worm gear under guard *G*, and a worm operated by the ratchet mechanism *H*. The ratchet lever *I* receives its impulse when it strikes the pin *J* on the back stroke of the table. One of the regular table reverse dogs is shown at *K*.

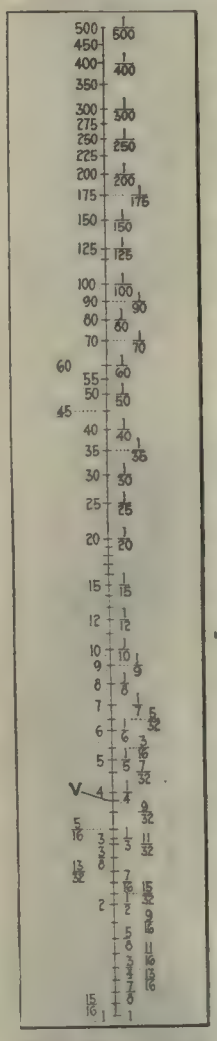


PLANING HOWITZER JACKETS

Universal Lathe and Grinder Chart*

By R. Poliakoff

Assistant Professor of Mechanical Technology, Technical Institute, Moscow, Russia, pro tempo New York



THE CHART AND HOW TO USE IT

On page 590, Vol. 49, of the *American Machinist* a chart compiled by the author was shown enabling one to find in a very convenient and quick manner the time required to turn a bar in a lathe or to grind it in a grinding machine. Herewith is shown how the same chart without any alteration in it can be used to find the number of revolutions per minute if the speed and diameter are known. The rule to proceed with is as follows:

Take the vertical distance between the numbers on the chart representing the speed *in feet* per minute and the diameter *in inches* and set it off from the division marked *V* on the chart upward if the number representing the speed is above the diameter number, and downward if the number representing the speed is below the diameter number. The result will show the number of revolutions per minute.

As the number expressing the speed in feet is usually larger than the diameter expressed in inches one will have to set off in most cases the distance upward from the division marked *V*.

Example 1—Speed, 150 ft.; diameter, 20 in.; number of revolutions, 28.5.

Example 2—Speed, 30 ft.; diameter, 40 in.; number of revolutions, 2.9.

Screws Used in Instrument Making

There seems to be a lack of knowledge regarding the sizes of screws used in instrument making. The table below is used in some of the larger instrument shops:

No.	Diameter	Threads per Inch
0	0.06	80
1	0.073	72
2	0.084	56
3	0.0973	48
4	0.1105	36
6	0.1368	32
8	0.1631	32
10	0.1894	32

The first two sizes are A. S. M. E. standard, and the whole A. S. M. E. series is to be preferred even though it is difficult to obtain the screws as very few concerns carry them in stock. On account of the finer threads the A. S. M. E. screws are better where there is much vibration. When the screws given above work or jar out too readily it is customary to substitute No. 2-64, No. 3-56 and No. 4-48 from the A. S. M. E. list.

Above the 10-32 size the S. A. E. list is used almost exclusively, owing to the fine threads.

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LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



To enable America to take the lead in the conquest of the air John D. Ryan, who recently resigned as director of the Aircraft Production Board, has proposed to the United States Government the establishing of an academy of aeronautics similar to West Point and Annapolis.

A new world airplane altitude record of 30,500 ft. was established at Ipswich, England, on Jan. 3, 1919, by Captain Lang, carrying an observer, Lieutenant Blowers. Both pilot and observer were suffering from frostbite on account of the cold experienced at 30,500 ft., which registered 38 deg. F. below zero. "For the first 8000 ft., the machine was tossed and buffeted about by a 25-mile gale, but after that the going was smooth," said Captain Lang. "The sun was bright and we could make out ships plainly several miles to sea. At 28,000 ft. our oxygen ran short. Blowers fainted and was unconscious until we landed, but I was lucky enough to stick it out." The previous airplane altitude record was 28,900 ft., established Sept. 18, 1918, by Capt. R. W. Schroeder of the Wilbur Wright Aviation Field.

An experimental airplane built by the Carolina Aircraft Co., using wood veneer in the wing construction not only for ribs but also for the actual wing covering, was tested with satisfactory results by the National Advisory Committee for Aeronautics. It was found that the internal drift wires may be eliminated and the same weight per square foot of service obtained as in the ordinary wing constructions.

Launching an airplane from a dirigible was successfully carried out by the United States Navy Department. An airplane was attached by a 100-ft. cable to the dirigible. Both rose to about 3000 ft., and the airplane was released. After diving about 1000 ft. the airplane obtained sufficient speed to continue its usual flight. In a similar line, the Glenn L. Martin Co. had a contract with the United States Government to construct a large bombing plane with a smaller pilot plane fastened to it, so as to automatically control the larger plane and direct its course after the smaller pilot plane had been released. This plan was never completed, as the order was cancelled when hostilities ceased.

The Aerial Transportation Committee has been organized by the Aero Club of America, with Rear-Admiral Robert E. Peary as chairman. The purpose is to coöperate with the Post Office Department in establishing aerial mail lines and to advise any business organization in the United States interested in this line in establishing aerodromes.

An interesting feature on the Gray tractor, model of 1919, manufactured by the Gray Tractor Co., Minneapolis, Minn., is the very simple design of the gearset. It has no bevel gears nor differentials. In all there are but six gears cut from drop-forged heat-treated steel blanks. The gearset is completely inclosed and runs in oil. The final drive is accomplished by a heavy-duty roller chain made of heat-treated nickel steel inclosed and running in oil. It is driven by hardened driving sprockets on both ends of the jackshaft and runs over cast-steel sprockets on the drive hubs which are attached to the ends of the drum, not to the axle. The drum is driven evenly from both ends, and power is transmitted to the rims through the riveted and solid ends. The chain drive is spring mounted.



CURTISS FLYING BOAT N.C.-1

The naval flying boat N. C.-1, the largest seaplane in the world, which carried recently 51 passengers in a trial flight at the naval air station at Rockaway, N. Y., was built by the Curtiss Engineering Corporation, Garden City, L. I., to the design of the Bureau of Construction and Repair of the Navy Department. The hydroplane has a 126-ft. wing spread, giving approximately a wing area of 2700 sq.ft. Both upper and lower wings of 2 deg. of incidence have a chord of 12 ft. and a wing gap of 14 ft. near the boat and 12 ft. at the wing tips. The lower plane has a 5-deg. dihedral. The over-all length of the machine is 70 ft., while the height is 25 ft. The power plant consists of three low-compression 350-hp. Liberty motors, each driving a four-bladed propeller. The total weight of the machine, with full load, is 22,000 lb. when carrying 900 gal. of gasoline, which is sufficient for a 13-hour flight. The usual crew consists of five men. The speed of the N. C.-1 is 45 knots on water and 80 miles in the air. The hydroplane is of the boat-body type and leaves the water after a 1000-ft. run. It draws 21 in. light and 31 in. with full load. The N. C.-1 on its trial made a trip from Rockaway, N. Y., to Washington, D. C., via Hampton Roads, about 350 miles, in 5 hours and 30 min., reaching an altitude of 2000 ft. in 10 minutes.



Sparks from the

Personnel of New Ordnance Divisions

Disposition of Work in Various Arsenals Will Afford Greater Degree of Specialization

The following are the assignments of officers under the new Ordnance office orders reorganizing this department. The chief of manufacture has not yet been named: Assistant Chief of Ordnance, Brig.-Gen. W. S. Peirce; Chief of District Offices, Brig.-Gen. W. S. Peirce; Chief of Technical Staff, Brig.-Gen C. L'H. Ruggles; Inspector of Ordnance Establishments, Col. W. W. Gibson; Chief of Administration Division, Col. W. W. Gibson; Chief of Artillery Ammunition, Metal Components Division, Col. E. M. Shinkle; Chief of Artillery Division, Col. G. F. Jenks; Chief of Automatic Arms and Small Arms Division, Col. Earl McFarland; Chief of Aircraft Armament Division, Col. Earl McFarland; Chief of Ordnance Field Service, Col. J. C. Heckman; Chief of Explosives, Chemicals and Loading Division, Col. C. T. Harris; Chief of Trench Warfare Division, Lieut.-Col. E. J. W. Ragsdale; Chief of Tank, Tractor and Trailer Division, Lieut.-Col. H. W. Alden.

How Work Will Be Assigned

Disposition of work in various manufacturing arsenals is to be as follows: Watertown is to be a gun-forging, steel-casting and armor piercing projectile plant for manufacturing seacoast gun carriages and the heavier types of mobile-gun carriages not mounted on wheeled mounts. Watervliet is to be retained as a plant for the development and manufacture of guns of all caliber up to 18 in., and is to be further expanded and equipped for the manufacture of 75-mm. guns by the transfer of machinery from war plants. Rock Island Arsenal is to be retained for the development and manufacture of field-artillery material, tractors and tanks. Springfield is to be retained and expanded for the development and manufacture of rifles, machine guns and pistols. New buildings are to be erected and equipped by government-owned machinery from commercial plants. Frankford is to be retained as a plant for the development and manufacture of small-arms ammunition, optical instruments and gages. Aberdeen Proving Ground is to be developed as a training and instruction center and as the main experimental station and proving ground for the department. The Erie Proving Ground is to be retained for the development and proof of artillery projectiles. Savannah Proving Ground is to be operated as a subpost of Rock Island Arsenal.

* * *

Work on State Highways

The Bureau of Public Roads of the United States Department of Agriculture has collected from the highway departments of the various states figures indicating the probable number of returned soldiers and sailors that can be used during the present year in connection with road construction and repair. Replies were received from 38 states, but only 29 gave definite figures. These include the use of nearly 12,000 as skilled workers and nearly 92,000 as unskilled workers. The skilled workers include masons, carpenters, quarry bosses, concrete finishers, road foremen, roller men and superintendents.

* * *

Exporting American Goods to Russia

Russia soon will be receiving American goods again. The War Trade Board is receiving applications for exportation of all commodities through Vladivostok. A limited amount of cargo space may be available from Pacific Coast cities direct to Russia's eastern port. In allocating space preference will be given to material covered by licenses issued on and after Oct. 7 under conditions which the War Trade Board is prepared to define and to discuss with exporters, giving due consideration to the particular transaction in question.

* * *

The New "Infant Industry"

The total value of dyestuffs exported in the fiscal year 1918 was $17,000,000 against $12,000,000 in 1917, $5,000,000 in 1916, $1,000,000 in 1915 and less than $500,000 in 1914, the year preceding the war. Prior to the war the export of dyes and dyestuffs had never exceeded $500,000, while imports of dyestuffs prior to the war aggregated from $10,000,000 to $15,000,000 a year. Dyestuffs exported to Great Britain in the fiscal year 1918 totaled over $2,500,000 against $70,000 in the year before the war; to France, $1,630,000 against $2000 in the year preceding the war; to Italy, $1,182,000 against $11,000 in 1914; to Japan, $3,233,000 against nothing in 1914; to India, $1,948,000 against $93 in 1914, and to Brazil, $1,282,000 against $65 in 1914.

Elected President of the New England Foundrymen's Association

Robert E. Newcomb, superintendent of the Deane Works of the Worthington Pump and Machinery Corporation, was elected president of the New England Foundrymen's Association at a meeting at the Exchange Club, Boston, Jan. 8, 1919.

Mr. Newcomb completed his engineering training at Sibley College,



ROBERT E. NEWCOMB

Cornell University, and was graduated in the class of 1907 with the degree of mechanical engineer. He then entered the Deane Works where he has been superintendent for the past 10 years.

He is a member of the American Society of Mechanical Engineers; associate of the American Institute of Electrical Engineers; member of the American Society for Testing Materials and chairman of the committee on packings, gaskets and pump valves; member of the New England Foundrymen's Association and a member of the National Founders Association.

* * *

A Century of Trade Progress

It was just 100 years ago that the little steamer "Savannah" built in New York for transatlantic experiment passed out of New York to Savannah, which port it left a few months later on its successful venture across the ocean, to which the steamship was up to that time unknown. By 1850 world international trade had grown to $4,000,000,000, by 1900 it was $20,000,000,000, by 1913 $40,000,000,000, and in the year just ended probably $50,000,000,000 when measured in the inflated currency of the present period. Meantime world railways had grown to 725,000 miles. It is difficult to realize that only one hundred years ago the world had no steamship crossing the ocean, not a mile of railway or a foot of telegraph or ocean cable, while as for telephones, wireless telegraphy or airplanes they are the product of this generation.

World's Industrial Forge

By E. C. Porter, News Editor

Chief of the Division of Safety Engineering Appointed

H. H. Cannon has been appointed chief of the Division of Safety Engineering, Working Conditions Service, Department of Labor, and has begun his service under the Government. Coöperating with the Division of Industrial Hygiene and Medicine and the Division of Labor Administration he will carry on the work of providing for the prevention of accidents in shops and factories.

Mr. Cannon, the new appointee of the department, has been a student at the University of Pennsylvania and the University of Wisconsin. During the war he served as safety superintendent for the International Shipbuilding Corporation at Hog Island. He was connected with the Independence Bureau of Philadelphia for three years. His experience in industrial plants includes service as safety supervisor in the du Pont plant at Carney's Point, as fire chief in the Midvale Steel plant at Eddystone and as chief engineer and electrical engineer in the Workmen's Compensation Bureau, New York.

* * *

Instruction for Shipyard Workers

The Board of Education, Newark, N. J., has perfected arrangements for the inauguration of evening classes of instruction for shipyard workers. The branches of study will include ship construction, machine work, blueprint reading, naval architecture and allied branches. A total of 526 employees from local shipbuilding plants has registered for the course.

* * *

Technical Men Needed in Hospital Workshop

Officers and enlisted men are needed by the Division of Physical Reconstruction for administrative and instruction work in hospitals. Men who have had technical, trade, commercial or agricultural training and experience are especially desired as instructors in the curative workshops.

Authority has been granted by the War Department to transfer to the Reconstruction Division any commissioned or noncommissioned officer or enlisted man from any branch of the service, who is no longer needed in his present assignment and who desires the transfer.

These men will be sent to hospitals functioning in physical reconstruction. The program is now in operation in 25 hospitals with an enrollment of 10,000 disabled soldiers in bedside and ward handicrafts and studies, technical and trade work in shops, agricultural work in hospital farms and gardens, stenography, stenotype, typewriting and other commercial work, and in general academic work.

More than 100 commissioned officers are in charge of the administrative service, and in supervisory positions, and nearly 500 enlisted men are in service as instructors.

The reconstruction work will last until the hospitals are cleared, probably by the summer of 1919.

* * *

The "Howard Evans" Launched

The first launching of the year was the barge "Howard Evans" at the shipbuilding plant of E. J. Tull, Pocomoke City, Md., on Jan. 1.

This new barge is one of the fleet of 20 steam towing boats and barges owned by the Diamond P Boat Line, with office at pier 45, North Philadelphia, Penn. It will be used to carry supplies and equipment to the foundries and shipbuilding plants along the coast, the Delaware River and to New York and Boston.

This barge is 190 ft. long, 23 ft. beam and 12 ft. hold, and has a carrying capacity of 1000 deadweight tons.

* * *

Engineers' Club of Philadelphia Will Hold Interesting Meeting

The Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall on Tuesday, Feb. 18, 1919, 8.15 p.m. Maj. Nevil Monroe Hopkins, Ph.D., of the Technical Research Section of the Ordnance Department, U. S. A., and member of the faculty of George Washington University, Washington, D. C. will present a paper, illustrated with lantern slides, entitled "The Spirit and Outlook for Research and Invention." Members of the club and of affiliated societies are privileged to invite ladies to be present at the meeting.

The following schedule of speakers has been arranged for the Tuesday noon luncheons: Feb: 11, Dr. William D. Lewis, principal of William Penn High School, "What the War Has Taught Us About the Educational Needs of Democracy." Feb. 18, Joseph A. Steinmetz, member, "News from the Peace Zone." Feb. 25, Dr. Edward Chiera, University of Pennsylvania, "The Problem of the Adriatic." Mar. 4, Alfred D. Flinn, secretary of Engineering Council, "Joint Activities of Engineers: A Résumé of the Work of Engineering Council and Engineering Foundation."

Large German Concern Now American Organization

Bosch Magneto Co. Officially Becomes American Bosch Magneto Corporation and Will Extend Its Scope

On Dec. 7, 1918, the Alien Property Custodian of the United States sold the entire property holdings, assets and patent rights of the Bosch Magneto Co. to the highest bidder, the American Bosch Magneto Corporation, which has taken over the entire holdings and organization of the old company, including the great Bosch works at Springfield, Mass., which comprise 250,000 sq. ft. in buildings alone and employ 1500 operatives; also the complete service and selling system throughout the United States, and the entire ownership of all United States and foreign patents and trademarks under which the old company operated.

Officers of the New Company

The officers of the new company are A. T. Murray, president; George A. MacDonald, vice president and treasurer; A. H. D. Altree, vice president; Leon W. Rosenthal, vice president, and J. A. MacMartin, secretary and assistant treasurer. The directors are A. T. Murray, Martin E. Kern, George A. MacDonald, Henry N. Sweet, C. H. Dwinnell, H. C. Dodge, Duncan C. Holmes, Philip L. Spalding and H. B. Benedict.

Mr. Murray, the president and director of the new company, is also president of the Bethlehem Motors Corporation, Allentown, Penn. Besides managing the Magneto Corporation Mr. Murray will continue as the active head of the Motors Corporation. Mr. MacDonald, vice president and treasurer, is also president of the Chicopee National Bank, Springfield, Mass. Mr. Kern is president of the Penn Counties Trust Co., Allentown, Penn., and is also treasurer of the Bethlehem Motors Corporation. Messrs. Sweet and Benedict are connected with Hornblower & Weeks, bankers, Boston and New York. Mr. Dwinnell is vice president of the First National Bank of Boston, and Mr. Holmes is vice president of the Chase Securities Corporation, New York. Mr. Dodge is chairman of the board of directors of the Gray & Davis Co., Boston, and president of the H. A. Wood Co., also of Boston. Mr. Spalding is president of the New England Telephone and Telegraph Co., Boston, Mass.

It is understood that the new organization intends to engage actively in the production of electrical apparatus for the various branches identified with the American automotive industry.

Surplus Trucks and Automobiles Not to Be Sold at Once

The Director of Munitions contradicts the statement in the newspapers to the effect that the Government intends to put on sale at once all trucks and motor passenger cars that are not being used in the service. The fact is that all trucks owned by the Government will be needed in its service for some time to come. In the disposal of surplus property every care will be taken to see that it is sold in a manner best adapted to cause as little disturbance to trade as possible.

* * *

Large Order for Tractors

The Hart-Parr Co.'s tractor works, Charles City, Iowa, have added $150,000 worth of new rapid, labor-saving machinery to their factory in the past two months. This machinery takes the place of older machinery that was not so economical for their work. The change from war-time to peace production at this factory is being worked out with very little loss to labor or of time. The war orders are nearly all completed and this permits a great increase in production of tractors. Orders for over 4000 are said to have been received for 1919 delivery.

* * *

Employment Service Active

Federal directors of the United States Employment Service from 41 states report that for the week ended Dec. 14 132,798 persons registered for employment. Of these 127,315 were referred out, of which 94,026 were placed in positions.

Of the above total registrations 116,013 were men and 16,785 women. The number of men placed during the week is 30,026; women 14,943, as against 106,490 men and 20,825 women referred.

Applications for help in the week amounted to 240,619 men and 33,018 women, making a total of 273,636.

* * *

Exports Twice as Large as Year's Imports

Heavy December shipments brought the total exports for 1918 to $6,150,000,000, a decrease of only $83,000,000 from the 1917 total, according to an announcement by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Imports for the year totaled $3,031,000,000, or not quite half the exports. Imports for the previous year were valued at $2,952,000,000.

Exports for December, the first full month after the signing of the armistice, reached $566,000,000, a decided increase over the $522,000,000 recorded for November, although not up to the high mark of $600,000,000 for December, 1917. Imports for December, however, were low, being $211,000,000 against $251,000,000 for the previous November and $288,000,000 for December of the previous year.

Imports as well as exports of gold continued to decrease, the imports amounting to $62,000,000 in the calendar year 1918 against $522,000,000 in 1917, and the exports to $41,000,000 and $372,000,000 in the same year.

Imports of silver increased from $53,000,000 in the calendar year 1917 to $71,000,000 in 1918. The exports of silver during December, 1918, amounted to $48,000,000, a larger amount than in any month during the past three years. For the calendar year exports of silver amounted to $253,000,000 in 1918 against $84,000,000.

Personals

GRAHAM W. BROGAN, formerly with the Duesenberg Motor Corporation, has been made advertising manager of the Black & Decker Manufacturing Co., Baltimore, Md.

CLEMENT BOOTH, until recently engineer in the Standard Roller Bearing factory, Philadelphia, Penn., is now with the Hale & Kilburn Corporation as production engineer.

D. G. CAYWOOD, formerly sales manager of the Brunner Manufacturing Co., Utica, N. Y., has become special representative for the Black & Decker Manufacturing Co., Baltimore, Md.

CHARLES B. WILSON, president and manager of the Wilson Foundry and Machine Co., Pontiac, Mich., has been elected vice president of the Curtiss Airplane and Motor Corporation, Buffalo, N. Y.

JAMES A. BUTLER and F. ALBER HAYES have incorporated under the name of Butler & Haynes, Inc., mechanical and chemical consultants and experimental engineers, with offices at 220 Devonshire St., Boston, Mass.

MAJ. N. C. WALPOLE of the Ordnance Division has received an honorable discharge from the service and has returned to his duties as Southern sales manager of the Niles-Bement-Pond Co. and the Pratt & Whitney Co., with offices at 2015 First Ave., Birmingham, Ala.

A. A. HELLER, treasurer and general manager of the International Oxygen Co., 115 Broadway, New York City, has given up his active duties as manager. EUGENE SCHOEN has been appointed to take his place as manager. Mr. Heller, as treasurer, continues in charge of the financial departments of the business.

C. J. BROWN, connected with the sales division of the R. D. Nuttall Co. for the past three years, has become associated with FRANK M. EBB, representing the Silver Manufacturing Co., the National Forge and Tool Co., the Horseberg Forge Co. and the Meadville Malleable Iron Co. in the Pittsburgh district. Mr. Brown will be located at 902 Second National Bank Building, Pittsburgh.

Business Items

The Hoyt-Noi Steel Co., Chicago, Ill., representative and distributor of Armco products, has changed its name to the General Steel Company.

The New Albany Machine Manufacturing Co. has been incorporated with a capital of $50,000 to manufacture stone machinery. The incorporators are Henry H. Martin, Carl W. Martin and L. E. Martin.

The Onondaga Steel Co., Inc., Syracuse, N. Y., has recently purchased 12 acres of land at Eastwood, near Syracuse. New buildings are planned for the near future, and by early spring it is expected that the entire plant will be removed from Syracuse.

The P-W-V Automatic Machine Corporation, a Massachusetts concern, has purchased the entire radial automatic screw-machine business from the Fitchburg Automatic Machine Works department of the Fitchburg Machine Works, and is making plans for a considerably larger output of this four-spindle screw machine. It is rumored that an extensive modern plant at Springfield is included in the plans. The officers of the new company are C. E. Van Norman, president; L. M. Waite, vice president and sales manager, and C. J. Wetzel, secretary-treasurer.

Obituary

ROLLA C. CARPENTER, who until less than two years ago was professor of experimental engineering at Sibley College, Cornell University, died at his home in Ithaca, N. Y., on Jan. 19. He was a noted inventor and author. His books include the well-known textbooks, "Experimental Engineering," "Heating and Ventilating Buildings" and "Internal Combustion Engines." Besides these he has written many important articles for the American Society of Mechanical Engineers and for various engineering periodicals. He retired from Sibley College early in 1917, after nearly 30 years of teaching. He was a judge in the Department of Machinery at the Chicago Exposition in 1893, the Buffalo Exposition in 1901 and also the Jamestown Exposition in 1907. Professor Carpenter was a member of the following engineering societies and clubs: American Society of Mechanical Engineers, of which he was a past vice president; American Society of Heating and Ventilating Engineers, of which he was a past president; American Institute of Mining Engineers; American Society of Refrigerating Engineers; American Society for Testing Materials; American Society of Automotive Engineers; Michigan Engineering Society, the Engineers' Club and the New York Railroad Club.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Steels, Electric Carbon Tool

Carnegie Steel Co., Carnegie Building, Pittsburgh, Penn.

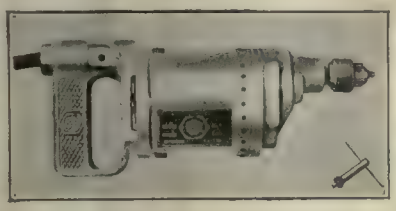
"American Machinist," Jan. 2, 1919

This company has recently placed on the market a new line of electric carbon tool steels, these being made in five grades ranging from 70- to 130-point carbon content. These steels are made up in a considerable variety of sizes and shapes generally required for machine-shop tool work.

Drill, Electric, with Pistol Grip and Trigger

Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md.

"American Machinist," Jan. 16, 1919

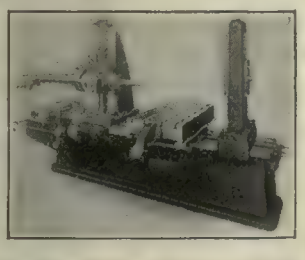


Equipped with a pistol grip and trigger switch and is claimed to be the lightest machine of its capacity on the market. Its weight is only 6¾ lb., and its capacity is drills up to ⅞ in. in diameter. The over-all dimensions are 4 in. in diameter by 12 in. long and a series-compensated motor furnishes the power. A no-load speed of 1600 r.p.m. is attained, dropping to 1000 r.p.m. at full load when the energy consumed is 175 watts.

Boring Mill, Horizontal

Blomquist-Eck Machine Co., 1146 East 152d St., New York City.

"American Machinist," Jan. 2, 1919



Diameter of spindle, 3⅛ in.; travel of spindle, 30 in.; taper in spindle, Morse No. 5; number of speed changes, twelve, 16 to 196 r.p.m.; number of feed changes for spindle or table, 9; number of feed changes for spindle or table with back gears, 18; feeds, 0.003 to 0.518 in. per spindle revolution; working surface of table, 24 x 54 in.; automatic longitudinal feed of table, 36 in.; automatic traverse feed or parallel movement of table with bed, 37 in.; maximum distance from spindle nose to outboard bearing, 5 ft. 5 in.; maximum distance from top of plain working table to center of spindle, 27 in.; maximum distance from top of bed to top of table, 10 in.; weight, crated, 11,600 lb.; horsepower recommended, 5; motor recommended, constant speed, 900 to 1200 r.p.m.

(This card is to replace the similar one published on page 92a.)

Thread-Gage Lapping Machine

H. E. Harris Engineering Co., 1047 Broad St., Bridgeport, Conn.

"American Machinist," Jan. 23, 1919

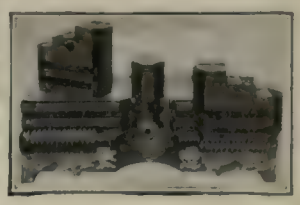


The drive is from either of the two grooved pulleys through the double cone-shaped spider. It has been the intention to include such features as should be conducive to the comfort of the operator. His left hand and arm rest upon the bench and, a slight pressure with either the thumb or index finger will cause the lapping spindle to drive in the desired direction. In lapping female gages the lap is held in the chuck and the gage in the operator's right hand. In lapping male gages the gage is held in the chuck and the lap is in the operator's hand. The reversing mechanism requires a very slight movement of the spindle, this being obtained by pressing on the vertical lever shown at the left.

Chuck, Lathe

Terkelsen & Wennberg, 326 A St., Boston, Mass.

"American Machinist," Jan. 16, 1919



The body is of heavy single-piece construction and is ground to a finish. The back is not slotted, which is claimed to give it exceptional strength, and thrust bearings are provided at the end of each screw. The jaws are double gibbed, heat-treated and ground all over and are interchangeable. The double-gibbed jaws are claimed to give longer life and greater accuracy than those of the single-gib type. The scrolls are of steel forgings, while the pinions are carbon steel heat-treated. The threads on the screws are cut from end to end without any necking except at the lower end for the thrust ring, and can be easily removed. The thrust ring is made in one piece. It is also said that the construction of the chuck brings it close to the lathe spindle.

Tapping Attachment, Back-Geared

Landau Machine and Drill Press Co., Inc., 19-25 West 44th St., New York City.

"American Machinist," Jan. 16, 1919

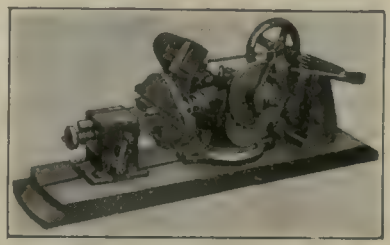


The device is at present made in two sizes, No. 1 taking taps up to ⅝ in. and No. 2 taps from ¼ to 1 in., both being fitted with standard Morse taper shanks. The construction is such that it will work to the full length of the tap. When the tap reaches the bottom of the hole it is automatically released to prevent breakage. The back gears are used to reduce the speed of the tap, the reversing speed being 7 to 1. All parts are hardened and ground and the gears for both tapping and reversing are constantly in mesh. The No. 1 attachment is equipped with a Jacobs chuck.

Graduating Machine

Schipper Machine and Tool Co., Aurora, Ind.

"American Machinist," Jan. 23, 1919

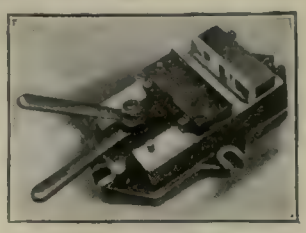


This machine consists of a Schipper 10-in. index head and a graduating attachment. It will graduate work at angles of from 45 to 90 deg. inclusive and up to 10 in. in diameter. It weighs 110 lb. complete and may be used on a milling or planing machine table or bench. It is easily applied or detached from the index head.

Vise, Quick-Acting Milling

Hartford Special Machinery Co., Hartford, Conn.

"American Machinist," Jan. 23, 1919



A 5-in. quick-acting vise made of drop-forgings, castings and bar stock, the parts being machined all over and gaged to permit interchangeability. All fitting and sliding surfaces are hardened and ground and the sliding jaw is scraped to the base. The sliding jaw has a T-slot that receives the head of the bolt carrying the bearing, which has serrations to engage those on the sliding jaw. The eccentric of the binder handle fits in the cam handle and both swing on the same bearing, which is clamped to the jaw by the bolt. In operation the sliding jaw is adjusted to the work by clamping the bearing in its proper place. The cam moves the jaw up to the work and partly clamps it, while a movement of the eccentric gives a final tightening.

Patented Aug. 20, 1918

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.27	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	4.17	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	4.17	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.77	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.52	4.45	4.47*	4.39	4.27	4.20

* For ⅜-in. plates.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.52	6.445	5.75	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.42	6.405	5.65	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.37	6.295	5.60	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.32	6.245	5.50	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.72	5.645	4.95	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.62	5.545	4.85	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.52	5.445	4.75	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.77	7.695	7.15	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.47	7.395	6.85	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.32	7.245	6.70	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
3/16, 11/32, 5/16, ¼, 9/32, 8/32 No. 8, 5/32 and No. 10	25.50 to 33.00	5/16 by 12 in. long	14.00
		¼ by 19 in. long	12.00
		⅜ by 19 in. long	10.00
No. 12		½ by 21 in. long	10.00
3/32, No. 14 and 1/16		* Special Welding Wire	
No. 18		¼	33.00
No. 20		5/32	30.00
		1/16	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of No. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼, and ⅜	47%	20½%	⅛ to 1¼	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	⅛ to 1¼	36%	21%
½	48%	35½%			
¾ to 1½	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	43%	27%	43%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	38%	29%	39%	23%	37.1%	23.1%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	20.50*	26.00	23.50
Tin in 5-ton lots	72.00	72.00	85.00
Lead	5.75	7.05	6.50
Spelter	7.85	8.60	8.00
ST. LOUIS			
Lead	5.45	6.75	6.35
Spelter	7.50	8.25	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	29.00	38.00	31.00	31.00	32.50	32.00	35.00
Copper wire (carload lots)	28.00	35.00	32.00	32.00	28.50	28.50	34.00
Brass sheets	29.00	39.75	30.75	32.00	33.00	29.00	35.00
Brass pipe	37.00	46.00	36.50	38.00	40.00	37.00	41.00
Solder (half and half) (case lots)	41.00	55.00	48.00	44.00	43.25	39.00	41.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$26.00	$25.00
New York	27.40	30.00
Cleveland	30.00	34.00
Chicago	28.50	37.00

American Machinist

From the Chief of Ordnance

Major-General C. C. Williams

Asks Co-operation of Our Readers

TWO years before the war—to be exact in January, 1915—the *American Machinist* set itself the task of educating the American manufacturing public toward preparedness by the widespread publication of methods of ordnance manufacture. This policy it has consistently followed up to the present time, with the result that educational work of exceeding importance to our public safety has been accomplished.

Now that the excitement of actual warfare is over there is a natural tendency to forget what we have learned. To counteract this tendency and to conserve our present public asset of knowledge of ordnance engineering and manufacture, the *American Machinist* is initiating a new editorial department entitled "United States Army Ordnance News." In so doing it is in my estimation performing a public service fully as important as its previous service during the war.

I urge upon American manufacturers who have made ordnance material, upon civilian engineers who have had to do with its design or manufacture, upon officers who came into the Ordnance Department from civilian life and who have gone or are now going back to their former occupations, that they contribute their experiences and add to their experience through these columns, so that the knowledge of ordnance that we have gained as a nation during the past 20 months may not be lost or considered an exclusive prerogative of those who remain in the regular establishment. The Government arsenals and the Ordnance Department are but a nucleus for the greater organization of our manufacturers and civilian engineers. It was these manufacturers and these engineers who made possible the accomplishments of the past, and it is to these men that we must look in the future. Their knowledge of ordnance engineering and manufacture is our greatest assurance of real preparedness.

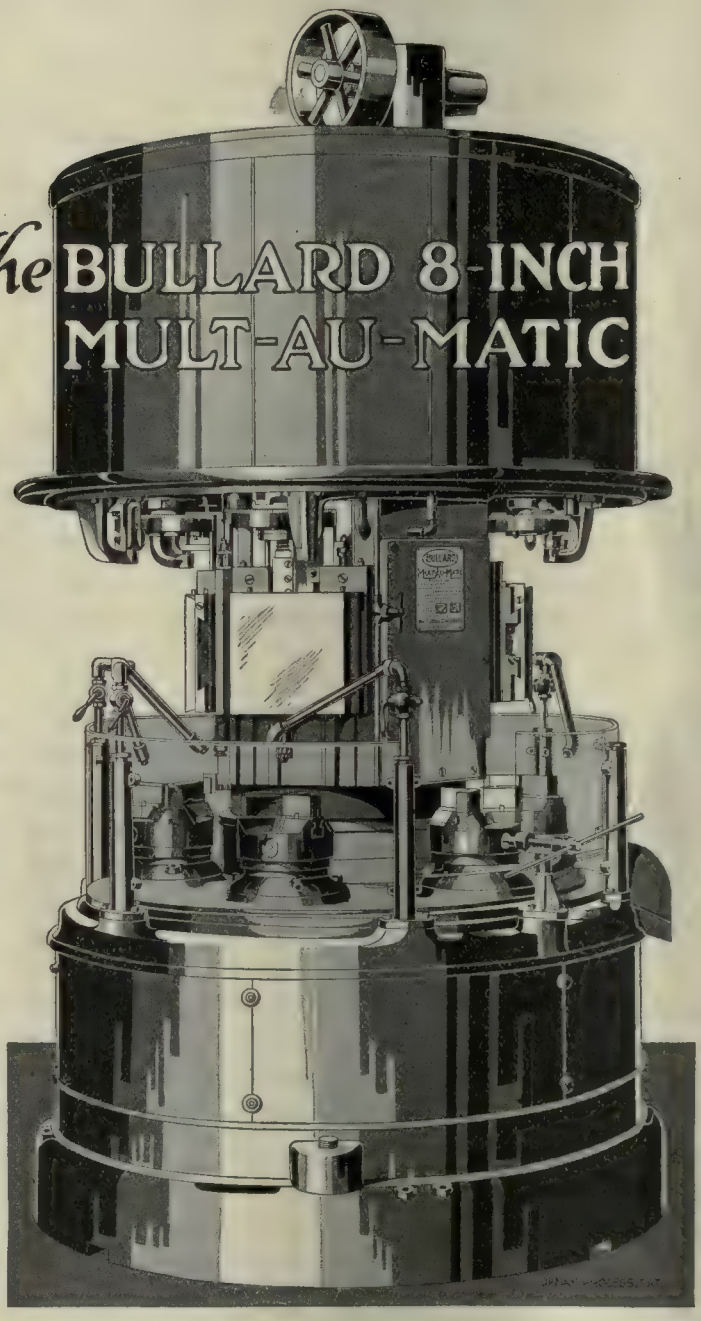
Washington, D. C.
Jan. 23, 1919



See Page 262 of this issue

February 6, 1919 American Machinist Vol. 50, No. 5

The BULLARD 8-INCH MULT-AU-MATIC



THE new Bullard 8-in. Mult-Au-Matic, like its larger predecessor which was the pioneer station-type machine tool, is the development of the idea that automaticity in machine tools need not be accompanied by restricting specialization. The demonstration of this idea in the 14-in. machine, having successfully passed its five-year period of probation, and having been tested in some 150 installations, the fruition of that idea in a second size of the same type of machine is of especial interest. No machine tool has a wider range of work than the engine lathe. No machine tool is more simple in its tooling than the engine lathe, with its single-pointed tool fed longitudinally, transversely or at any angle by means of its compound rest. The idea behind the Mult-Au-Matic is that of combining the breadth of range and simple tooling of the engine lathe with the precision and time saving of a strictly automatic process; in reality it is the making automatic of six engine lathes working in sequence and operated by one man whose duties consist of loading and unloading. The one phase of lathe operation which has not been included in the function of this machine is turning between centers. The first impression one gets in watching any one of the five working stations of the 8-in. Mult-Au-Matic is that here is an engine lathe standing on its head and apparently benefiting by its change in position, for all of the customarily manually operated lathe motions are followed out without human guidance and hence also without the possibility of human lapses in time and accuracy. The field of the 8-in. Mult-Au-Matic includes all classes of castings, forgings or bar-stock sections, cut to length, coming within its capacity and which require boring, turning, facing or threading operations, either singly or in combination. Briefly it comprises six independent vertical lathes automatically operated in combination on a series of pieces of the same form and size, all of the sequence of operations, including chucking, being performed simultaneously. Thus there is produced a completely finished piece in the time required for the longest operation of the sequence plus the few seconds needed for the indexing of the carrier and its spindles from one station to the next. The six independent work-holding spindles

Five years ago the American Machinist announced to the public the original 14-in. Bullard Mult-Au-Matic, which was the first station-type machine tool built in America for the market. In this issue we present to the public for the first time the new Bullard 8-in. Mult-Au-Matic. This new and smaller machine, while it follows the general principles of operation of its 14-in. predecessor, contains 2500 fewer parts, but many new features which will bring this new type of Mult-Au-Matic into an entirely new field of work.

are mounted on a carrier, or turret, which revolves around a central column having six faces, the first of which, being the loading station, is blank. On the remaining five faces are mounted tool-carrying slides which are independently adjustable in amount, rate and direction of movement.

The base, which is cylindrical in form, forms a rigid surface plate on which is mounted the machine proper. This base, as shown in Fig. 1, is divided into two sections, the lower of which serves as a tank of large capacity for cutting lubricant or "coolant" and the upper as a reservoir for the lubricating oil circulated throughout the machine. Within each reservoir is an independent power pump for circulating its contents. The column, a rigid cylindrical unit, is firmly secured to the base. On its lower end is formed the main, or central, bearing for the spindle carrier, or turret. Within this section is incorporated the indexing and turret registry mechanism. On its upper end, hexagonal in form, are mounted the independent tool-carrying heads, and on the head of the column and firmly secured thereto is mounted a strongly ribbed base for the feed and driving mechanism, an interior view of which is shown in Fig. 4. The carrier, or turret, in which are mounted the work-spindles and which is shown in Fig. 3, embodies in its construction facilities for the readjustment of the spindles in relation to each other as well as to the registry mechanism. The bearing of the carrier on the column is tapered to provide a fine adjustment at this point.

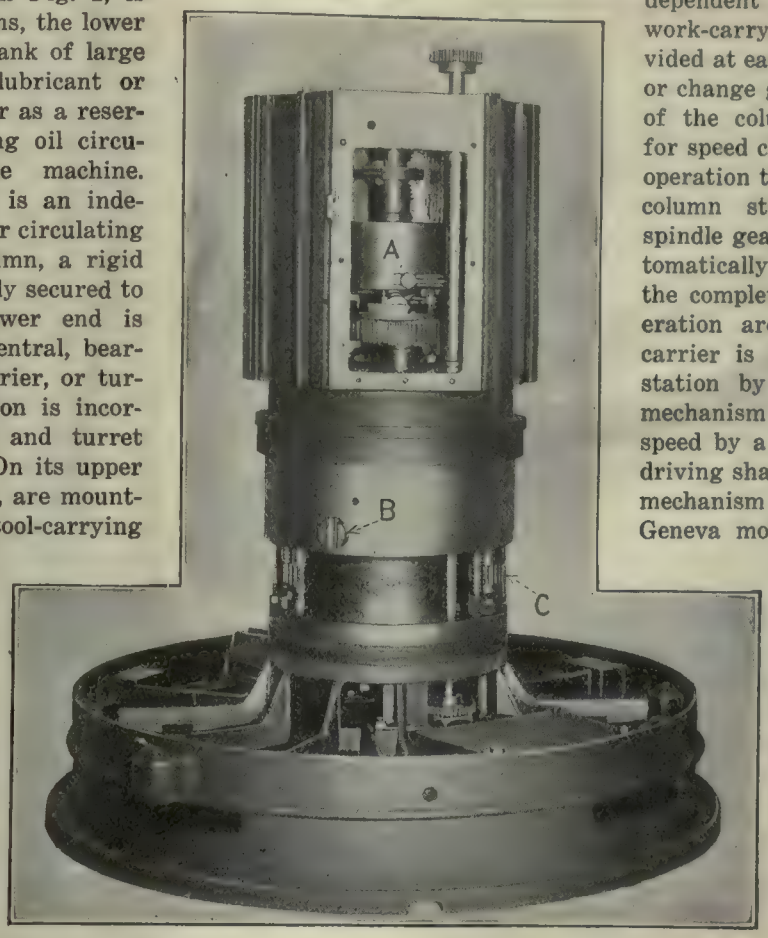


Fig. 1. Surface-plate form of machine base and hexagonal column. The base contains an upper and lower compartment, the former containing the supply of lubricating oil and the latter the coolant. Each compartment has its independent circulating pump. The main controller drum can be seen at A, the locking pin at B and one of the work-spindle driving pinions at C.

The controlling drum, carrier indexing mechanism, registry master pin and carrier binder are contained within the column. These parts are readily accessible for inspection or adjustment by the removal of a plate at the loading station and are shown at *A* in Fig. 1.

The individual feed works, which are illustrated in Fig. 4, are units in construction and serve as supports for the top plate, on which is mounted the driving-pulley bracket. A 10-hp. motor is sufficient for all conditions of load.

In type and proportion the work spindles follow closely the design of those used in the Bullard boring mills and vertical turret lathes. Two cylindrical bearings are provided to absorb side strains and a self-centering conical thrust bearing at the upper end of the spindle is provided to take care of the vertical pressures. The spindle head is in the form of a plain faceplate, to which may be secured specially designed three-jaw chucks, as illustrated in Fig. 2, or special work-holding fixtures as required. The spindles are driven by spur gearing and each spindle gear is mounted between adjustable friction surfaces which serve as a safety device. Means for obtaining widely variable independent selective speeds for work-carrying spindles are provided at each station. Transformer or change gears located at the head of the column provide the means for speed changes. In the indexing operation the driving pinions at the column stations and the work-spindle gears in the carrier are automatically disengaged, and after the completion of the indexing operation are again engaged. The carrier is rotated from station to station by power. The indexing mechanism is driven at a constant speed by a connection to the main driving shaft of the machine. This mechanism (a modification of the Geneva motion) actuates the carrier from station to station without jar, providing the necessary acceleration and retardation to advance the carrier and bring it to rest. Continued accuracy in the registry of the carrier and spindles with the tool stations is absolutely essential. Of equal importance is the ability to correct inaccuracy, should it arise, in any one of the registry positions, without affecting the others. This object is attained as follows: Each registry pin is tightly fitted to the carrier, one serving for each work spindle. The opposing master pin, located in the column, is actuated by a cam on the controlling shaft. The registry pins are milled to give an inclined contact face, those in the carrier forming a wedge, while the master pin presents a mating jaw. A slot milled in the master pin provides a limited amount of spring opening and, as it is forced into engagement with the opposing wedge, the freedom required for its sliding fit in the column is eliminated, thus insuring accuracy in registry.

The carrier binder, mounted in the column, is actuated in conjunction with the master registry pin, and serves not only to bind the carrier in its indexed position, but also to take up such freedom in the bearing of the carrier on the column as is required in indexing the carrier from station to station. The carrier is brought to rest by the indexing device before the registry pins

are engaged with the purpose of eliminating shock and jar. The tool-carrying heads are mounted on the faces of the column at the five work stations. These heads are entirely independent in direction, amount and rate of movement, and consist of a main slide gibbed to the column, on which is mounted a secondary slide to which the tool combination may be secured. The secondary slide may be swiveled to 90 deg. either way of the work axis and rigidly located at any angle. For straight boring, reaming and turning, the secondary slide is locked at zero and the entire head moves as a unit throughout the distance required to complete the operation, meets its stop and is returned. For taper boring, angular turning or facing at any angle with the work axis the secondary slide is set at the desired angle. The entire head is advanced to the work, the main slide brought to rest by a stop and locked in position. The motion is then taken up by the secondary slide which is fed the distance required, brought to rest by an adjustable stop and returned through its original path. The heads are rapidly advanced to the point where feed should begin, the feeds then engaged at the predetermined rate per revolution and at the completion of the feed movement are rapidly returned. The rate of advance and return is constant regardless of feed or spindle speed, but the point of change from rapid advance to feed is adjustable. The rate of feed at each station is determined by change gears shown at *D* in Fig. 4. Any head may be geared up to feed a determined thread pitch.

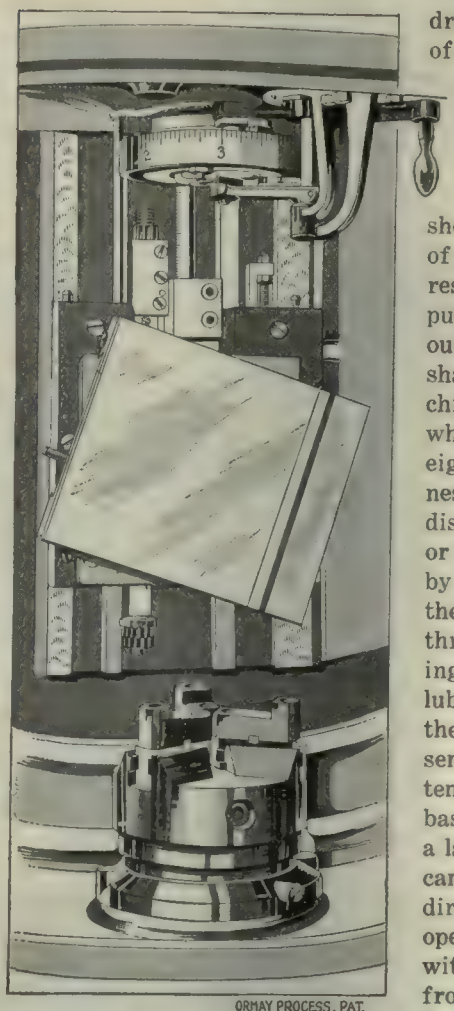


Fig. 2. View of one of the five working stations, showing close-up of compound tool slide

Each tool head having independent feed works has as well an independent manual control. At any point in its advance motion the feed may be disengaged and again engaged. This feature is intended to accomplish a saving in the time required for setting up a job. The main drive shaft revolves at a constant speed and is in motion so long as power is applied. The lubricating-oil circulating pump and drive shaft for the indexing mechanism directly geared thereto are therefore also in continuous motion at constant speed. The mechanism for rapid advance and return of the tool heads, independent from and yet a part of the feed works, is also directly connected with the main drive shaft and therefore driven at a constant speed irrespective of the speed of work spindles or rate of feed. The time element of all automatic motions is therefore constant and cannot be varied or adjusted by the operator. The lubrication of the Mult-Au-Matic shows careful planning. In the base of the machine, which forms a large reservoir, is located the circulating pump, which is directly and continuously driven from the main drive shaft. Forced to the top of the machine the oil passes through a filter which removes all impurities and foreign matter and insures its cleanliness. After filtration it is led to the distributing reservoir in the top plate or motor base, from which it is fed by gravity in large streams first to the feed works and thence down through the entire machine, all bearings and gears being under flooded lubrication. As an integral part of the machine and included as an essential element in its design is the system of chip and water guards. The base of the machine, as stated, forms a large reservoir for the cutting lubricant or coolant, the circulation pump, direct connected to the main drive and operable when required, is mounted within the base. Lubricant drawn from the reservoir is forced through ducts in the base and is delivered at the cutting tools by adjustable nozzles mounted on the chip-guard stanchions within which is an extension of the ducts in the base. The lubricant, after performing its function, is returned by channels in the carrier to the point of chip discharge and with the chips is delivered to a separating and settling tank located at the discharge chute, returning clean lubricant therefrom to the reservoir in the base.

Owing to the principle on which the Mult-Au-Matic operates, the total time for machining a piece on it is the time of the longest single operation plus the slight amount of time required for indexing. Fig. 5 shows a developed view and Fig. 6 the tooling diagram for a taper roller-bearing cup and gives the speeds and feeds for the various operations. Total machining times of 1 min. or less are not infrequent. The following are the principal dimensions and specifications of the 8-in. Mult-Au-Matic: Capacity, 8 in. in diameter by 6 in. in height; chuck, 10 in. in diameter, with 8-in. capacity; spindle

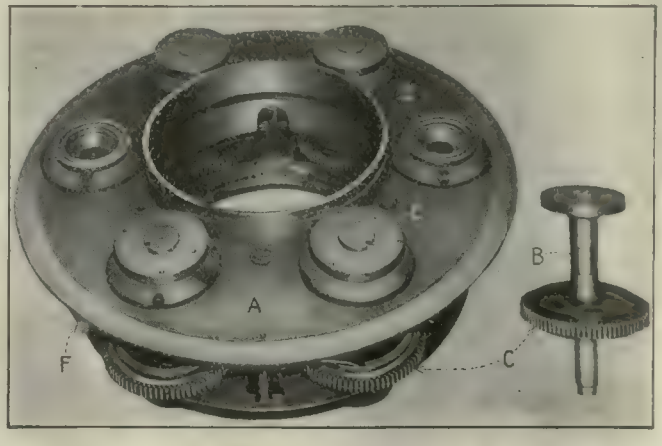


Fig. 3. Work-spindle carrier with four spindles assembled. The spindle B is driven by the gear C, which meshes with the pinion shown at C in the halftone, Fig. 1

head, 9¾ in. in diameter; spindle speeds (standard) 33, 42, 48, 66, 82, 100, 122, 150, 208, 233 and 300 r.p.m; movement of tool heads, 6 in. vertically, 3 in. horizontally or angularly; feed rates per revolution (standard), 0.0067, 0.0086, 0.0096, 0.0133, 0.0162, 0.02, 0.0244, 0.03 0.0415, 0.0467, 0.06 in.; main drive pulley, 14 x 4½ in., 760 r.p.m.; motor 10 hp., 1800 r.p.m.; projected floor space, machine only, 67 in. in diameter; chip container, 29 in. x 15 in.; height, without motor, 137 in.; net weight, 18,000 lb. One of the features intended to promote flexibility of setup and at the same time decrease the expense of tool equipment is the use of transverse and angular feeds. The incorporation of these features does away with the necessity of sweep cutters for facing. The total time for any piece machined on the Mult-Au-Matic is that required for the longest operation performed on any one head plus the slight time required to index the work-spindle carrier mechanism from station to station. This means that one particular working station is always the limiting station, and since each tool head at each station rises as soon as it has performed its work, this limiting station is determined at a glance and it is also very easily noticed how far behind the other heads the limiting station is in its performance. Thus the scheme of operation on this machine for maximum efficiency in connection with large lots is to devise ways and means to reduce the time taken by the limiting station at its work either by subdividing the cuts or revising the method of tool operation. One feature which goes a long way

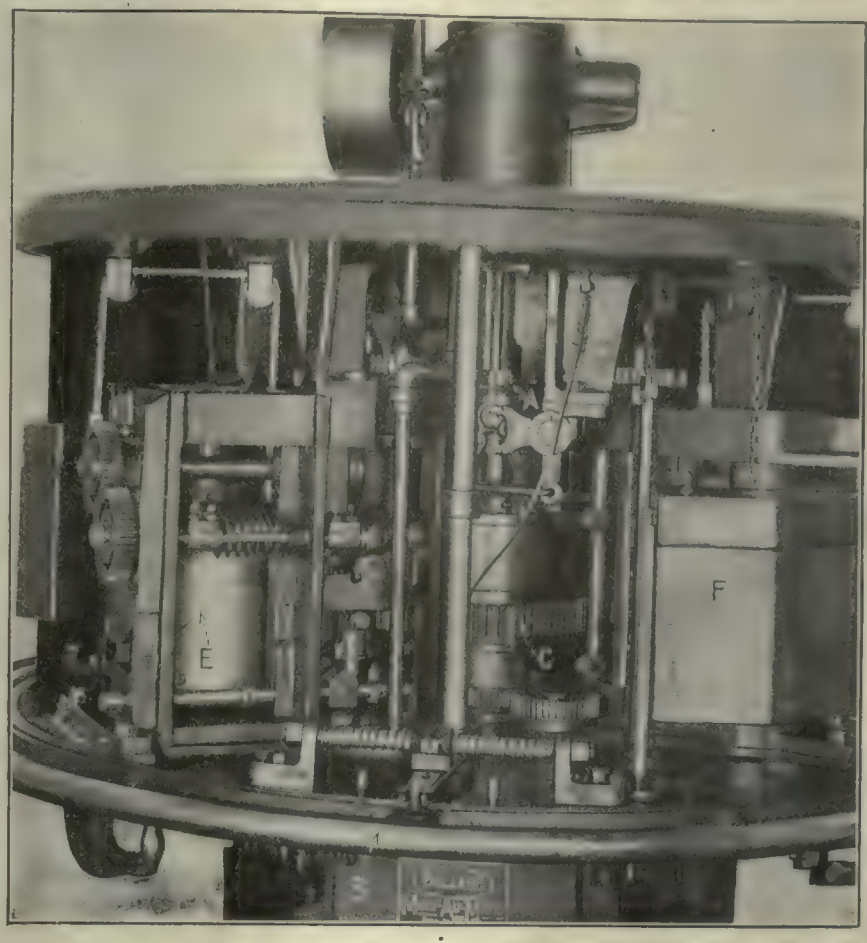


Fig. 4. Inside view of the "upper story" of the 8-in. Mult-Au-Matic with sheet-metal splash guards removed. A is the main drive shaft; B, the manual-control clutch ring; C, work-spindle drive; D, feed change gears; E, quick-return cam on feed head; F, counterweight on fifth station of the machine

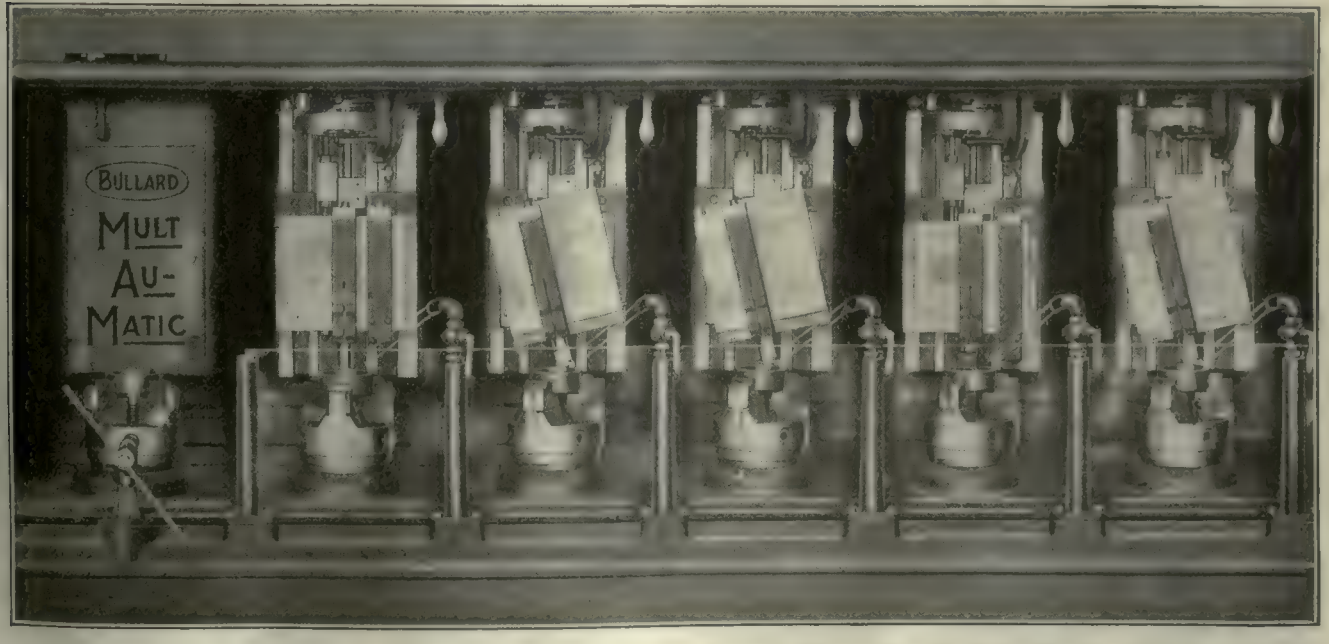


Fig. 5. Developed view of the loading station and five working stations, showing the Mult-Au-Matic tooled for machining a conical roller-bearing race

toward the elimination of lost time is the use of independent feeds and speeds for each station. It is an obvious fact that the rate of feed and speed best suited to a drill working in alloy steel is destructive to a reamer working in the same material. A shouldering or recessing tool is quickly ruined if fed at the same rate of feed used for a roughing cut, and if the feed of a roughing tool is reduced to accommodate that suitable for a parting tool its productive efficiency is of course correspondingly reduced.

Motor drive is provided for this machine when desired; in such cases the motor is mounted on the top of the feed works "umbrella," which is the name given to the top plate and which serves not only as a cover for the entire feed works but also as a means of securing them in a single unit.

Sequence and Interrelation of Functions of the 8-Inch Mult-Au-Matic

STARTING FUNCTIONS

1. Power is applied to the constant-speed main drive pulley which actuates, (a) the lubricating-oil circulating pump; (b) the coolant circulating pump; (c) the controller clutch ring within the column, through which all automatic functions are timed and actuated.

2. Main clutch is manually operated, applying power to work-spindle drive.

3. Safety lock at loading station is manually operated, releasing control drum.

OPERATING FUNCTIONS

4. Control drum advances and bell crank motion engages plunger with slot in constantly revolving controller clutch ring.

5. Secondary drive clutch automatically disengages, bringing work spindles to rest.

6. Carrier binder is released by cams on central control shaft and master registering pin is withdrawn.

7. The carrier is advanced one station by Geneva motion, the driving pinions and work spindle gears being automatically disengaged and reëngaged at the new station.

8. The master registering pin is engaged by cams on central control shaft, the carrier binder operates and indexing is completed.

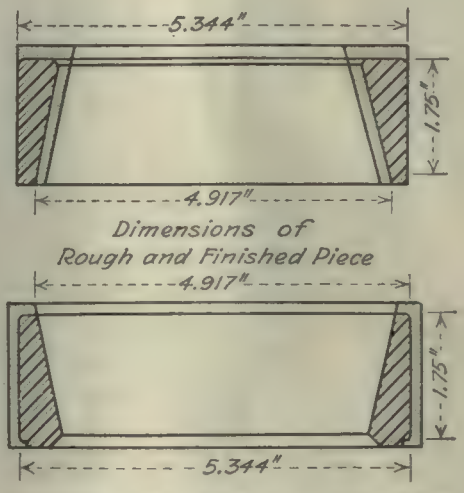
9. The secondary drive clutch engages, applying power to the work spindles and feed works and simultaneously engaging the rapid advance motion of feed works. (The upper control drum is provided with cams for both spindle drive and feed works engagement.) Control drums and shaft are now at rest.

(Functions 4 to 9 inclusive take place during one revolution of the feed drum and are performed in a total time of 3 seconds.)

10. Tool heads are rapidly advanced to a point selected for cutting feed to begin. (This is adjustable for each head.)

11. Rapid advance is disengaged and feed is engaged by trip dog adjustably mounted on feed-control ring, which is directly driven by feed drum on each head.

12. Each tool head feeds (either vertically, horizontally or in any selected angular direction) to the point of positive stop located on face of column and adjusted as required.



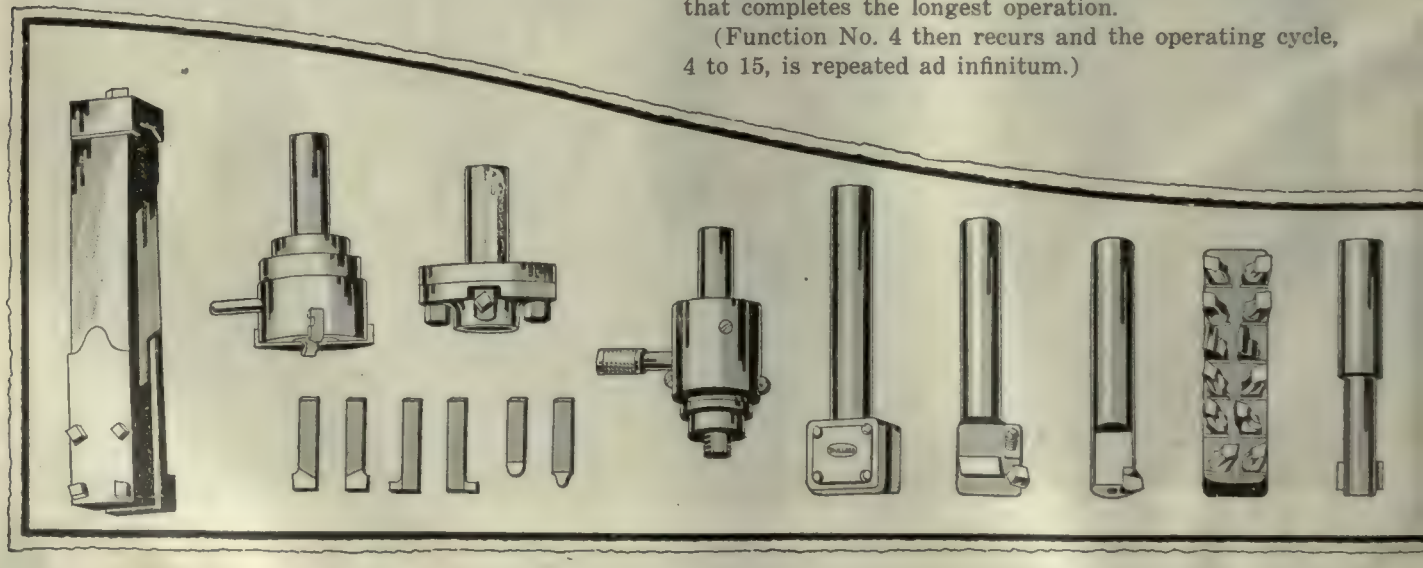
Tapered roller bearing race, finished complete ready for hardening and grinding in 112 seconds

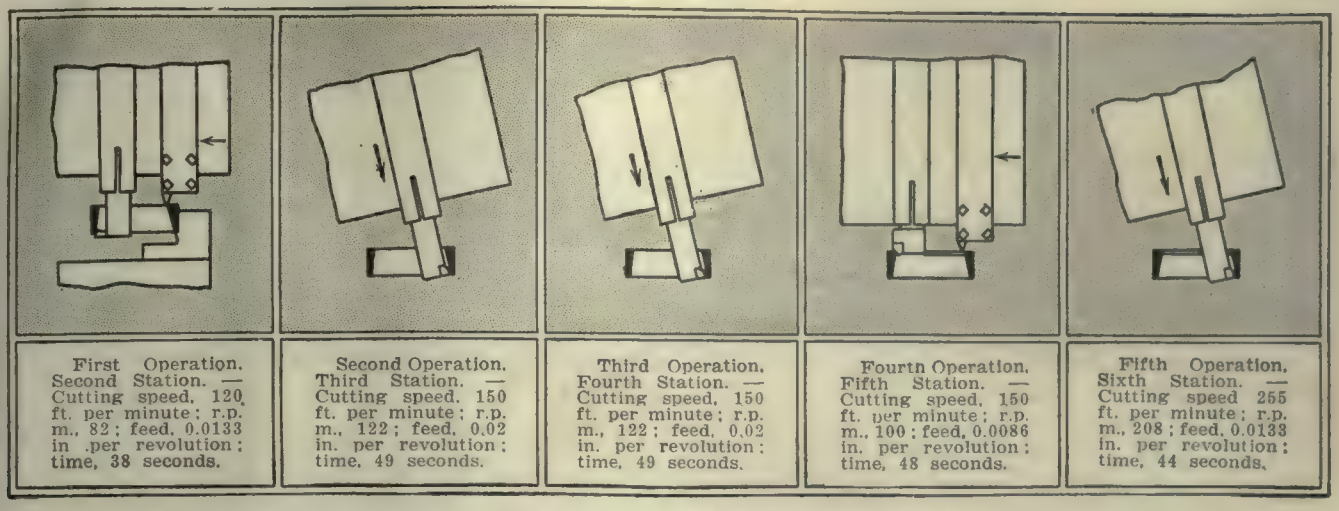
13. Tool head is rapidly returned to its initial position by a quick cam on feed drum.

14. Control-drum lock (one for each tool head) is released by dog on feed control drum, which also disengages the feed clutch.

15. Control drum is released by return of the head that completes the longest operation.

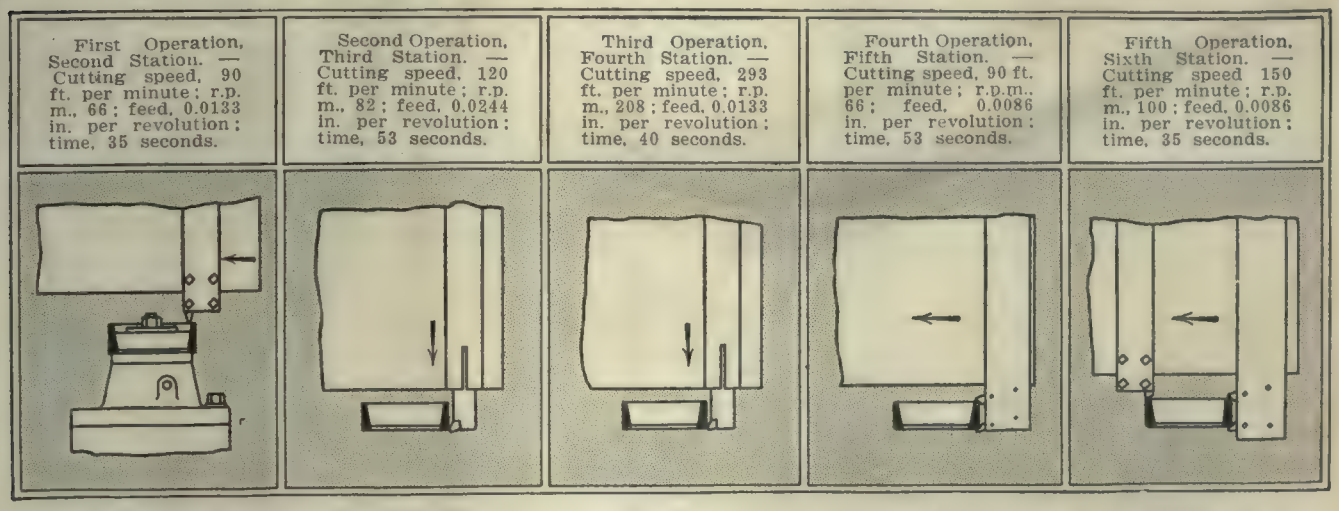
(Function No. 4 then recurs and the operating cycle, 4 to 15, is repeated ad infinitum.)





First Operation. Second Station. — Cutting speed, 120 ft. per minute; r.p.m., 82; feed, 0.0133 in. per revolution; time, 38 seconds.	Second Operation. Third Station. — Cutting speed, 150 ft. per minute; r.p.m., 122; feed, 0.02 in. per revolution; time, 49 seconds.	Third Operation. Fourth Station. — Cutting speed, 150 ft. per minute; r.p.m., 122; feed, 0.02 in. per revolution; time, 49 seconds.	Fourth Operation. Fifth Station. — Cutting speed, 150 ft. per minute; r.p.m., 100; feed, 0.0086 in. per revolution; time, 48 seconds.	Fifth Operation. Sixth Station. — Cutting speed 255 ft. per minute; r.p.m., 208; feed, 0.0133 in. per revolution; time, 44 seconds.

First chucking: Longest operation, 49 sec., index, 3 sec.; advance of tool heads 2 sec. Total, 54 seconds.

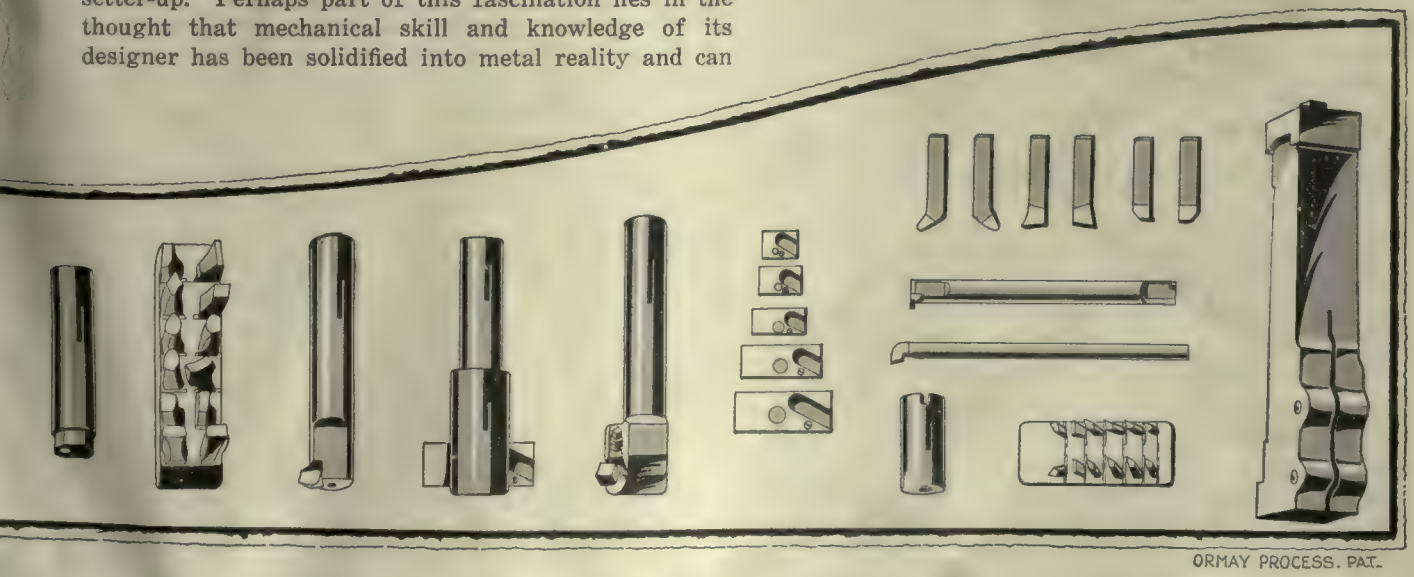


First Operation. Second Station. — Cutting speed, 90 ft. per minute; r.p.m., 66; feed, 0.0133 in. per revolution; time, 35 seconds.	Second Operation. Third Station. — Cutting speed, 120 ft. per minute; r.p.m., 82; feed, 0.0244 in. per revolution; time, 53 seconds.	Third Operation. Fourth Station. — Cutting speed, 293 ft. per minute; r.p.m., 208; feed, 0.0133 in. per revolution; time, 40 seconds.	Fourth Operation. Fifth Station. — Cutting speed, 90 ft. per minute; r.p.m., 66; feed, 0.0086 in. per revolution; time, 53 seconds.	Fifth Operation. Sixth Station. — Cutting speed 150 ft. per minute; r.p.m., 100; feed, 0.0086 in. per revolution; time, 35 seconds.

Second chucking: Longest operation, 53 sec.; index, 3 sec.; advance of tool heads, 2 sec. Total time, 58 seconds.

Fig. 6. Chart of tooling operations. Upper diagram shows operations on first chucking of tapered roller bearing race. Lower diagram shows second chucking

There is something fascinating about the operation of any automatic machine. Perhaps it lies in the demonstration of untiring faithfulness with which such a machine carries out the original instructions of its setter-up. Perhaps part of this fascination lies in the thought that mechanical skill and knowledge of its designer has been solidified into metal reality and can be put to work untiringly perpetuating this skill and knowledge. It is interesting to speculate how far automaticity can go, and this machine of the Bullards has demonstrated that it can go a long way.



ORMAY PROCESS. PAT.

An Accumulative Graphic Record

By J. B. CONWAY

SEVERAL years ago I was industrial manager of a well-known gas-engine manufacturer, and after certain changes in the method of production had been made I found it necessary to devise a chart for recording the weekly output of certain departments. Prior to this a daily record was maintained, which was totaled at the end of the week. While this served its purpose in a measure it did not portray a vivid record for comparison, and after several weeks of continuous entries the executives were compelled to work over a maze of figures in order to compare one week with the next.

To grasp quickly the essential facts the chart here reproduced was used with the exception of the several colors employed in the original. Along the left-hand margin is given in figures the required monthly output of units, which was 3300 in this instance. Each square represents 100 units, reading from bottom to top. The weekly periods are shown at the top of the chart. Heavy vertical lines divide the weekly periods into periods of four weeks.

The Weekly Output

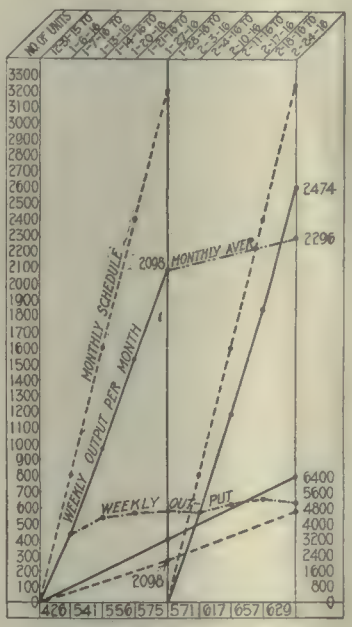
The monthly schedule is also shown by a "curve" representing the normal weekly output expected. The actual weekly output is shown for the month by the line beneath. It will be readily seen how any deviation from the normal-output curve is brought into prominence when compared in this manner. In the first month the output was only 2098, or a decrease of 1102 from the normal, which was 3200. To the foreman or superintendent responsible for getting production the figures 3200, 2098 and 1102 do not have the same significance that the gap shown on the chart between the two curves has, and they are not so readily comprehended.

Across the lower margin is entered in figures the actual number of units manufactured per week, the first week producing 426, the second 541, and so on. These figures not only amplify but verify the points on the curve for the weekly output. The curve marked "Weekly Output" is for convenience in comparing one week's output with another, and was found useful as an object lesson in talking over the results of the past week with the foremen who were more able to appreciate the fluctuations in the curve than the difference in the totals. This statement in no way casts reflections on the ability or intelligence of the foremen. If the reader has any misgivings he should himself make a few comparisons numerically.

The two curves at the bottom of the chart indicate the expected output per week for a period of two months and the actual output per week compared graphically. The scale for these curves is shown at the right-hand side of the chart extending from 0 to 6400, each square representing 800 units. Attention is called to the use of figures again to verify the points on the curve, which for the first month are 2098 and for the second month 4572, the latter being the accumulated total, or the sum of the first and second month's output. The first figure checks that represented by the curve showing the actual output per month and the latter is the sum of 2098 and 2474.

It will be noticed that a considerable gain was made during the second month over that preceding and is readily recognized by the wide divergence of the two curves for the first month and the greater parallelism of the two for the second month. This is seen at a glance in making a comparison, even though no figures were available.

The curve starting with the end of the first month and making its path across the chart is the "Monthly Average," which is the sum of the output for the two months divided by the number of months. This, like the weekly output curve, serves as a comparison of one month's work with another. When carried for only two months as shown the curve does not show up to its best advantage, but it must be borne in mind that this entire chart carried a record for a six months' output and at the end of 12 months the two six-months' charts were fastened together, thereby giving a complete and comprehensive record for the year. In this respect the average monthly curve was an important factor of the chart. The original chart was made on quadrille paper with about five divisions to the inch. The monthly schedule was shown in red drawing ink; the weekly output in green; the weekly output per week in orange and the monthly schedule for two months with the actual output for the same period by blue lines. The average monthly curve was represented by an alternate green and orange dash. When operated in colors as described (or any other combination that may be desired) the chart has more individuality and presents a more attractive appearance.



GRAPHIC-RECORD CHART

The underlying principles of the chart may be employed to advantage for recording the units of production of almost any article, the only changes necessary being the dates and the substitution of the name of the article, if desired, for that of the "units" on the left, and the quantity required.

The chart is so arranged that the busy executive may see at a glance the condition of his business by merely observing the curves, going into details later or at his convenience. Attention is also called to the "check" introduced and mentioned previously, as this is found to be of considerable assistance in guarding against wrong entries and consequent errors in the records.



I—Thermit Welding: Its History, Nature and Uses*

This article is the first of a series intended to cover the field of modern welding and cutting in a broader way than has been previously done. The articles will pay attention to the practical rather than the theoretical side. Apparatus and equipment will be described and detailed directions given for their practical use.

THE affinity of finely powdered aluminum for oxygen, sulphur, chlorine, etc., is such that it is utilized to effect a reduction of metals from their respective oxides, sulphides and chlorides. This was known for many years and is generally credited to Frederick Wohler. About 1894 Claude Vautin found that when aluminum in a finely divided state was mixed with such compounds and ignited, an exceedingly high temperature was developed by the rapid oxidation of the aluminum. Since fine aluminum will not burn at a temperature below that of molten cast iron Vautin and others first heated the mixtures in a crucible. The result was that the initial temperature was so high at the moment of ignition that the reaction was explosive.

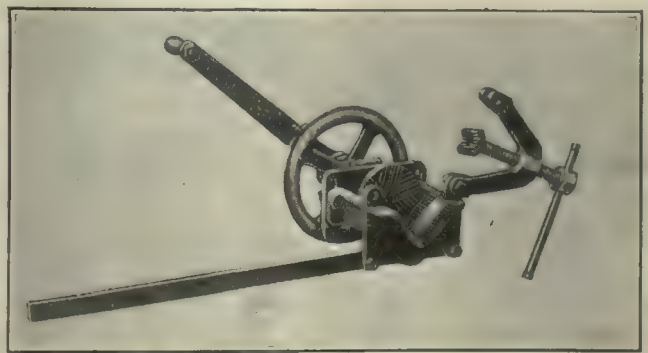


FIG. 1. PIPE-FACING MACHINE OPEN TO RECEIVE PIPE

Profiting by the experiments already made Dr. Hans Goldschmidt of Essen, Germany, discovered a method of igniting a cold mixture of fine aluminum and iron oxide by means of a barium-peroxide fuse which was set off by means of a storm match. His first discovery was made about 1895 or 1896 while trying to reduce chromium and manganese. Later magnesium powder or ribbon was used for ignition purposes, being set off in the same way. A mixture of a few pounds of the powders was found to burn quickly and the resulting temperature was very high. The original patent for the reduction of metals, upon which all his following patents were founded, was granted March 16, 1897, the serial number being 615,700. Over 40 have been issued since and more are pending. About 1898 Dr. Goldschmidt made use of his reduction method to weld two pieces of iron together. From this time on the experiments developed and difficulties were overcome until a process was evolved for the commercial use of the reaction for welding and other purposes. The process so developed was called the Thermit process. The company handling the mixtures and apparatus was originally known as the Goldschmidt Thermit Co., but in 1918 the name was changed to the Metals and Thermit Corporation, New York.

The present Thermit reaction is $8Al + 3Fe_3O_4 = 9Fe + 4Al_2O_3$. Expressed in weights this is 217 parts aluminum plus 732 parts magnetite = 540 parts steel plus 409 parts slag, or approximately 3 parts of aluminum plus 10 parts of magnetite will produce on com-

*For the author's forthcoming book, "Modern Welding and Cutting." All rights reserved.

bustion 7 parts of steel. The steel produced by the reaction represents about one-half of the original Thermit by weight and one-third by volume.

Commercial Thermit is a mixture of finely divided aluminum and less finely divided magnetic iron scale. The aluminum is about like granulated sugar and the scale like coarse sand, the ratio by weight being approximately three of iron scale to one of aluminum.

According to the company just mentioned the average analysis of Thermit steel is:

	Per Cent.
Carbon	0.05 to 0.10
Manganese	0.08 to 0.10
Silicon	0.09 to 0.20
Sulphur	0.03 to 0.04
Phosphorus	0.04 to 0.05
Aluminum	0.07 to 0.18

Of course to produce a steel of the foregoing composition the aluminum and iron scale must be very pure. For the mixture, scale from Bessemer or open-hearth steel would probably come close to meeting commercial demands. The average tensile strength of a Thermit weld of the foregoing average composition is about 61,000 lb. per square inch. This can be varied by adding other elements. The elastic limit is slightly more than half this figure, or an average of about 34,000 pounds.

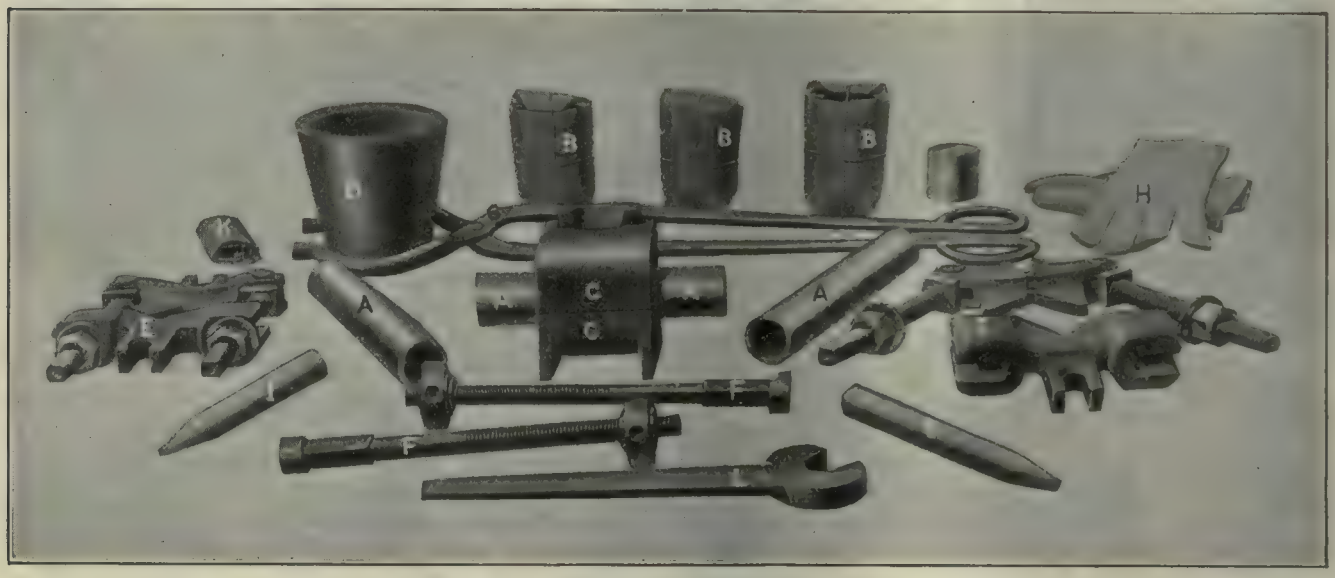


FIG. 2 MATERIALS FOR WELDING PIPE

Temperature and Characteristics

While the temperature of the reaction is too high to be measured by a pyrometer it can be calculated quite accurately theoretically and Prof. Joseph W. Richards in his book "Metallurgical Calculations," gives it as 2694 deg. C., which is equal to 4881 deg. F. M. Féry, using his radiation pyrometer, found the temperature of the stream of steel as it issued from the crucible to be 2300 deg. C. (4172 F.). Making allowance for the chilling effect of the crucible this is probably about right. Considering the melting point of steel to be about 1350 deg. C. Thermit steel is nearly twice as hot.

There is absolutely nothing explosive about the present Thermit reaction and no danger is incurred in storing it or handling the material owing to the fact that it takes over 1300 deg. C. of heat to ignite it. It is for this reason that a special ignition powder must be used for starting the reaction. The ignition powder, however, must be kept away from heat, and in particular the box containing it should be tightly closed before the Thermit reaction takes place, so as to prevent any spark from dropping into it. All Thermit materials must be kept dry, for Thermit that has once become wet cannot be restored to its original condition by drying.

There are two different methods of using Thermit for welding purposes. For convenience these methods may be designated (1) the plastic method and (2) the fusion method. The first is used principally for welding together the ends of pipes. Here the pipe ends are first machined off so that they will fit snugly together. A mold is then placed around the ends, and Thermit is poured into the mold from a crucible. The Thermit mixture is first placed in the crucible and ignited by means of a small amount of ignition powder set off by a match. After the reaction the molten content of the crucible is poured into the mold and around the pipe ends. By pouring from the top of the crucible the slag enters the mold first and surrounds and coats the pipe ends and the inside of the mold and thus prevents the pipe ends from being burned through. This allows the Thermit to heat the pipe ends to a welding heat, after which they are forced together, causing a slightly upset welded joint.

The second, or fusion method, is the more commonly used. In using this method a mold is also used to surround the parts to be welded, but the parts must be preheated—usually to a red heat—in order to prevent the Thermit being chilled by contact with the colder metal and causing an imperfect weld. The Thermit to be used is placed in a cone-shaped crucible so made that the melted Thermit steel may be run out of the bottom into the mold, thus preventing the slag from getting into the mold and spoiling the perfect fusion of the parts. In this method it is also necessary to have the parts to be welded some distance apart in order to give the Thermit steel an opportunity to properly fuse the surfaces desired and produce a perfect union. The distance the parts are separated depends on the size and nature of the pieces and whether the weld is to be made on two separate pieces or is merely to weld a cracked place.

This last method is especially adapted for welding

together large heavy parts of considerable section, on account of the Thermit steel being produced and introduced into the weld quickly in bulk and thereby resulting in but one contraction throughout the entire mass of metal. Provision to compensate for this contraction can always be made, so that when the metal cools there will exist practically no strains. Welds requiring as high as 4000 lb. or more of Thermit have been completed successfully. A big advantage of the process is that huge welds may often be made without dismantling the machine or structure, thus saving an enormous amount of labor and time in many cases.

Neither method, however, is commercially or practically adapted to welding very small sections or long seams in thin sections, which work can be better accomplished by the oxyacetylene or electric welding processes. It should, however, be used for welding shafts no matter how small when the break is in a journal. It is interesting to note in this connection that neither the oxyacetylene nor the electric welding process has proved practical for welding trolley rails together. All so-called welded joints by those methods consist merely in welding plates to the rails and the joint therefore is never really eliminated. The Thermit process, on the other hand, has proved extremely efficient and economical for this work, and thousands of Thermit-welded rail joints have been in service for years in all parts of the world.

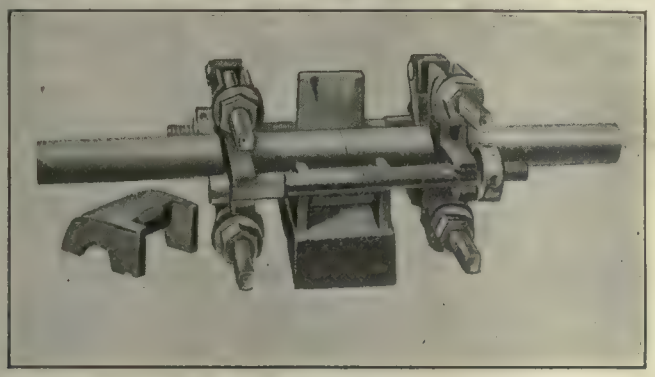


FIG. 3. PIPE HELD IN CLAMPS, MOLD PARTLY ASSEMBLED

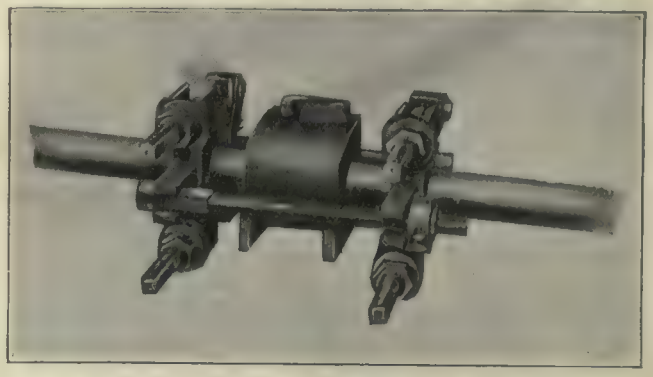


FIG. 4. MOLD FULLY ASSEMBLED FOR WELD

Kinds of Thermit Commonly Used

For commercial welding purposes there are now produced three varieties of Thermit known as:

Plain Thermit.

Railroad Thermit.

Cast-iron Thermit.

Plain Thermit is simply a mixture of aluminum and iron oxide, as previously stated, and is used in making pipe welds and welding necks on mill rolls and pinions where the Thermit is merely used as a heating agent to bring the pipe ends up to a welding temperature and the roll and pinion ends to a molten state.

Railroad Thermit is plain Thermit with the addition of ⅝ per cent. nickel, 1 per cent. manganese and 15 per cent mild-steel punchings. This grade is used in connection with steel welds.

Cast-iron Thermit is plain Thermit with the addition of 3 per cent. ferrosilicon and 20 per cent. mild-steel punchings, and is used, as its name implies, for welding cast-iron parts.

Taking up now the various uses of the three varieties of commercial Thermit we will first describe in detail the butt welding of pipe. This process is especially adapted to welding joints in the pipes in refrigerating plants and for high-pressure steam, hydraulic or compressed-air pipe lines. It is also applicable to the welding of superheater units for locomotives. The joints so welded are permanent, nonleakable and never require attention, and the original cost compares very favorably with that of the special mechanical joints of any type used for refrigerating or high-pressure purposes. All of the apparatus necessary for the work is easily portable, so that the work may be done anywhere.

In preparing pipe for butt welding it is first necessary to insure that the ends are cut square. If the pipe is threaded the threaded portions will have to be cut off. While the ends of the pipe may of course be squared by various mechanical means the company handling Thermit makes a small portable machine for the purpose, which is much more satisfactory to use than anything else. This device is shown in Fig. 1. The operation of this machine is so obvious to any mechanic that further explanation of its operation and method of use would be needless, except to say that the crank handle by which the cutter is rotated has a ratchet on it so that the cutter may be worked in close quarters.

If after the pipe ends have been faced off they should become tarnished they should be brightened with clean, fine emery cloth or a flat carborundum stone, but in no case should the faced ends be touched with a file or the fingers.

When the pipe ends have been properly faced off, the pipe is lined up so that the faced ends will butt squarely together and then the mold is put in place. In welding coils or bends suitable apparatus should be rigged up to keep the pipe in alignment. Where the pipes are close together in coils it is usually possible to spring out the pipe to be welded so as to permit the adjustment of the mold and clamps.

A Pipe-Welding Outfit

A complete outfit for welding pipe, less the facing machine, is shown in Fig. 2. In this cut, pieces of pipe are shown at *A;* welding portions of Thermit at *B;* cast-iron mold at *C;* at *D* is the magnesia-lined crucible; *E*, clamps; *F*, turnbuckles for clamps; *G*, crucible tongs; *H*, gloves; *I*, pins for tightening turnbuckle nuts; *J*, ignition powder; *K*, dark glasses, and *L*, wrench for tightening nuts of clamps. In order to make the procedure clearer a pipe-mold and clamp unit is shown in Fig. 3. Here the pipe is shown securely clamped in place

with the ends butting together. When putting this apparatus in place the clamps are first adjusted at an even distance from the ends of the pipe and securely clamped. The two tension bolts are then adjusted so as to bring an even bearing all around on the pipe ends,

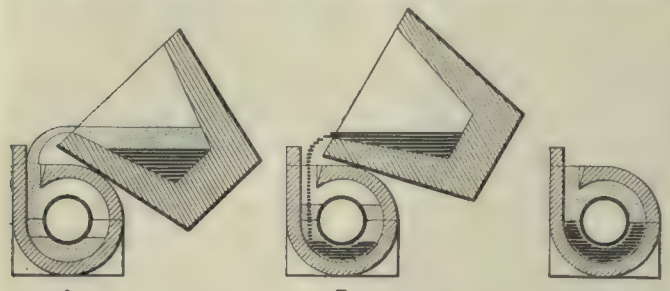


FIG. 5. POURING SLAG AND STEEL INTO THE MOLD

but care must be taken not to put such a tension on the pipe that it will buckle when heated. Just enough tension to hold the ends securely is all that is needed. It will be seen that while a set of clamps may be used for a number of sizes of pipe a mold can only be used for the size for which it was made.

How the Mold Is Used

The lower part of the mold is shown in place, but the top part of the mold is shown at the left ready to be put on. The slightly beveled recesses in the top and bottom parts of the mold are for the pouring gate. Before putting the top part of the mold in place care must be taken to see that the lower part is blocked up or held so as to be in close contact with the pipe. This may be done by means of wedges, earth or any other means at hand that will stay in place during the process. With the top part of the mold in place, as shown in Fig. 4, the operator next prepares the Thermit for pouring. This is done by placing the crucible tongs on the ground convenient to the mold and then setting the crucible in the jaws of the tongs. It is very important that the crucible be thoroughly dried before using, and if it is a new crucible it is advisable to burn a pound or so of Thermit in it and then pour the contents out on dry sand. This is the quickest and most convenient way of drying a crucible. The operator should have the handles of the tongs placed toward him convenient for pouring the metal when the reaction is completed. If double tongs are used, as sometimes is necessary with large crucibles, the helper should stand opposite the operator in readiness to help pick up the crucible at the proper time. Blue or special glasses should be worn to protect the eyes from the glare of the reaction.

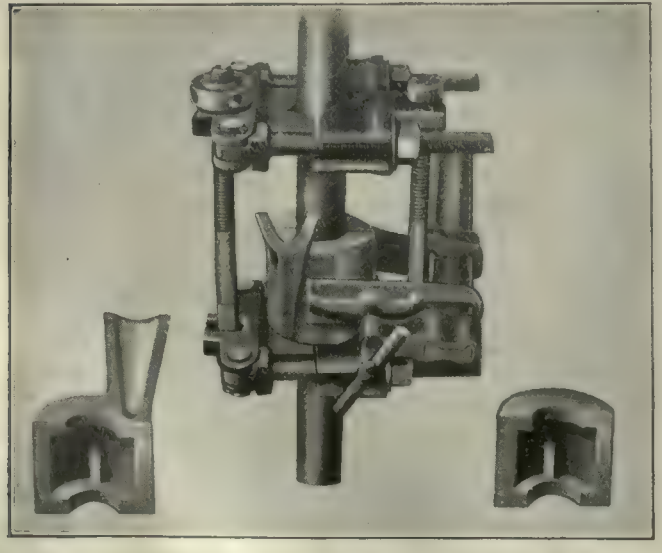


FIG. 6. MOLD FOR WELDING VERTICAL PIPE

As each size of pipe must have its own size of mold so must the portions of Thermit be measured out in order to have the proper amount for a given size of pipe. This is taken care of by the concern making the Thermit, which puts it into bags, each containing a certain amount of Thermit suitable for a given welding job. For all ordinary jobs this scheme makes it unnecessary for the operator to do any special calculating in order to know how much to use in order to do the work and not waste material.

Placing and Igniting the Thermit

With a bag containing the proper amount of Thermit the operator pours about one-half into the crucible and the rest in a hand scoop for feeding into the crucible during the reaction. Having therefore one part of this portion in the crucible and the remainder in a scoop he places a half spoonful of ignition powder (barium peroxide) in one spot on top of the Thermit in the crucible. This is set off by means of a parlor match, which is applied immediately after striking and before the head is burned off, to the ignition powder itself or else to another match head set into the ignition powder.

The ignition of the powder in turn starts the Thermit reaction. After the reaction is well started the operator adds the rest of the Thermit from the scoop, trying to keep about one-half of the surface of the molten material covered with unburned Thermit, and pouring in a steady stream until all the Thermit is in the crucible. He should then immediately grasp the crucible with the tongs, obtaining a firm grip, and pour the contents into the mold, the slag entering first. The pour should be made as soon as the Thermit has reacted and the slag has come to the top. The crucible and tongs are then set aside and a short time is allowed to elapse for the Thermit mass to bring the ends of the pipe to a welding heat. Shortly after pouring the operator should turn the tension nuts enough to keep a constant pressure to determine when the pipe begins to soften. He should then wait for 10 to 20 sec., depending on the weight of pipe, and then force the ends together by means of four quarter turns (one complete revolution) of the nuts. It usually takes about 10 sec. from the time the pipe softens for it to reach a welding heat, or from 45 sec. to 1½ min. from the time of pouring.

Removing the Mold

After the clamps have been drawn up, the mold should be allowed to remain in place for 3 or 4 min. longer, after which the clamps can be removed and the cast-iron mold knocked away from the pipe by means of a hammer. The Thermit steel and slag will come away from the pipe with the mold and can be knocked out of the mold afterward.

Care must be taken in every case that a complete welding portion be used, as only the full measure of Thermit will give a good weld.

It is advisable where joints are being welded in quan-

tities to have several molds so as not to use molds continuously while hot. It is also advantageous to allow the mold with its contents of steel and slag to remain on the pipe for a considerable time before removing. If they can be left 10 to 15 min. it is all the better.

It has been found in practice that two men, one facing the pipe with the pipe-facing machine and the other doing the welding, can complete a weld inside of 10 min. and that it is a simple matter for them to make from 40 to 50 finished pipe welds a day.

It must be understood from the foregoing that the slag that forms on top of the molten material in the crucible is poured into the mold first. As soon as this slag strikes the cold pipe and inner surface of the mold it forms a protective coating which prevents the superheated liquid steel which flows in after it from coming in direct contact with either the pipe or the mold. The heat of the entire mass, however, serves to bring the pipe ends to the desired temperature. The method of pouring will be understood from Fig. 5. In this cut *A* shows the slag flowing into the mold and coating the pipe and inside of the mold; *B* shows the slag in the mold and the steel following, displacing the slag in the bottom part of the mold, and *C* shows the mold about half full of steel, but a film of slag separating it from the pipe and mold.

The foregoing instructions apply to welding pipe in a horizontal position. Vertical pipe, however, can be welded in essentially the same manner, but a special mold is required. This mold is constructed in such a way as to divide the Thermit-steel collar into two parts, so that it may be readily removed from the pipe on the completion of the weld. The mold also has a different type of pouring gate, as will be seen in Fig. 6.

The same method used for welding pipe may be used for welding bars or rods of mild steel or wrought iron of various sizes and shapes, but this method is not applicable to welding cast iron or high-carbon steel. For the latter work another method must be used.

It may be of interest to compare the cost of a Thermit-welded joint with that of mechanically coupled pipe, and for this the reader is referred to Table I, which was taken from *Reactions*, which is the house organ of the Metal and Thermit Corporation. While accurate determination of the cost that will cover general practice is always difficult there is no doubt about the superiority from every standpoint of the Thermit-welded joint where a solid, leak-proof and especially strong coupling is wanted. For ammonia-pipe or similar installations the solid joint is one that every real engineer will recommend.

As to the comparative strength of a Thermit-welded pipe joint the following is taken from a report made by Prof. Frederick L. Pryor of Stevens Institute July 10, 1914:

"Two classes of pipe, standard weight and extra heavy, were tested, the sizes selected for each type being 1 in. and 1¼ in. Six samples each of 1-in. standard, 1-in. extra heavy, 1¼-in. standard and 1¼-in. extra heavy were selected for test, three being used for the bursting test and three for the tensile test. One specimen was left in its original form and two specimens were cut in half and joined together, one with a Thermit weld and one with standard-threaded couplings. One specimen of each size and type was subjected to tensile and bursting tests. Standard-weight couplings were used for standard pipe and extra heavy couplings for extra heavy pipe, and the welded specimens were put together by your process. The thickness of the material at the weld was afterward determined and found to be about 0.02 in. more than the thickness of the pipe for the 1-in. specimens, and about 0.075 in. more than the thickness of the pipe for the 1¼-in. specimens. A number of pieces of pipe were measured to check the thickness with the accepted standard and each specimen was within the tolerance factor.

"The tension tests were made in the usual manner, except that a plug was inserted in each end of the pipe in order to assist the gripping action in the machine.

"The bursting test was made by pumping oil into the pipe under pressure, the actual pressure to force the plug into the cylinder being determined by the dimensions of the pressure plug and the weight on the scale beam.

"In the tension tests all the pipes joined by couplings ruptured in the root of the thread at the coupling, and the welded samples ruptured away from the weld with one exception.

"In the bursting tests all samples, including those put together by couplings and welds, ruptured in the seam of pipe. The location of the ruptures for both the tension and bursting tests are noted in Table II."

Professor Pryor also at about the same time made some vibratory tests. The pipe selected was 1¼-in. extra heavy, and each test piece was composed of 6-ft. lengths joined together by the coupling or weld. The

TABLE I.—COMPARATIVE COSTS OF MECHANICAL AND THERMIT JOINTS, TAKEN FROM "REACTIONS" FOR THE FIRST QUARTER OF 1918, WITH THERMIT FIGURED AT 35 CENTS PER POUND

Size of Pipe, Inches	Average Net Cost Square Arm Flanges with Bolts and Gaskets	Average Net Price Installing and Sweating on Pipe	Total Cost of Installation	Cost of Materials for Thermit Weld	Labor per Joint One Man at 30c per Hour	Total Cost Thermit Weld per Joint
½	$1 01	$0 18	$1.19	$0 24	$0 10	$0.34
1	1 13	0 18	1.31	0 44	0 10	0.54
1¼	1 45	0 24	1.69	0 65	0 10	0.75
1½	1 51	0 30	1.81	0 80	0 10	0.90
2	1 67	0 42	2.09	0 95	0 10	1.05
2½	3 15	0 60	3.75	1 44	0 125	1.57
3	4 16	0 90	5.06	2 33	0 15	2.48
3½	4 47	1 20	5.67	3 06	0 15	3.21
4	5 35	1 20	6.55	4 60	0 175	4.78

The above costs for mechanical joints are based on standard list prices less a 37 per cent. discount.

Thermit welds were made in the presence of Professor Pryor by a representative of the Thermit company and were regular standard Thermit joints. These 12-ft. pieces with a joint in the center were subjected to a vibratory motion, the pipe depressed and raised 2 in. below and above the center line. The test pipe was filled with water under 22 lb. pressure in order to show the first failure of the material. Two tests were made of the pipe joined with extra heavy screwed coupling and one test of the welded joint pipe. The reason only one test was made on the Thermit-welded pipe was that the number of deflections on it was about 250 times the deflections made on the screwed coupling, with no sign of any deleterious effect. Both the screwed-joint specimens broke just outside the coupling in the root of the thread under 6160 and 3430 vibrations respectively. The Thermit specimen was vibrated 1,566,340 times, after which it was removed from the test and at the time no injury was apparent. The speed of these vibrations was about 225 vibrations per minute.

TABLE II.—RESULTS OF TENSION AND BURSTING TESTS ON SCREW-COUPLED AND THERMIT-WELDED PIPE JOINTS

	DIMENSIONS IN INCHES		
	Outside Diameter	Inside Diameter	Thickness
1″ standard	1.315	1.049	.133
1¼″ standard	1.660	1.380	.140
1″ extra heavy	1.315	.951	.182
1¼″ extra heavy	1.660	1.272	.194

Character of Pipe	Yield Point, (Actual), Lbs.	Ultimate Tensile Strength, (Actual), Lbs.	Approximate Location of Rupture	Bursting Pressure, Lbs. Sq. In.	Approximate Location of Rupture
1″ Standard					
Straight	18,000	27,900	Between grips	11,580	Center of pipe
Coupling	17,250	20,320	Root of thread at coupling	9,260	6″ from coupling
Welded	16,500	26,130	2½″ from weld	10,560	4″ from weld
1″ Extra Heavy					
Straight	19,200	34,730	Between grips	13,510	2″ from end of pipe
Coupling	.....	18,770	Root of thread at coupling	13,310	3″ from end of pipe
Welded	23,000	34,970	8″ from weld	14,220	2″ from end of pipe
1¼″ Standard					
Straight	22,300	37,670	Between grips	9,440	7″ from end of pipe
Coupling	21,380	28,500	Root of thread at coupling	8,050	7″ from end of pipe
Welded	20,930	36,020	At weld	8,460	1½″ from end of pipe
1¼″ Extra Heavy					
Straight	29,380	50,620	Between grips	12,900	1½″ from end of pipe
Coupling	29,100	29,100	Root of thread at coupling	12,770	2″ from end of pipe
Welded	27,800	50,980	6″ from weld	11,490	1″ from end of pipe

Draftsman or Engineer?

By E. W. Weaver

Mechanical drawing is the written language of engineering and is directly analogous to the written-word language. It might be possible for a man to be a real engineer without being able to read or write the language, just as a person might be an author without being able to read or write.

There are varying degrees of proficiency in the use of language. To adhere to the comparison: (1) The beginner learns to read and write. (2) Later stenography may be taken up, learning to take down the expressions of another and type them out in presentable manner. (3) In case special ability is shown, the stenographer may be trusted to frame the general form and expression of the letter, but the general intent is settled by another. (4) Next comes the ability to think thoughts that are worth writing down. (5) It is not absolutely necessary for the individual to pass through all of the preceding stages in order to arrive at the fourth; a few exceptional ones may skip them all and land themselves successfully in this latter class, but the chances are very much against such an accomplishment, and as a matter of fact it is quite as unusual to find a really competent engineer who cannot read and write the language of his profession as it is to find a good author who is unfamiliar with English. (6) The ability to convince someone who has need of his services that the thoughts and ideas evolved are worth setting forth on paper and paying for either in money, publicity or other valuable perquisites. In engineering work there is such a gradual shading off in degree of skill, knowledge and accomplishment that it is practically impossible to draw a definite line of demarcation to denote where the draftsman class ends and that of the engineer begins. My own method of reaching this decision would be to place in the engineer class all those individuals competent to make the proper decisions in matters involving practical matters of a technical nature and capable of rendering sound judgment thereon. It may be that the nature of the work is such that he works over the drawing board, just as some authors type their own essays. A good many employers and executives take a narrow view and do not give their men the recognition they deserve. They feel that if they call a man an engineer they ought to pay him more than they do when they call him a draftsman. On the other hand a good many engineers feel that it is beneath their dignity to operate a T-square and triangle.

Engineering schools are run for the purpose of turning out engineers, not draftsmen, and there is a natural desire on the part of the graduate to feel that the time and effort he has spent on his course have made him an engineer. As a matter of fact he may have the sound judgment that entitles him at once to the rank of engineer, while on the other hand he may never get it and will never deserve a rank above that of draftsman. The knowledge and judgment one has, together with a certain amount of ability to convince others that he has them, are not dependent on the possession of a B.S. or an M.E. degree, some of the best engineers never having seen the inside of an engineering school

How the 155-Mm. Howitzer Is Made—V

By J. V. HUNTER
Western Editor *American Machinist*



The breech of this howitzer contains approximately 96 distinct parts, all of which require a high degree of manufacturing ability to insure accuracy of production. Many of the more important parts of this intricate and interesting mechanism are shown in the illustration accompanying this article, and the operations involved in the manufacture are described.

RAPIDITY of fire and ease of handling most field guns depend upon the design and execution of the mechanical details of the breech mechanism. A good idea of the general appearance of the closed breech may be obtained from Fig. 87. In this view the firing-mechanism housing which carries the primer is in place and the percussion hammer is in position ready for striking.

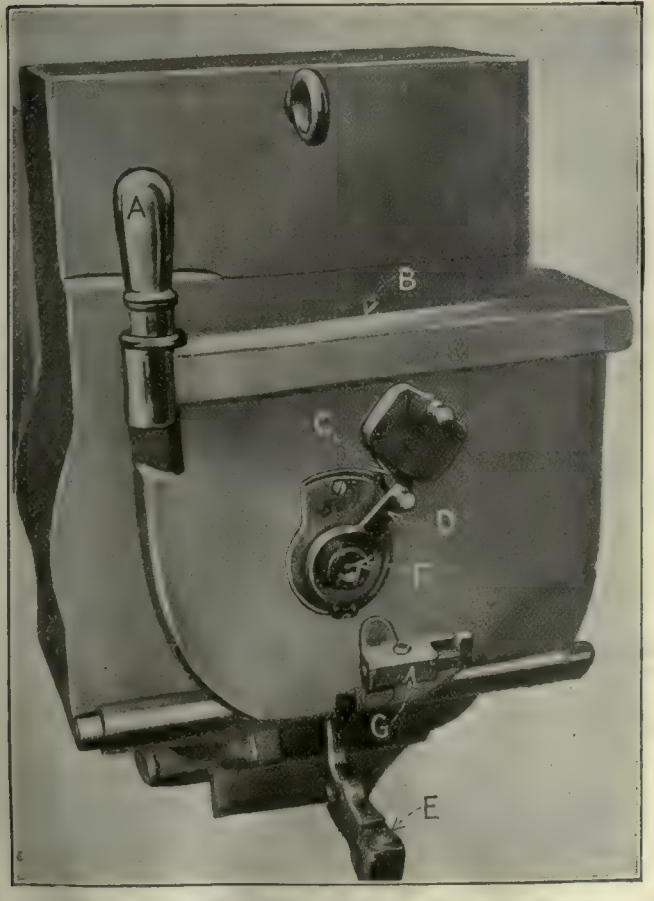


FIG. 87. VIEW OF GUN WITH BREECH CLOSED

To open the breech the handle *A* is pressed downward; this action trips the operating-lever latch, which is housed inside of the lever *B*. The handle and lever are then swung to the right and in so doing their first action is to operate the rack inside of the block carrier, which gives the breech block a 45-deg. turn, disengaging its thread sectors from the corresponding thread sectors within the breech. Further swinging of the operating lever carries the breech block open and clear of the line of opening of the cartridge chamber to permit the introduction of the cartridge.

When the breech block has thus been swung open to its furthest point, as indicated in Fig. 88, the operating-lever latch locks and holds it in that position. This prevents any tendency toward closing during loading when the gun may be depressed at an angle of 20 deg. or more. In closing the breech the latch is tripped by the same downward motion of the handle.

The Firing-Mechanism Housing

The firing-mechanism housing, which may be seen hanging on the eyebolt at *A*, Fig. 88, is in place in the breech block in Fig. 87. The latch *C* catches the handle *D* of this mechanism and prevents danger of partial disengagement during firing. During transportation of the gun the hammer *E* is raised up against the firing pin *F* and held in that position by the latch *G*.

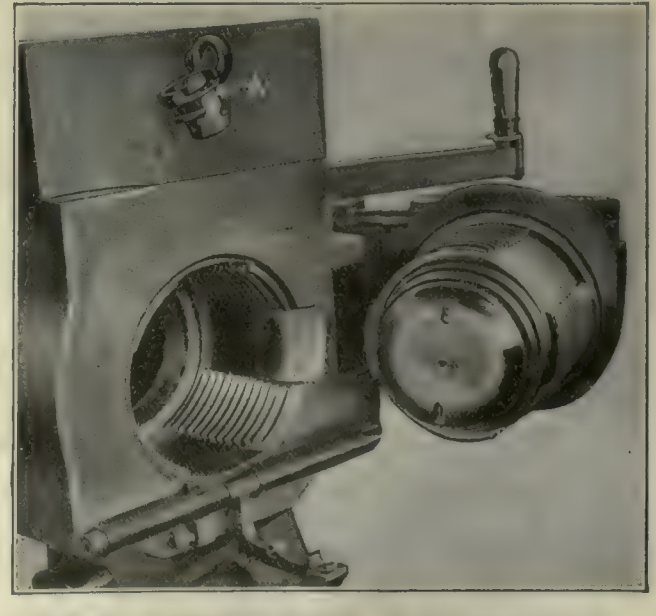


FIG. 88. INTERIOR OF GUN AND BREECH BLOCK

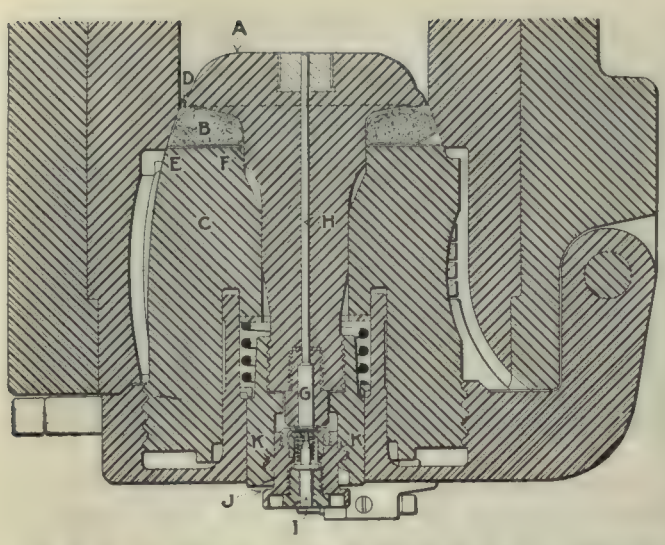


FIG. 89. HORIZONTAL SECTION THROUGH BREECH MECHANISM

A horizontal section through the breech mechanism is shown in Fig. 89. The obturator spindle *A* takes the direct thrust of the firing charge. In receiving this thrust it exerts pressure upon the gas-check pad *B*, forcing it to expand against the gas-check seat and sealing the breech against any backward escape of the gases. Three steel rings *D*, *E* and *F* aid in distributing the compression on the gas-check pad and forcing it to expand in the proper direction. The breech block is the part *C*.

Placing the Primer

The primer cartridge is placed in the position *G* and on discharge fires through the vent hole *H* in the obturator spindle. The firing pin is shown at *I*, and is held in the housing *J*. The threads by which the firing-pin housing is screwed into the breech block are shown in section at *K*.

The breech-block carrier *A*, Fig. 90, is swung from the hinged pin *B*. This hinged pin is held in place by the collar *C* and detent pin *D*. In case of emergency, such as abandoning the gun, the detent pin can be pulled out and the collar and hinge pin instantly removed, permitting the breech mechanism to be lifted off and carried away, thus rendering the gun useless to the enemy.



FIG. 96. HEAT-TREATING FURNACES AND SOME OF THE QUENCHING TANKS

At *E* is the rack shown in mesh with the toothed section of the breech block.

Rack Block Explained

The rack block is shown in the section at *G*. When this functions to lock the rack its spring *H* forces it upward and to the right, as viewed in the side elevation, and allows it to project beyond the inner face of the breech-block carrier. When the breech block is closed, the inner face of the carrier comes in contact with the breech end of the gun, and the rack lock *G* is forced back into its recess, releasing the rack, which is then free to rotate the breech block.

The larger parts used in the assembling of the gun and breech mechanism are shown in Fig. 91, in which *A* is the bridle, *B* the counterweight, *C* the gas-check pad, *D* the breech block and *E* the obturator spindle.

Fig. 92 shows three views of the breech-block carrier and indicates to some extent the amount of machine work required in its production.

Other parts used in connection with the breech mechanism are illustrated in Fig. 93. *A* is the percussion-hammer assembly, including the operating shaft and lock bolt, and *B* the firing-mechanism housing ready

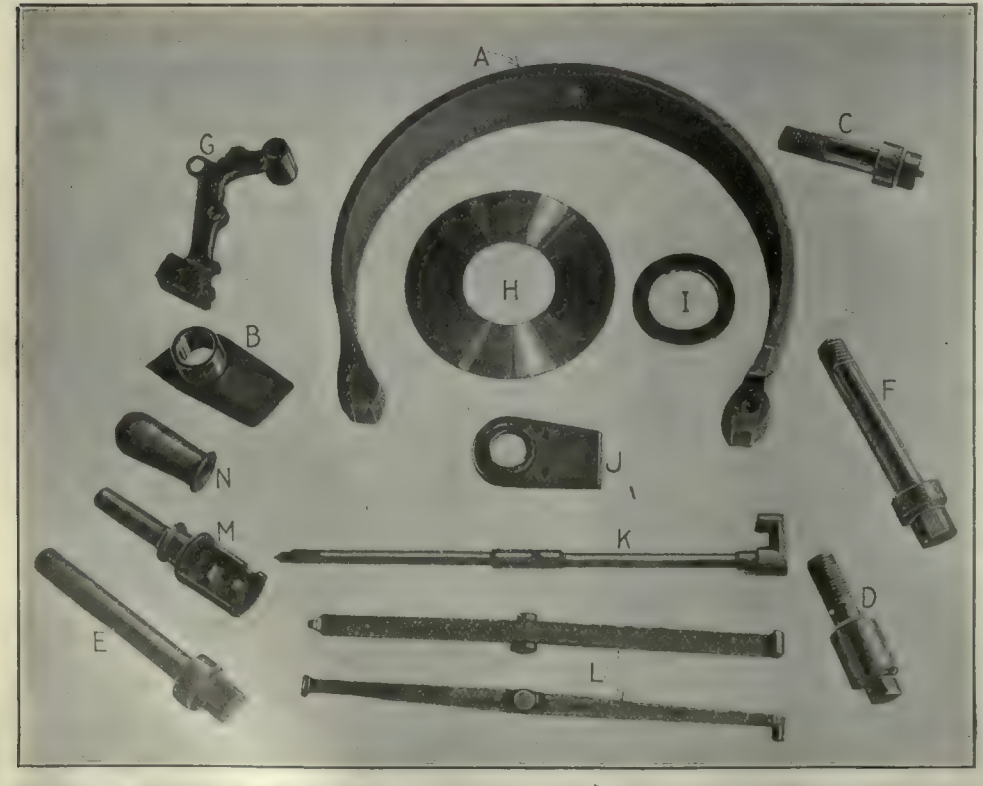


FIG. 94. HOLDING-DOWN BAND, HAMMER SHAFT, OPERATING-LEVER LATCH AND VARIOUS OTHER PARTS

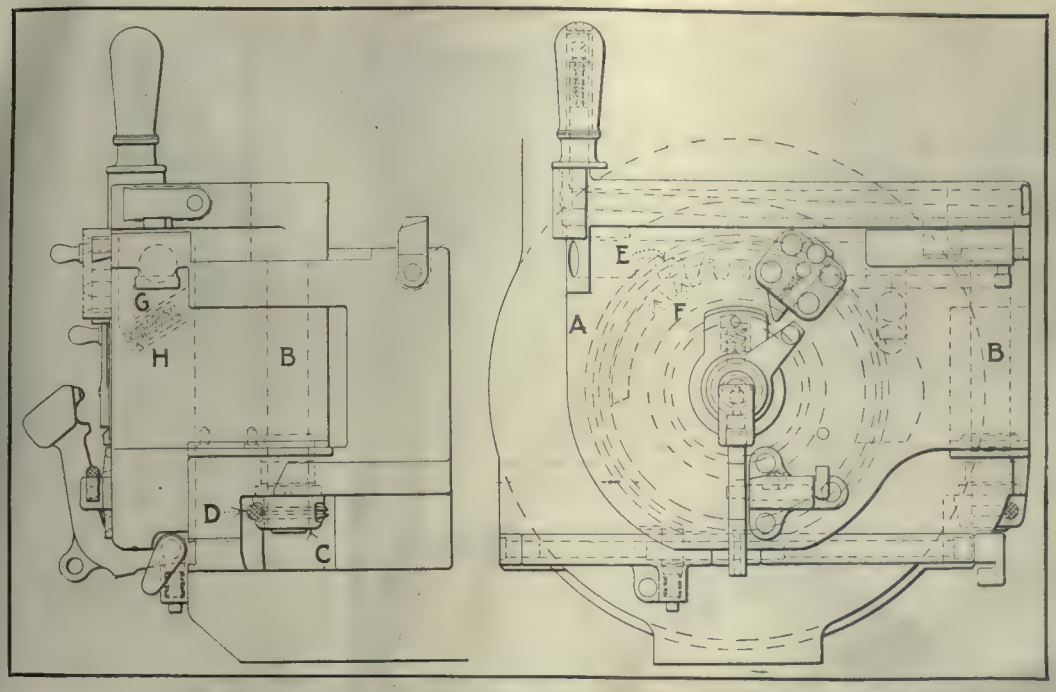


FIG. 90. DETAILS OF THE BREECH AND OPERATING MECHANISM

to receive the firing-mechanism block *C*. *D* is the firing-mechanism block latch; *E* the percussion-hammer lock bolt; *G* the equalizing rings for the gas-check pad; *H* the operating lever, and *I* the rack.

Another group of the larger parts required for the breech-mechanism assembly is illustrated in Fig. 94. Some of the parts shown are used on the gun body and do not belong to the breech mechanism. Of these the largest part *A* is the holding-down band used for retaining the gun body on its carriage. The regulating plate *B* goes on the hinged recess section of the breech end of the gun to take up the wear from the swinging of the hinge section of the block carrier. The screws *C*, *D*, *E* and *F* are used for attaching the bridle block and the counterweight to the gun body.

Details of Breech Mechanism

Of the parts that belong to the breech mechanism *G* is the percussion hammer; *H* the filling-in disk; *I* the spindle spring, front seat; *J* the block carrier-hinge bearing plate; *K* the percussion-hammer operating shaft; *L* the operating-lever latch; *M* the operating-lever handle, and *N* the operating-lever handle sleeve. Practically all of the smaller parts used in the assembly of the breech mechanism are in Fig. 95.

As has been explained elsewhere the tube and the jacket receive their heat treatment at the forging plant before they are shipped to the gun plant. The remainder of the forgings, which are all practically portions of the breech mechanism, is shipped to the gun plant in the rough and without heat treatment. They receive the necessary heat treatment either before or after machining as the specifications require. A complete heat-treating department has been installed at the gun plant and a small part of the equipment is shown in Fig. 96. The furnaces shown are for heat treatment only. On the opposite side of the room are the furnaces used for case hardening, and in the foreground are the quenching tanks.

After heat treatment every part is subjected to Brinell hardness test both by the gun plant and by the Government inspectors.

Heat Treatment

The specifications for the heat treatment of the various parts of the breech mechanism are very thorough and extensive. Each part must receive almost individual treatment. By that is meant that no batch of miscellaneous mixed parts can be put into the furnace at one time. A number of different grades and classes

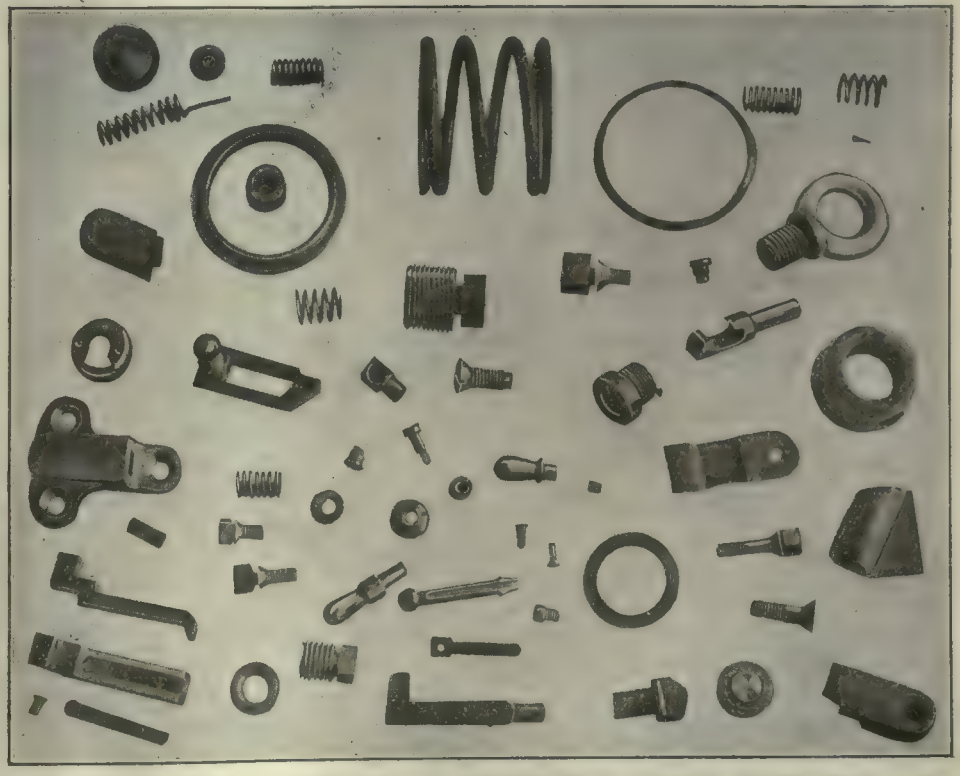
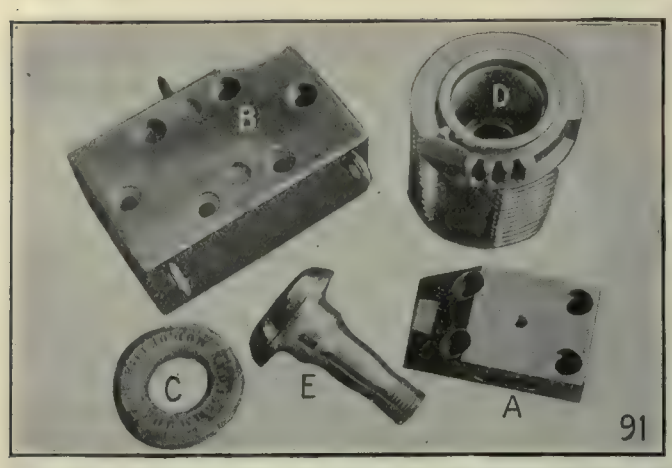
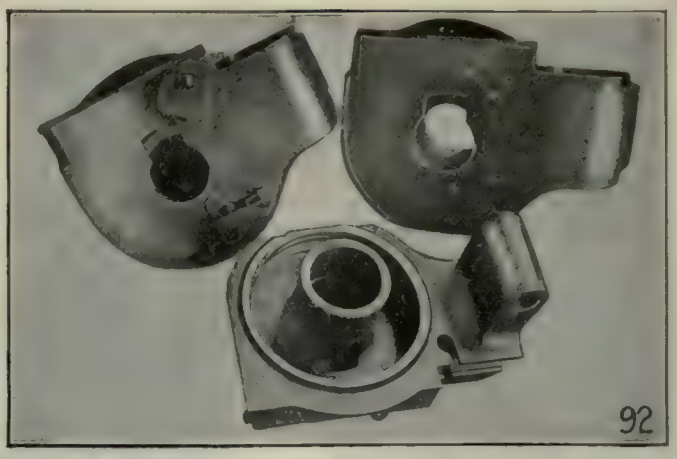
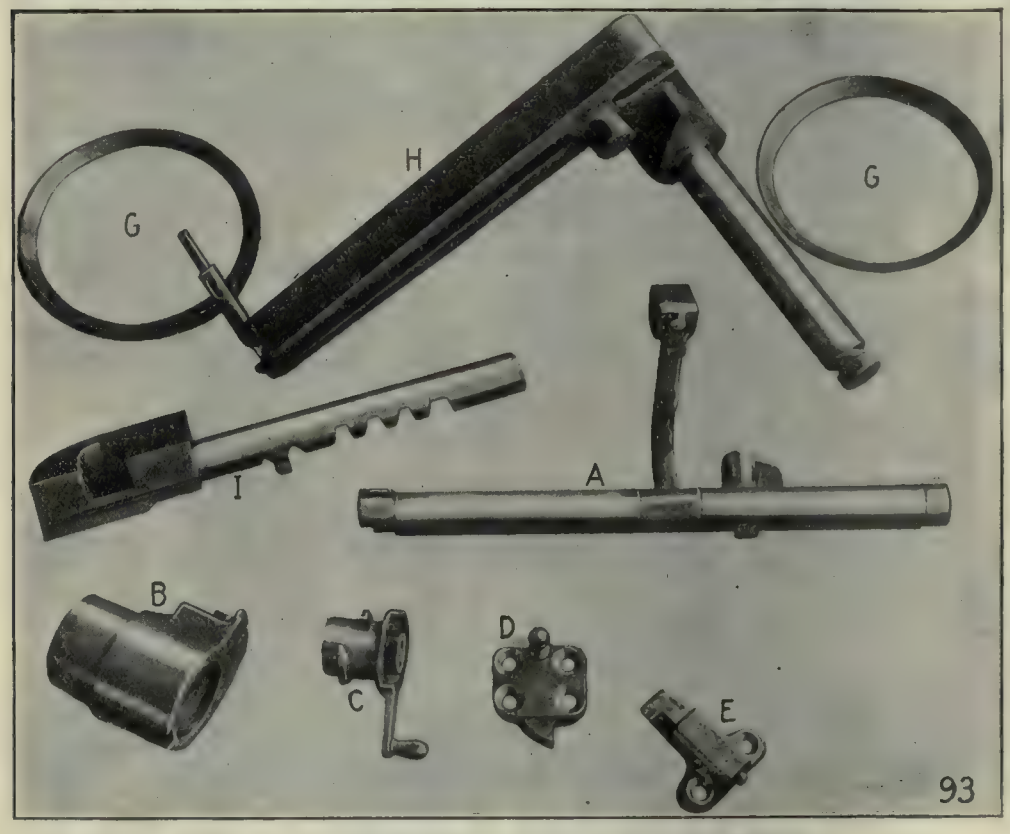


FIG. 95. SMALL PARTS USED IN ASSEMBLY OF BREECH MECHANISM







FIGS. 91 TO 93. OPERATING PARTS OF THE HOWITZER

Fig. 91—Counterweight, bridle block, breech block and spindle parts. Fig. 92—Assembled and unassembled block carriers. Fig. 93—Operating lever, rack, hammer-assembly and firing-mechanism housing

of steel are used in the breech mechanism. Even from the same grade of steel it not infrequently becomes necessary to select varying grades of hardness as shown by the Brinell hardness tests to meet the different requirements.

Recutting Files

By Charles E. Kail

After reading over the article by S. A. Inscoe, on "Recutting Files," page 70 of the *American Machinist*, I am constrained to take exception to the last paragraph wherein he intimates that the acid method of recutting is inefficient and not much more efficacious than the wire brush, etc.

I am in agreement with him when he says in effect that no real mechanic can be deceived with an acid recut file, but that does not alter the fact that a considerable saving can be effected by the proper use of this method.

The process here described is to my knowledge in successful use by two companies, one doing the work on a commercial basis, the other treating only files used in its own plant.

This process is galvanic, being quite similar to electroplating except that the work becomes the anode and the cathode is supplied by the tank lining; the current flowing from instead of to the work.

A lead-lined tank is used, the bottom of which is covered with some insulating material to prevent too much cathode surface being exposed.

The negative terminal of the plating dynamo is connected to the lead lining and a brass bar extending across the tank and insulated therefrom is connected to the positive terminal. The solution used is sulphuric acid and water in a proportion of 1 to 5 and with a current of from 4 to 6 volts the work should be completed in about one-half hour.

The files are suspended vertically from the anode bar with suitable hooks and wires, and so arranged that they will be immersed in the acid up to the tang.

Files should be perfectly free from grease before going to the tank and to this end should be boiled in a strong solution of potash and then subjected to a thorough washing in hot water to make certain that there is no alkali carried over into the acid to remove the alkali.

To prevent the files from rusting after they have been sharpened, rinse them well in running water and then suspend them in boiling water containing a small amount of sal soda until they are heated through. They will then dry out without a sign of rust.

Enlisting Labor in Production

By L. W. SCHMIDT

Making labor interested in the part it is taking in production is one of the later methods used in Europe, and it has been found to increase the output. But equally important it has also been found that it developed a different mental attitude in the worker by widening his knowledge, stimulating his ideas and inculcating in him the meaning of responsibility. One way of obtaining the confidence and coöperation of the men is through the blackboard, the use of which is graphically explained in this treatise.

ON A recent visit to Europe to investigate industrial conditions I saw on a blackboard in one of the factories a chart about 6 x 9 ft. It showed two graphic curves delineating the monthly production of the factory and that of the industrial region comprising the Rhineland, Luxemburg, northeastern France and Belgium. The purpose of this chart was to show the workmen in the plant the relative importance of the factory as a producer of machines compared with other factories in the district, as well as to let labor understand the position of the firm as a leader in its particular field and to encourage it to take a pride in the prosperity of the concern. Similar boards were discovered in other parts.

A leading bank engaged in the financing of the Russian wheat crop, with the help of a graphic chart, kept before its employees the fact that a considerable percentage of the wheat crop of Russia had been financed each year by that bank and its correspondents. A more ambitious chart was displayed in the workshop of a machine-tool factory, which showed the yearly growth of the factory's business and its foreign connections, and there is no doubt that these charts have been of most value in educating the workman to take an intelligent interest not only in the workings of the factory which employs him but in the country as a whole.

Make Men Realize Importance of Their Work

What has been done in Europe might be done with still better results by the manufacturers of this country if factory managers, staff organizers and others were to make a more extensive use of educational methods to interest employees in their work and to implant in them a better understanding of the economic factors determining their own prosperity. Just now the nation is going through a period of great internal and external strain. The machine industry especially is called upon to accomplish feats considered impossible only a few years ago. On the successful completion of this task depends the future of the nation, and the utmost exertion, therefore, is demanded of all.

It is essential that everybody should understand what is demanded of him and that all engaged in the work of production should be enlisted not only as unthinking beings doing their work because they must earn a living, but as live factors intelligently accomplishing the work on which they are set. To gain this coöperation of all the productive factors of the nation more is wanted than the payment of high wages. Enthusiasm will have to be created. There must be the pride of individual accomplishments to the good of all.

To this end factory owners will have to take labor into their confidence. The man behind the machine must know what are the aims for which he toils with all the others around him; he must be made to see the importance of the achievement that is attempted.

The machinery industry today is an important link in the defensive position of the country. It provides the essential tools for all other industries. Successful and speedy operation of the machine industry, therefore, is absolutely essential to the general prosperity of the country. Every man should realize this fact. He should understand that every machine that cannot be supplied on the day it was promised may hold up the defensive preparations of the nation for weeks—may decide victory or defeat.

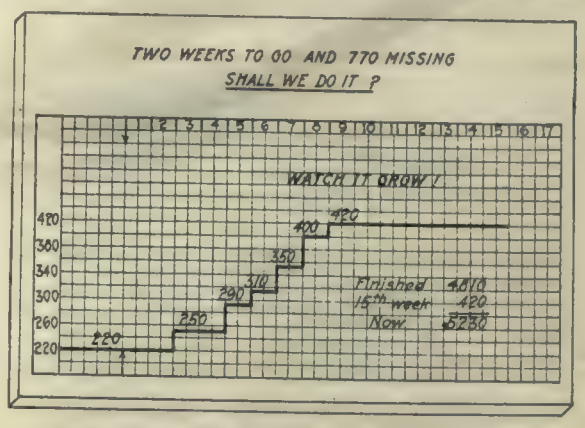


FIG. 1. SHOWING RATE OF PROGRESS

What is proposed here is not a complex system of education, necessitating lectures and attendance of the men after working hours, time better spent in recreation. It can proceed while the general work of the factory is going on. It is in fact closely related to the everyday duties of all the men engaged in the plant. Nothing is required but a number of large blackboards, white ink and an instrument capable of drawing white lines and writing figures and inscriptions. These blackboards should be placed where they can be seen easily by the working staff, one in the general office, one in the workmen's entrance of the factory and in other suitable places, and one in the workshops. The boards can be used for writing, or blueprints or other multiplied announcements may be displayed on them, which latter method saves a good deal of work. In every case the lines and type must be bold, so that they will be seen easily and will impress themselves on the mind of the reader.

Just now when the machine-tool factories of America have their hands full to keep abreast with production, many plants have had to double their output in order to satisfy the demands of the Government and private customers. Most orders are for earliest possible de-

livery and necessitate the employment of additional men and equipment. To finish the jobs as they come in and to make ready for new ones require the most loyal support of everyone in the factory. To gain this they should know the reason why, and they should be permitted to see for themselves.

Let us assume the case of a factory having accepted an order for 6000 tools to be delivered inside four months, the usual output being 900 tools a month. To execute this order it is necessary to increase the number of men and equipment. Here the blackboards will come handy. They will carry the initial announcement:

> TO OUR MEN
>
> The Government relies on us for the supply of 6000 machines, which we have pledged ourselves to deliver inside four months. To keep our pledge we will have to add new men to our forces. We shall also have to make an extension of the present factory equipment.
>
> Uncle Sam relies on us. We must rely on you.

After a few days this notice will be replaced by a new one. This will be a descriptive chart with the following inscription:

> Seventeen weeks to make 6000 tools. Shall we get there?
>
> Watch yourselves doing it.

The chart shown on the previous page is already in a state of progress; 15 weeks of the period of work have elapsed, and the final attainment is near. During the first week it shows the usual production of the factory during one week, which in this case is assumed to be 225 tools. As the work progresses and the new men and equipment begin to bear on production the number of tools produced every week increases, not always on an even basis, but rapidly. In the lower right-hand space the progress of the work is shown in figures in Fig. 1. These figures are changed every week, as should also the inscription on the chart.

When the job is completed the last week's production is filled out. The inscription on the chart runs now:

> 6070 tools produced in four months by our factory. You did it.
>
> Uncle Sam thanks you.

This kind of campaign has done good service, and its value as a "getting together" call lies in its appeal to the natural sporting instinct of the men.

The production figure obtained by the factory in the four months of the campaign may constitute a record of production. It is well to inform the men of this. It is peculiar that everybody likes records. One of the most uncomfortable nights I ever had was when I was crossing the Atlantic some years ago on one of the ocean greyhounds when it was endeavoring to establish a record, but all discomfort was forgotten next morning when I heard the record was beaten. People will work with greater zeal when they see something ahead of them, the achievement of which they may be proud of in later years. If a record for the factory, therefore, has been established this fact should be made something of. The men must be shown how it was obtained, and they should get their share of the success.

Another important purpose to which the blackboard can be put is educating the workman to his relation to the factory. This is a time when labor gets its full due. It has taken the leading place in constructive economics, but it has not yet taken on its shoulders the responsibility incidental to its new and increasing importance as an economic factor.

Wages have risen rapidly during the past few years in the machine industries of the country. Still labor clamors for more increases, resulting very often in disputes, though generally manufacturers have anticipated these disputes by making increases. There is today

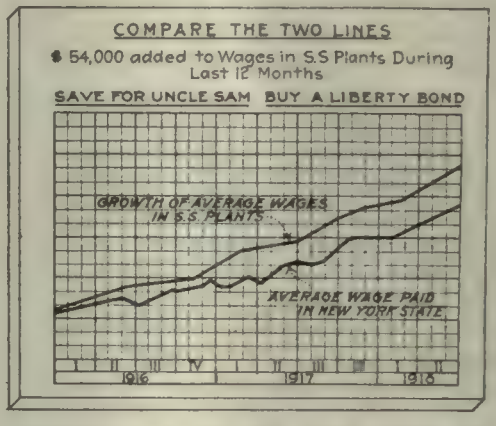


FIG. 2. SHOWING GROWTH AND COMPARISON OF WAGES

no machine factory in this country which does not pay higher wages than a year ago. Labor has not yet realized fully the benefit of these increases. The rising cost of living in many cases has neutralized the effect of the additional wages. The increase, nevertheless, might be explained to the individual employee by demonstrating it to him in some form, but as the matter is one of great delicacy the presentation of the facts requires tact.

The belief that the men should be left in the dark as to the part they play in the factory is still subscribed to by many. My experience, however, seems to prove the contrary. The wage question has been tackled repeatedly and successfully by taking the staff into the confidence of the management, showing what has been done and instructing the men about the relative position of their own work in the earning scheme of the plant.

The facts demonstrated on a chart and plainly exhibited in the workrooms will help. The appeal will be stronger if it can be connected with some national question foremost in the mind of all at that time. The chart, Fig. 2, was used by a factory during the recent Liberty Loan drive.

It was displayed in the pay office of all the plants of the company. As will be seen it shows two curves. The lower designates the average wage disbursement of the national industry during 1916, 1917 and part of

1918, the upper the average wage paid in the factory making the display. The latter was considerably higher than the average wage, which is frequently the case in factories where specialties are manufactured and which consequently require a higher percentage of highly skilled labor. The instructive value of such a demonstration can be strengthened if the wage factor is also shown in its influence on the cost of production.

Wages, after all, are the governing factor of all price increases. Coal, while still in the ground, costs nothing, neither does the iron nor any other undeveloped raw material. All of these are gifts of nature and are useless in their natural state. All raw materials have to be won from the soil and improved before they

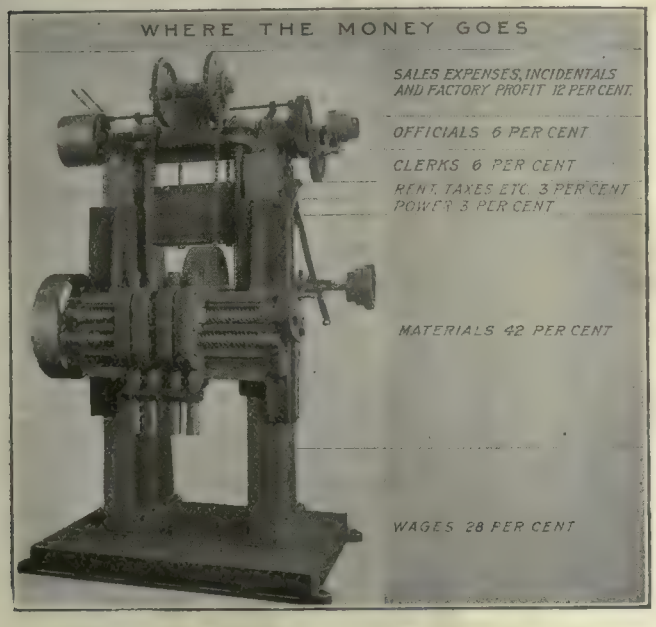


FIG. 3. ILLUSTRATING MANUFACTURING COSTS

can be used for industrial consumption. In the case of iron the ore has to be mined; it has to be smelted and turned into the form in which it is bought by the machinery-building industry. Coal has to be mined, broken and transported to the power houses and places where it is required. Before the material has completed the process of improvement to the industrial form, before it has reached the point of consumption, it requires the application of labor. This labor has to be paid for and it is the principal factor in the cost of the material. By operation of this law the cost of iron increases with every step up to when it reaches the consumer.

How can this best be explained to the men?

In the *American Machinist*, Vol. 48, page 210, there is a chart describing the relative distribution of the cost of manufacturing a $100 unit of machine tools, which might be used with advantage to show to the men how profits are distributed. A better plan would be to demonstrate the facts on one of the machines built in the factory. The advantage of this method is that it reaches the less imaginative mind more easily than a chart, and its value to the factory lies principally in the unimpeachable correctness of the facts stated. Whenever a chart of this kind is laid before the men it must be worked out to stand thorough examination. Such a chart is shown in Fig. 3.

The drawing itself can be displayed in the usual manner. Several inscriptions will suggest themselves to the mind of the staff manager.

Another feature that can be handled by the educational method is the carrying out of general factory policies affecting the men and staff, the correcting of habitual faults, negligence and so on. Just now, when conservation has become an urgent necessity, waste should be eliminated wherever possible. The men are too easily inclined to believe that there is not much lost by their occasional negligence, and it is difficult to explain that continual waste must result in large losses of money and material.

Fines, warnings, notices and premiums have all been made use of with varying results. Neither of these methods, however, has been completely successful. Notices are forgotten as soon as the men have become familiar with them; fines are paid rather than care being taken, and soon things are back to where they were. Waste may occur in the careless use of supplies, in overapplication of power, in negligence in the handling of tools and machinery. As long as it was only a matter of money loss the harm was not so serious At the worst it meant only a reduction in profits, but today waste means the weakening of the defensive position of the nation, and concerns not only the factory but the country at large. This refers as much to power and coal as to cleaning rags, oil or whatever kinds of supplies.

To lay the situation before the men, even if only an incomplete result can be obtained, the outcome of the investigation should be made known to the employees and an announcement like the following is recommended:

> During the last month we have spent $ ..... for general supplies. Our power house has consumed ..... tons of coal. Uncle Sam needs oil, rags, screws, lead, copper and other supplies. Your home needs coal during the coming winter.
>
> We have been asked to conserve supplies and coal.
>
> Help us do it.

A few days after this announcement has obtained the necessary attention it can be replaced by a graphic chart showing the expenditure for supplies for the last three months and the consumption of coal. The inscription now reads:

> Do not waste supplies. Do not waste power.

As in the first instance the chart is continued from month to month with varying inscriptions.

If an improvement is noticeable, this fact should be made something of. Not only should full credit be given to the men, but the methods by which the improvement was obtained should be shown. Special suggestions should be invited and men having made accepted suggestions should receive a premium. A premium to be distributed to the whole force if considerable savings are made will have good results.

Experience has shown that this kind of campaign is nearly always successful. The men soon take an interest in the problems which are put up for solution and they will wait from month to month for the progress of the conservation scheme.

The first and principal rule of all staff campaigning must always be variety. If the charts and the blackboard have done their duty they should be dispensed with and another scheme adopted, as it is only by making occasional changes that it is possible to keep up the interest of the men, which of course must be the main object of the campaign.

Returned Soldiers and Sailors as Better Mechanics

By C. E. Shaffner

When the first quota of drafted men was leaving for the cantonment camps I heard a shop foreman say to a young machine operator who was answering the call: "Well, son, I guess it will be a long time before the old shop will look the same to you again." He was expressing the view frequently heard in these days of reconstruction that military and naval service unfits a man for return to his place in industry.

Perhaps this has been true to a great extent following wars in the past, but there seems little evidence at present that former soldiers and sailors will have any difficulty in adapting themselves to factory and shop work. On the contrary it appears that they are taking up their old tasks with an interest and energy that are nothing short of remarkable, considering the sudden change in their mode of living. I have reached these conclusions from observations made in different plants, and while of course I have not had an opportunity to deal with numerous cases I believe nevertheless that the instances which have come to my attention are typical.

Just as a kind of general illustration I have in mind the case of a young Canadian soldier who was invalided home some months ago and finally discharged from further service. When he left a Detroit factory at the outbreak of the war he had not carried with him a reputation as a very good mechanic, but when he applied to his former employers they gave him employment largely because of the scarcity of mechanics. They were agreeably surprised to find from the start such a remarkable improvement in his work that he was soon made a subforeman in a department which required particular accuracy in workmanship and close attention to details. Since the work he had to do consisted in the final assembly of a 3-in. antiaircraft cannon it is altogether likely that he displayed a keener interest in the proper construction of the finished product because of his service at the front, but the fact remains that his ability to take care of a great many small details of construction and his absolute insistence upon having them carried out properly had come undoubtedly from the military training he had received.

That this regard for small things, which may mean a great deal, especially characterizes the changed attitude of former soldiers and sailors is evidenced by the following instances which I have observed: A young man mustered out of naval service returned to his shaping machine in a Middle Western factory. A week later he suggested to the committee appointed for the purpose of receiving suggestions regarding improvements in factory methods and conditions that the electric lights over practically all the machines in his department be raised and in addition that close-grained wire netting be placed in front of a number of machines so that there would be absolute protection from flying chips of steel. Here were two matters of considerable importance which had been entirely overlooked, probably because they seemed too trivial. And yet they earned for the ex-sailor a money prize.

Another mechanic who had graduated from the tank service established a system of inspection in an Eastern factory, thereby eliminating delays which had previously seriously interfered with machining. He was placed in this department because his physical condition would not permit him to do heavier work. And what he succeeded in doing merely amounted to properly developing the working capacity of the inspection force. As a result a machine operator instead of having to wait for half an hour or perhaps longer because micrometers had not been passed upon was able to go ahead with his job simply for the reason that the inspectors had been taught to work faster and without needless delays in running around the factory to different tool cribs and in useless conversations.

As the months pass a great many more instances like those described by the writer will no doubt be disclosed as thousands of soldiers and sailors return to civil life. It will be decidedly interesting to note from a careful analysis of these cases what experiences and methods of training have resulted in a finished man product with new mental equipment for peace as well as war.

Accurately Spaced Drilled Holes

By Edward A. Stein

The article on page 88 of the *American Machinist* by Wilbur L. Coble entitled "Accurately Spaced Drilled Holes" is interesting, but the method here described has some advantages.

Instead of locating the button in the usual way, that is drilling and tapping for a holding screw, take a piece of flat cold-rolled steel of a thickness equal to half the length of the button, a width of twice the button's diameter and of sufficient length to allow for clamping to the work. Drill and ream a hole near one end in which the button will be a press fit, press in the button, taking care that it does not project on the bottom of the plate, then clamp the piece to the work.

After properly locating the button by tapping the piece with a hammer or a soft piece of metal give the clamp a final tightening and then drill the work, using the button as a drill bushing. The hole in the work can be enlarged, preferably with a counterbore that will allow for reaming with a standard hand reamer.

The foregoing method seems to have the following advantages: There is no drilled and tapped hole (for holding the button) to lead the drill off; and there is less chance of a smaller drill moving the bottom out of location than when using a drill equal to the diameter of the button.

This method is recommended on any job where a tolerance of + or — 0.001 in. is allowed. When closer limits are required the holes must be bored.

Testing Materials for Hardness

By HOWARD ENSAW

During recent years many firms and individuals that were regularly engaged on work which did not necessitate any intimate knowledge of the composition or the structure of the material they were using have suddenly been called upon to acquire that knowledge. The material they use must satisfy certain specified tests

THE scleroscope and Brinell machine and even in some cases the sclerometer test have become very popular. These instruments are undoubtedly of considerable assistance if used with care, and the results applied in a correct manner.

In the case of the scleroscope a steel hammer is allowed a 10-in. drop in a glass tube which must be absolutely vertical. This hammer is about ¼ in. in diameter by ⅜ in. long, and is tipped with a diamond striker. On soft material the tip penetrates further into the surface than on hard material, and in the case of case-hardened mild steel or hardened tool steel the impression is so slight and consequently the area covered by the diamond so minute that the force of the blow approaches 500,000 lb. per square inch.

The height of a rebound measured at the top of the hammer is taken as a measure of the hardness of the material tested. This is to a certain extent very convenient, but the operator should guard against applying his results without further consideration.

As the area covered by the diamond is so very small it is most difficult to detect the soft places without spending a great deal of time and letting the hammer fall a number of times in a small area.

When the hardener removes the object from the furnace for quenching, his tongs only touch the object on two or three small areas, but in some cases local cooling takes place before the object reaches the quenching bath and those places from which the heat was taken come out soft. A random scleroscope test on the article would possibly register a satisfactory degree of hardness, but the soft place would probably reveal itself when the article was in use. If an insufficiently high temperature is reached when reheating for the quenching then also we are likely to have soft places.

Other causes of soft areas are carelessness in grinding, the use of an unsuitable wheel or a correct wheel in bad condition and poor distribution of the cooling water. In any case the chances are that these soft areas may be missed when tested by the scleroscope, and an alternative test will be suggested later.

Also in this instrument we must admit that the rebound is really caused to a great extent by the material under test returning to its original state after being distorted by the blow of the hammer, and the rebound consequently must be a measure of the faculty of recovering its original state. This seems to show that the instrument is not applied properly because we do not desire to measure that faculty, and when materials which are not hard, when compared with a piece of annealed vanadium steel, can show a scleroscope reading as high as the latter then it is time to confine this instrument to its proper sphere.

In this connection it will be interesting for users of the instrument to take a piece of rubber and test this. The rubber should be flat on the top and bottom and placed on one of the standard test pieces supplied with the instrument. The test piece should then be placed on the anvil supplied and this will give a good, solid foundation.

The writer has recently tested three samples of celluloid under the scleroscope with the following results: The first sample gave 65 deg. of hardness, the second gave 60 deg., and the third gave 61 deg. These results would seem to indicate that the celluloid is harder than a sample of good quality cold-worked high-speed steel, but at the same time each specimen tried could easily be cut with a pocket knife.

A sample of bone registered 45 deg. of hardness, apparently being as hard as chrome-nickel steel, and could be cut with a knife. A sample of rubber gave 34 deg. of hardness, which corresponds approximately with annealed 1 per cent. carbon tool steel.

These results indicate that scleroscope values must not be used in too wide a field, and when making comparative tests it is advisable to confine ourselves to one brand of material only.

It may be said that if the limitations of this instrument are appreciated it can be put to a very useful purpose, particularly for obtaining a comparative determination of the condition of samples of similar material.

Testing by means of the sclerometer has not attained much favor in Great Britain, but as its action is not so local as the scleroscope it has an advantage in this way, but on the other hand it is not nearly so convenient to use. By means of a diamond under a fixed load a scratch is made on the test piece and the dimensions of this scratch are measured by microscope. These dimensions are then taken as a comparative hardness reading.

The File Test

In testing hardened-steel parts the file test is still remarkably popular, and although there are some objections to its use it probably gives the hardener more confidence in his conclusions than the more elaborate and scientific tests.

Quite a large percentage of hardeners in our factories today are men who were on the job before either Brinell or Shore began to make our metallurgists look at the hardness problem in a very serious light. The methods of the hardener at that time were remarkably crude, and as they were ignorant of the possibilities of recording the extent of hardness the necessity of the file test then is obvious. Hardeners are a careful and thorough set of men, but they look upon the works' chemist as a deadly enemy if he suggests new ideas or modern instruments. The result is that the file still has adherents and really is reliable.

It is a matter of regret that we cannot establish in connection with this test a figure for comparison. An article can be tested and we can guarantee it to be

hardened all over to a satisfactory extent, but we cannot place data on record for future reference, nor can we certify to a fastidious client that the article conforms to a certain degree of hardness.

As the quenched-steel articles are as hard as the file, the hard places destroy the teeth, and consequently the file cannot be used again in the same place. This means a great deal of expense in files when hardening quantities. Also the files themselves are liable to a considerable amount of variation, and a hardened ball race may damage a poor file without being sufficiently hard to perform the duty for which it is made.

Another hand-applied test is the bar test, which is carried out generally with a hardened-steel rod about $\frac{3}{16}$ in. in diameter. This rod is ground at the end, and by attempting to scratch the article under test a comparison of the hardness is obtained. When the corners are rubbed up the bar is again ground on the end. It will be noticed that by this method many cutting edges can be obtained, all of which are practically identical, and thus the results are more uniform than the file method.

In the case of the Brinell test (which was only put forward in its present state as late as 1910) we have a really good machine and the results are fairly reliable, but a great objection is that this test cannot be conveniently applied to articles merely hardened and quenched. The results are of extreme value in connection with materials as rolled or in the case of oil-hardened steels. In operation the test is simple, although it takes more time than the scleroscope, and when the test has once been made the impression always remains and can be easily read if the records are lost.

The Probability of Damaging Machine

A hardened-steel ball 10 mm. in diameter is pressed into the test piece with a vertically applied load of 3000 kg. The spherical area of the impression left after an application of 30 sec. is calculated from the diameter, which is measured by microscope. Then the pressure per unit area is taken as the Brinell-hardness numeral.

Obviously when the hardness of the material to be tested approaches the hardness of the ball in the Brinell machine then the probability of damaging the latter increases and this upsets the reading. As a regular practice it is best to test materials only up to about 578 Brinell number, which is represented by a ball impression of 2.55 millimeters.

We see then that in hardness testing there are several methods which can be used, each method having peculiar advantages for or disadvantages against operation within certain ranges, and it is not a difficult matter to choose the most suitable test for any specific case.

The limitations of each method should be fully realized and the danger of assuming too much from results should be guarded against. This fault is exhibited very much today in the case of ultimate stress of materials. It is often assumed that this value has a certain constant relation to the Brinell-hardness numeral. It is also frequently assumed that the scleroscope hardness number has a fixed and constant relation to the Brinell number, and unless matters like these are treated most carefully, trouble is likely to ensue.—[The author has failed to call attention to and emphasize the fact that all of the methods of testing hardness are comparative. A rubber ball will bounce higher than a lead ball if both are dropped from an equal altitude and strike a cubic foot of granite. If dropped from the same height into soft mud their rebound will be equal, but that does not mean that lead and rubber are equally resilient. With all of these methods of testing hardness certain standards are set up and similar pieces should test similarly to their standard.—Editor.]

Notes on the Care of the Steam Hammer

By A. S. Hesse

Hollow dies on a steam hammer are a prolific cause of breakage of the piston rods. The trouble occurs when the hammersmith has learned that the hollow exists and to obtain better work he works on one end of the dies instead of using the center. This practice puts a side strain on the rod which eventually causes it to snap.

The hammer dies should always be kept as level as possible and should come together flat. The front and back edges of the upper and lower dies should match and the corners should be rounded up equally on both sides. When the two dies line up well it is possible to forge a shoulder without first fullering or dressing it up by hand on the anvil.

The item of steam consumption is of importance in any shop, and the forge-shop foreman can aid in saving by periodically inspecting and making sure that the valves and piston rings of the steam hammers are in good shape. A steam hammer with worn and poorly fitting rings and valves is a heavy consumer of steam.

Exhausting the steam from the hammer into a shop-heating line is bad practice unless there is ample provision to guard against a variable back pressure. The valve gear of a hammer is composed of a slide and cam motion and held together only by the weight of the moving parts. A hammer has no fixed length of stroke, and an operator only learns by experience and practice to handle it properly; consequently when back pressure of varying degrees is added to interfere with the freedom of the valve motion he soon has trouble in properly regulating the blow.

When no provision is made on the live-steam line to remove the condensed water before it reaches the hammer other complications follow. The hammer must always be ready for immediate use when the smith reaches it, and water not removed from the steam line quickly chokes the cylinder and valve.

A common source of waste about the older types of steam hammers is due to their not being provided with automatically operated oilers. I have seen such hammers provided with a hand-operated oiler, which the helper worked now and then when he chanced to think about it. Each time he pumped from ½ pt. to 1 pt. of oil into the cylinder, and of course immediately the hammer went into use nearly all of this oil was blown out with the exhaust steam. An automatic oiler feeding a drop or two a minute only when the hammer is in use would be far more efficient, saving most of the oil otherwise used and insuring that the hammer would be efficiently oiled.

The best lubricant I have found for the guides of the hammer is a mixture consisting of 1 lb. of white lead thoroughly mixed into ½ gal. of heavy cylinder oil. This is applied with a brush to the guides, valve cam and slide and will stay on longer than machine oil.

Bill Introduced in Congress to Dispose of Surplus Machine Tools

Representative Charles Pope Caldwell of New York on Tuesday, February 4, introduced the following bill:

> **To provide for further educational facilities by requiring the War Department to loan certain machine tools not in use for Government purposes to trade and technical schools and universities; and for other purposes.**

Be it Enacted by the Senate and House of Representatives of the United States of America in Congress Assembled **that the Secretary of War shall lend to trade and technical schools and universities and other recognized educational institutions which in the discretion of the Secretary of War should have such equipment the machine tools suitable for their use which are owned by the United States of America, which are under the control of the War Department, and which are not being used for Government purposes;**
Provided, however, that each institution so equipped shall be responsible to the United States of America, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

The proposal that the Government use this surplus equipment to equip trade schools throughout the country was made in the American Machinist, January 23, 1919, in an editorial entitled "The Solution of the War Tool Problem."

It now remains for *you* to get back of this movement with all of your energy. It requires no argument to demonstrate that the establishment of national trade schools guarantees American industrial supremacy.

Wire your representative in Congress today!

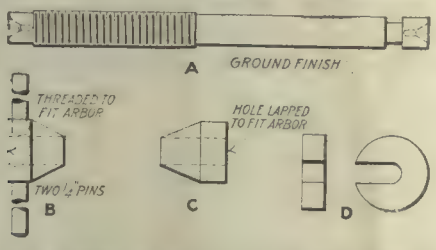


Mandrel for Grinding Wristpins

By Edward N. Moor, Jr.

The drawing shows a quick-change mandrel for holding automobile wristpins for grinding.

Part *A* is made of machine steel casehardened and ground and of suitable diameter to slip onto the bore of the wristpin. The hardened cone *B* screws into the mandrel and carries two pins for the purpose of setting up the nut and also to act as drivers, thus doing away with the necessity for the dog. Part *C*, the other cone, is a push fit on the body of *A*, and part *D* is notched to fit the neck in *A*. For loading the mandrel part *B* is



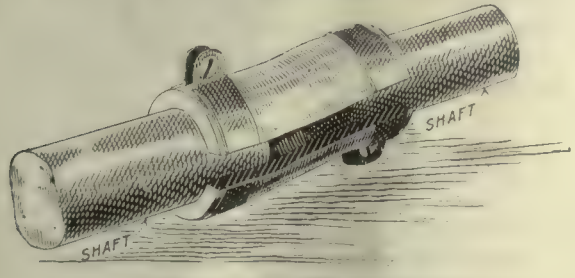
MANDREL FOR GRINDING WRISTPINS

left in place and is adjusted lengthwise to fit different lengths of pins. First slip on a wristpin and then slide on part *C* and drop part *D* into the notch. Hold the wristpin and mandrel in one hand and set up *B* with the other hand, using the two pins as a wrench.

An Efficient Flexible-Shaft Coupling

By W. Heusser

Two shafts each $1\frac{3}{16}$ in. in diameter were out of alignment about $\frac{3}{16}$ in. Commercial couplings were tried, but did not work satisfactorily. Finally the two



HOSE FOR SHAFT COUPLING

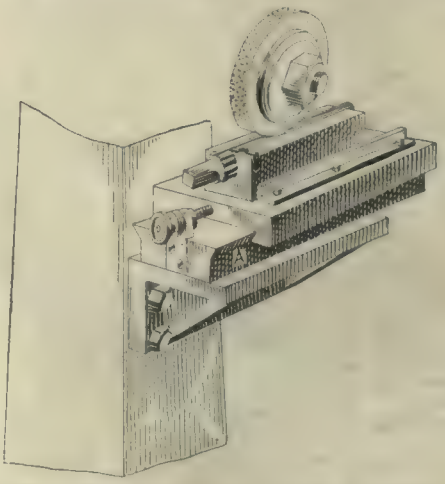
shaft ends were connected together by means of a short piece of heavy steam hose, as shown in the sketch. This coupling has proved satisfactory in every respect. It is noiseless and flexible, requires no oil and no attention whatsoever, besides being very cheap. The length of the hose is 6 in., the inside diameter $1\frac{1}{4}$ in. and the outside diameter 2 in. The wall is inlaid with heavy cotton fabric. It transmits 1 hp. at a speed of 350 r.p.m., has been running for one year and shows no sign of wear.

Grinding Taper Reamers in a Small Shop

By J. A. Lucas

In a little country machine shop, the grinding equipment of which consisted of a lone tool-grinding machine of the usual pedestal type with double end arbor, some taper reamers had to be reground.

The shop was what is sometimes known as a "one-man" or a "two-man" shop, having but one lathe, one drilling and one shaping machine, a power hacksaw, etc., including the tool-grinding machine referred to. There



DEVICE FOR GRINDING TAPER REAMERS

were four of the reamers, each of a different taper, and they had been purchased at odd times to meet special requirements.

A cutter and reamer grinding machine was beyond the proprietor's means, and even had it not been its purchase was not warranted by the amount of work that could be provided for it. There was no near-by shop with such a machine to relieve the situation, and the "old man" was thrown upon his own resources.

The tool-grinding machine had been fitted with a table by bolting an angle plate to the pedestal, and vertical

adjustment of the work could be accomplished by means of a separate device shown at *A* in the cut and which consisted of a pair of sliding wedges dovetailed together after the manner of the cross-slide of a lathe, and provided with an adjusting screw.

To grind the reamers a square block of cast iron was first planed up all over and a hole drilled lengthwise through it, this hole afterward being reamed with the taper reamer to be ground. One side was then planed away approximately parallel with one side of the tapered hole, intersecting the latter at a point that would leave one tooth of the reamer exposed for its full length.

With the reamer in the hole, care being taken that the exposed tooth was exactly in the center of the opening, the block was placed in the vise of the shaping machine, resting upon the edge of the exposed tooth, and the bottom of the block was planed parallel.

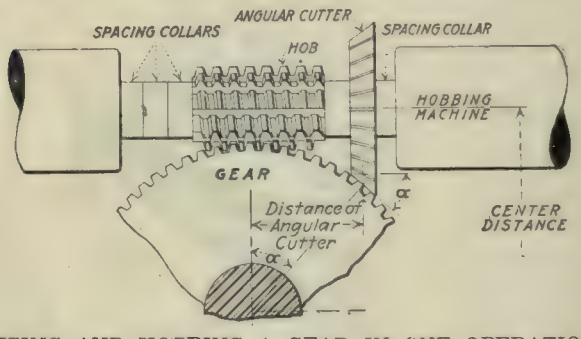
A steel finger for indexing completed the device and by running the block back and forth under the grinding wheel the reamer was ground as well as could have been done on a regular machine.

As the four reamers were of different taper it was of course necessary to provide each one with a block.

Sizing and Hobbing a Gear in One Operation

By Nikola Trbojevich

By mounting an angular cutter on the same arbor with the hob on the hobbing machine, as shown by the drawing, it is possible to cut a gear from a rough blank in one cut. The angular cutter takes care of the outside diameter, while the hob generates the teeth. This method of producing gears compares favorably with either of the other two usual methods: Turning the blank on a lathe or turret machine to the exact outside



SIZING AND HOBBING A GEAR IN ONE OPERATION

diameter and hobbing the teeth, or turning the blank to an approximate diameter and hobbing it with a so-called topping hob, a hob which removes metal from tops of teeth as well as from the sides and bottom. The first method requires a distinct, though, as a rule, not expensive, additional operation of turning. It also should be taken into account that when the forming of the outside and pitch diameters is done at two different settings and on two different machines the circles are likely to be not quite concentric, which is an error commonly found on gearing.

The topping hob obviates this latter difficulty with respect to the concentricity, but the amount of stock that can be removed with a topping hob from the outside diameter is somewhat limited. Besides there are some other difficulties connected with the use of topping hobs. In order to get a good-running gear it is often necessary to cut the teeth a trifle deeper than standard, while in some other cases a better result may be obtained by holding the hob back. In either case it is desirable to leave the outside diameter unchanged, which cannot be done with a topping hob.

It is interesting to note that the device, as shown in the cut, is adjustable within wide limits. By shifting the angular cutter toward or from the center line the outside diameter of the blank can be regulated, due to the taper effect of the arrangement. When the hob becomes dull and it is desired to shift it along on the arbor in order to bring another unused portion in contact with the gear it is only necessary to transpose one or more of the spacing collars from one side of the hob to the other. This will leave the angular cutter undisturbed in its position with respect to the center line because the total length of the hob and the spacing collars remains unchanged while the hob is shifted into another position.

The most advantageous angle and diameter of the angular cutter can best be determined from a fairly accurate layout by scaling. The nearest standard angle and diameter can be taken then because, as already explained, there is nothing particularly exact about the diameter and angle of cutter because of the adjustability of the mechanism. It is a good thing to place the cutter on that side of the hob which is advancing with respect to the gear blank, as then the cutter will work ahead of the hob and in that way size the blank before the hob had any chance to cut in.

It is also obvious from the diagram that the same arrangement may be used for cutting spiral gears.

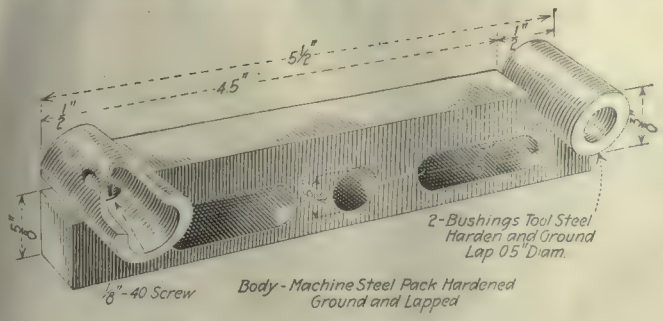
The above arrangement should be found useful in quantity production. A considerable advantage would be derived from the method in case of hardened gears having ground holes. As the outside and pitch circles are absolutely concentric the hole could be located rather from the outside than from the pitch circle, which would greatly simplify the problem of correctly holding the work in the grinding machine.—[We are in some doubt as to the practicability of this method, and for two reasons. Because of the angular position of the cutter arbor the cutter would not advance squarely to its cut but would have a tendency to turn the gear about its axis. This might or might not be detrimental to the surface produced, depending chiefly upon the rigidity of the setup. The principal difficulty, however, arises from the fact that the sizing cutter would reach the work an appreciable distance in advance of the hob, and the time wasted in feeding the cutter over this otherwise idle distance would serve to turn several gears in the ordinary manner.—Editor.]

A Simple Design of Sine Bar

By John Teckeer

One tool that is missing in the average toolmaker's kit is the sine bar. Micrometers, verniers, height gages and other expensive tools are there, but the sine bar is missing. This is due both to the scarcity of these tools and the difficulty of making one in working hours. The sketch shows a simplified design, accurate and much easier to make than the usual type.

As will be noted the diameter of the bushings must be accurate; the spacing, 4.5000 in., is equally important and the shoulders must be square with the sides. The



SIMPLE FORM OF SINE BAR

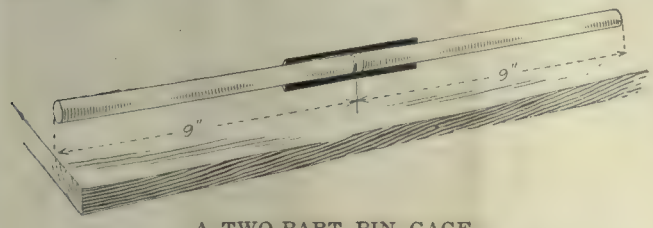
⅝-in. dimension can vary any amount provided both ends are the same. The slots and hole in the center are for convenience in attaching the bar to an angle plate.

Making Pin Gages Too Long for the "Mike"

By William Seelert

A clever shop kink came to my notice lately, which perhaps would be of interest to some of the practical men who read the *American Machinist*.

We had occasion to make some large pin and snap gages that called for a tolerance of 0.001 in. plus or



A TWO-PART PIN GAGE

minus, but were several inches larger than the largest micrometers in the shop.

This difficulty was overcome by making two pin gages, which afterward were held together by a snug-fitting bushing in the manner shown in the sketch. Thus an 18-in. gage was made by fitting two 9-in. pins. The latter came within the range of the outside micrometer available, and the necessary accuracy was obtained without trouble. The outside snap gages were adjusted to these pin gages. With this arrangement accurate gages can be made of two or three times the range of the largest "mike" on hand.

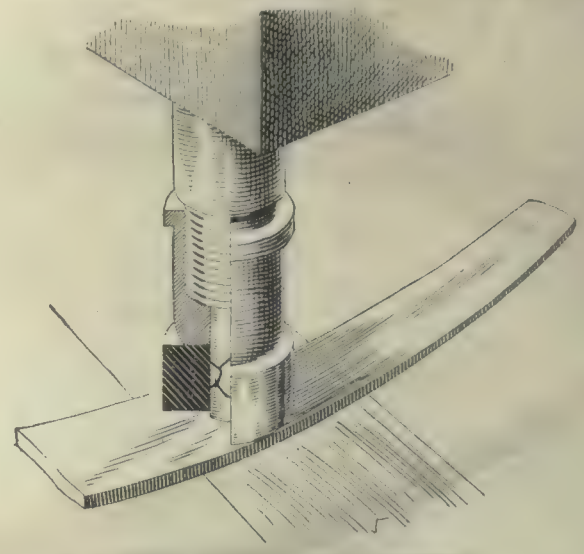
A Simple Guard for Punches

By L. W. Kinney

We have an operation of punching the center bolt hole in spring leaves. The leaves run from Nos. 6 to 00 B.W.G. in thickness, and when they are a little hard it is not unusual to break 20 or 30 punches in running a day's work of 30,000 holes. These punches in breaking often fly and injure the operators.

It is very difficult to arrange a guard that will protect the operator and at the same time not decrease the production. After trying several guards the idea was suggested to me of putting a soft rubber ring over the punch. The rubber compresses when the punch strikes the work, and when the punch breaks the particles are prevented from flying.

I have used these rings for over three years and have



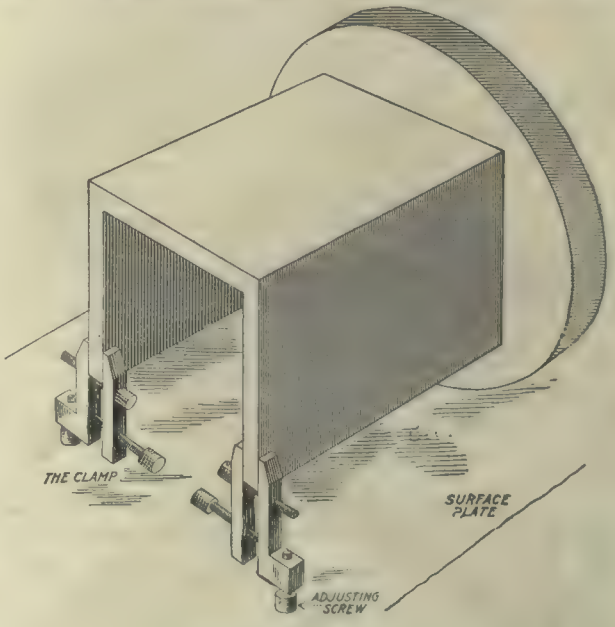
SIMPLE GUARD FOR PUNCHES

not had a man injured while using them. One rubber lasts about a week. The sketch shows the punch holder and punch with rubber ring in place.

A Handy Adjusting Clamp

By John Teckeer

A few days ago I noticed the inspector squaring up an awkward fixture preparatory to checking the dimensions. This particular casting was most irregular and



ADJUSTING CLAMP

had no favorable spots under which to set small jacks, nor was the finished surface convenient to strap against an angle plate. The outline of the fixture is shown in the sketch and the method of using the clamps is apparent. I believe the idea to be worthy of a wider field, so I am passing it along.

Lest We Forget

One of the greatest lessons we have learned from the war is that 80 per cent. of preparedness consists of "knowing how."

AS LONG as warfare is a possibility we must keep alive that knowledge of the engineering of war that we have gained at so much cost. This is not jingoism but common-sense patriotism.

At the outbreak of war the total commissioned personnel of the Ordnance Department was about 100 officers, whose collective knowledge of ordnance engineering, one of the most highly specialized sciences, represented the sum total of ordnance knowledge available to the War Department. Now several thousand civilian engineers have learned at least the rudiments or essential principles of this science.

Ordnance manufacture was known to less than a dozen arsenals, and considerably less than a hundred private plants in the United States. Now several thousand of our manufacturing plants, including practically all of our principal machine shops, have dealt with it.

Relations have been established between our regular army officers, our reserve officers, our manufacturers and our civilian engineers. It took time and cost many lives to establish these relations and to build up this working acquaintance.

What are we going to do with it?

Until the time comes when it is unmistakably safe to let this knowledge die, it is the sacred duty of every manufacturer, every civilian engineer, every regular officer and every reserve officer who has been connected in any way with ordnance to keep this knowledge alive and these relationships continued.

To facilitate this end and to promote the establishment of an American Ordnance Association which will include the officers who remain with the Government, the reserve officers who go back to private life and all of the civilian engineers and manufacturers who make ordnance possible, the *American Machinist* announces the establishment of a new editorial section known as "United States Army Ordnance News." In this section will be presented what has been learned by experience concerning ordnance design, manufacture, inspection and test. Personal notes concerning the members of this association will enable new acquaintances to be made, old acquaintances to be renewed or continued, and promote a community of fellowship between those who have evidenced their belief in preparedness by having served in our shops or army departments.

Additional pages will be added to our editorial section so that the incorporation of this material will not decrease the amount of our normal subject matter.

When the League of Nations throws the guns of the world upon the scrap pile, then, and not until then, can we safely forget what we have learned. Let each of us in the meantime serve our country by keeping alive the knowledge gained by experience and adding to it. It is a very practical thing that each of us can do toward the assurance of peace.

(See Page 263 of this issue)

U.S. ARMY ORDNANCE NEWS



THE Inspection Division of Ordnance has had its troubles, and they have been many. No organization can deal with more than 5000 contractors of all kinds, not to mention many more subcontractors, on a great variety of products and have smooth sailing all the way. As with other branches of inspection it has been the buffer between two opposing forces and has been "cussed" with equal fervor by both sides, but just as the shop inspector who plays the game squarely and has a fair amount of tact can eventually show both sides that he is a help and not a hindrance, so the Inspection Division came into its own.

There are of course as many varieties of inspectors as there are of contracts. And it is absolutely impossible to gather a large force of inspectors at short notice and under the trying conditions of war without picking some undesirables, the same as in any other business; but these were weeded out as fast as possible, and the average manufacturer today admits that the men of the Inspection Division helped production. The various proving grounds are the best evidence as to the quality of the munitions supplied. The Inspection Division has 12 branches in which we are particularly interested, these being artillery ammunition, carriages, education, explosives, gages, guns, instruments, machines and containers, metallurgical, proving ground, small arms, small-arms ammunition and trench warfare. The heads of these divisions are all shown in the organization chart which accompanies this article and which also shows the duties of each officer and the particular work which he directs.

The personnel of the Inspection Division during the first week in November consisted of 709 officers, 775 enlisted men and 26,450 civilians. Among them were one or two men who had been receiving from $50,000 to $60,000 a year before entering the service; 25 or more received over $10,000 a year, and with few exceptions every man entered the division at a financial sacrifice. Of the 709 officers there were 1 brigadier-general, 2 colonels, 15 lieutenant-colonels, 72 majors, 221 captains, 306 first lieutenants and 92 second lieutenants. Among the civilians all but 728

The Inspection Division has been called the watchdog of quality, but it is more than that. It has been the coördinator of the manufacturing capacity of the country. It has helped manufacturers to obtain greater tolerances where necessary; it has shown them how to get production in many cases; it brought together the makers of different components and helped keep the stream of munitions flowing to our boys in France. Its men, both military and civilian, faced the dangers of explosion in every loading plant and at the proving grounds, losing only twelve men in the great disaster at Morgan.



Preparing to load a monster howitzer. This is one of the late railway mounts. The cylinder above and to the right is one of the four recoil cylinders.

were employed in the district offices, this being divided as shown in the table. The large proportion of females is somewhat astonishing, and while the great majority of them were employed in a clerical capacity, there were a number doing government-inspection work in the various divisions, the heads of the various branches speaking highly of their work.

TABLE I. CIVILIAN PERSONNEL OF INSPECTION DIVISION ON NOVEMBER 2, 1918

	Males	Females	Total
Philadelphia	2,287	1,925	4,212
New York	1,975	1,591	3,566
Bridgeport	1,797	1,361	3,158
Chicago	1,143	917	2,060
Rochester	1,085	819	1,904
Toronto	874	904	1,778
Detroit	918	819	1,737
Cincinnati	845	812	1,657
Cleveland	927	571	1,498
Boston	466	953	1,419
Pittsburgh	649	733	1,382
Washington	337	616	953
St. Louis	243	155	398
Total	13,546	12,176	25,722

Personal equation counts in the Inspection Division to an even greater extent perhaps than in any other. Contractors occasionally went to Washington to complain of the inspector in their plant, but when asked to make specific charge or to state in what way they would have his decision changed they were unable to do so. Different temperaments clash instead of coöperate, and this was more noticeable with the Inspection Division and the contractors because of the constant contact between the two, but nearly all branch heads can cite instances where a transfer of inspectors proved beneficial to both sides.

The Question of Tolerances

The question of tolerance always arises wherever there is inspection, and this probably caused more disputes than anything else. Often have contractors gone to Washington to obtain greater tolerance on various parts, and having been successful found themselves no better off than before. Others were refused increased tolerances because most of the other shops doing the same work had no difficulty, and it was proved to them that the trouble was not so much with the tolerance as with their organizations.

An outcome of the insistent demand for specified tolerances was that it led to improved shop practice, as shops that formerly did not or could not work to fairly close limits were educated to find it possible and profitable to do so. Contractors have stated that whereas they thought they were doing good work before, it was war work that taught them what good work really is.

Other contractors admit that contrary to expectations the proportion of rejected material was frequently higher where large tolerance was permitted than where the work was held within close limits. This may only be explained by the psychological effect exercised on the worker who unconsciously becomes careless when a wide limit of error is allowed. In this connection, it may be well to call attention to the bad practice in some shops of using working gages of a wider limit of tolerance than the final-inspection gages. This often comes about from the habit of selecting gages as they come from the toolroom and keeping the most accurate ones for the final inspection and allowing the less accurate to be used on the work as it comes from the machines. The most successful contractors reverse this procedure and never allow the shop as much tolerance as can be passed in the final inspection. By this means they are assured that anything that satisfactorily passes the shop gages will be passed by the final inspection, and sometimes work that may have been rejected by the shop or working gage can be finally passed by the inspector's gage.

Gages Last Longer With Women

Again, in the matter of gages, an officer of the Inspection Division who was responsible for large production of shells and other ammunition unhesitatingly voiced his preference for women inspectors, first, as we might perhaps have good reason to expect, because their delicate touch was a distinct aid, and second, which is an entirely new idea to most of us, because the gages lasted longer when used by women than by men. This may be attributed to the same delicate touch and is not surprising, even if it has been overlooked in the past.

In ordinary manufacturing the Inspection Division has been the mediary between the contractor and the designer, in this case the Engineering Division, in endeavoring to obtain more liberal tolerances and also to influence design in view of its effect upon manufacturing. In this way it acted in a dual capacity, and when manufacturing got well under way it was admitted that the Inspection Division had done excellent work and had been instrumental in obtaining this production.

In the beginning all inspection work was centralized



Mobility is one of the greatest assets of artillery. This 9.2 howitzer can be fired directly from the tractor without the necessity of bracing of any kind.

in Washington, but this was not found as efficient as desired, so district offices were established. One of the big advantages accruing from this was the rapid adjustment of misunderstanding and the settlement of uncertainties without delay. The traveling supervisors who were first used found it impossible to visit the various districts often enough to prevent work being delayed. The visits of contractors to Washington were also unsatisfactory to both sides, as it often became necessary to refer to past correspondence and to review the whole case. After April, 1918, however, when the district offices began to function, there was a noticeable improvement in production, due in no small measure to their being able to take up and to settle nearly all questions without delay.

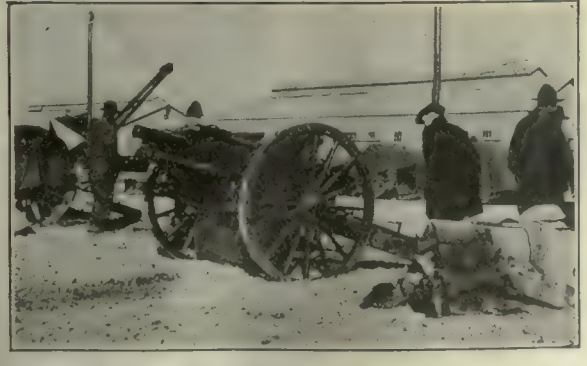
Engineering Division Decides Tolerance

Questions of tolerance or of design of course had to be decided by the Engineering Division, and this led to the placing of a representative of this division in each office. This course was not altogether satisfactory largely because of the difficulty of obtaining engineers who were familiar with the many products that were made in a single district. And, just as electrical-apparatus manufacturers and others have a central engineering department which coöperates with their district offices, it seems that a similar arrangement should be best for Ordnance.

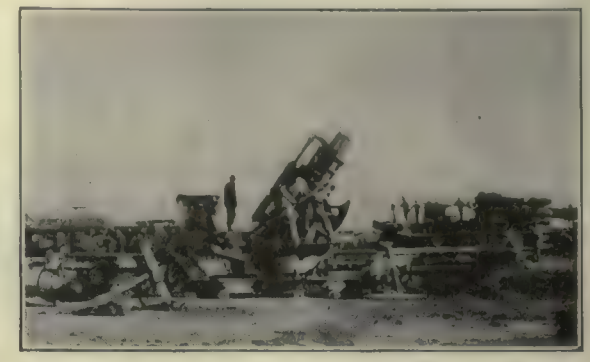
The field of activity of the Inspection Division is much broader than is understood. Planning, for example, which we always think of as being solely a function of production, plays an important part in the Inspection Division, and is divided into branches and groups, such as the Analysis Branch, the Records Branch and the Order of Work Branch. Each branch has one or more groups, as follows: In the Analysis Branch are the Schedules and Estimates Group. In the Records Branch, the Contract-File Group, the Progress Group, the Blueprint and Specifications Group, and the Index Group.

Work of the Schedules Group

The Schedules Group investigates contracts and ascertains whether or not the contract has been lived up to in detail, and takes steps to rectify any errors. It gets advance information from the Control Bureau or Procurement Division in regard to the material, quantity and kind, with the drawings and specifications applying



A gun that the French ordnance experts pronounced superior to their 75. The American split-trail 75 has greater latitude in elevation and traverse.



A mortar with a mount designed for use on the railways in France. Mortars are used in the destruction of earthworks and forts and fired at high elevations.

to each which enables the Inspection Division to have its inspectors on hand with the proper equipment as soon as the manufacturer has material to deliver. This is a marked improvement over the old system, where the Inspection Division was informed after the material on contract had been manufactured and was ready for inspection. The record of all contracts for ordnance, ammunition, equipment, material and stores is kept by this group, so that quick reference is always obtainable and shipping instructions available when material is ready. Approximately 100 contracts a day were handled by this group.

Reports Compiled by the Estimate Group

The Estimate Group audits all civilians' and officers' travel vouchers, averaging 30 a day. It compiles reports showing the cost of inspection per unit, audits vouchers covering purchase of material by ordnance departments. The Contract-File Group has a copy of all requisitions, procurement orders, contracts, amendments and other papers pertaining to ordnance orders. These files are also used by the various groups to distribute the material pertaining to war orders, such as progress reports, new data, etc.

Progress Reports on 8000 Contracts

The Progress Group distributes, files, checks and furnishes information about the weekly progress reports. Five copies of progress reports on 8000 active contracts went into this office each week, the majority being received during the first three days. They had to be carefully matched up, distributed and rapidly handled in order to correctly route such a large number of reports to the operators who desire them. This group also looked after delinquent reports and supplied information to the district offices.

The Blueprints and Specifications Group belongs to the Records Branch and supplies information to the sections and groups of the Inspection Division. It maintains a reference file containing copies of all ordnance drawings and specifications, and supplies all the sections of the Inspection Division with drawings for the inspection of material being manufactured. The index records of all ordnance material, numerical, alphabetical, geographical and the kind or nature of the material, are maintained in the Index Group. The numerical index is a complete serial file in which all numbers under

ordnance classification are filed either as active or completed contracts. This also shows whether the inspection is being carried on through the Ordnance Department or not, also supplying full information regarding an order upon which only the number is known. The alphabetical index is filed according to the name of the firm; the file is also supplemented by all available subcontract information, which is automatically supplied from the various districts. Until the installation of fixed records there was confusion over subcontractors, these being unknown to the Ordnance Department. The other files have their own fields of usefulness, as has the Interbureau Record which shows whether part of an order has already been inspected or purchased by another division, such as aircraft, construction, engineers, etc.



Vehicles for the transportation of supplies are important. This caterpillar-equipped cargo carrier will travel on soft ground and climb grades of 45 degrees.

The Order of Work Branch distributes and routes all kinds of contract information to the Inspection Division and district offices. This information includes copies of letters sent by the negotiator to the contractor, procurement information cards, requisitions for contracts and procurement orders or contracts. This branch distributed about 400 orders daily, seven copies of each requisition and four copies of each contract being necessary to supply the parties interested. It also routes incoming and outgoing reports, mail and documents for the Planning Section. It forwards and follows up requests for information necessary to keep the various cards and files up to date. It is the connecting link with other divisions of the Ordnance Department on proper routeing methods in order to bring about the greatest efficiency in the distribution of information.

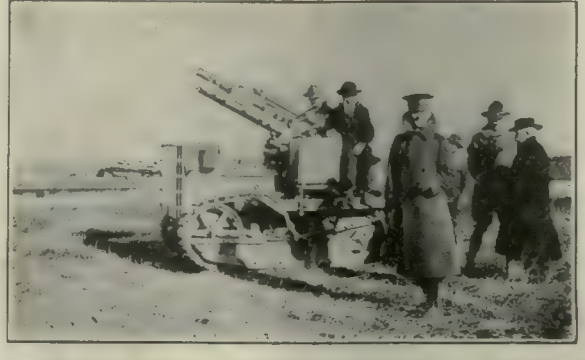
The Metallurgical Branch

The Metallurgical Branch of the Inspection Division has made a name for itself which few realize. Beginning with Capt. A. A. White (not a relative of the present head, Maj. A. H. White) and a stenographer in May, 1917, the branch has developed until there were 425 engineers of tests in the field in addition to the office force necessary to maintain the records in Washington and at the district offices. This clerical force was remarkably small, considering the amount of work it handled. The difficulty of getting men with the right training led to the establishment of training schools at Carnegie Technical Institute at Pittsburgh giving a six-weeks' course to those who already had at least two years of college work along similar lines. This was not confined to men, as there were about 20 women in the force, which number would have been increased had the war continued. While some of the work consisted of chemical analyses, such as where one project for 20,600,000 shells for 75-mm. guns required over 80,000 chemical tests, the bulk of it was physical, the physical tests running up to more than 700,000. Watching the heat treatments is the hardest task in this branch, and it is very important that there should be an observer at each furnace at all times to note the heat used and to check up the results.

Some idea of the size of this job may be had from the fact that a record is kept of the heat of every contract of every size of shell, and these records are instantly available in the Washington office. This meant the checking and recording of from 3000 to 3500 records every 24 hours and this was done with a force of not over 20 people in the office, a record which can hardly be equaled in business offices boasting of great efficiency. To show that these are not all simple records a few are reproduced herewith.

Each District Has Inspection Metallurgist

Since the adoption of the district plan each district has an inspection metallurgist who supervises all metallurgical work in his district and is responsible for the acceptance and rejection of all material from a metallurgical standpoint. This includes raw-material plants producing ferrous and nonferrous metals, specifically steel mills; steel and forging plants under the same management; cannon-forging plants; plants producing armor plates for tanks, tractors and carriages; smelters and refineries; bronze, brass and other nonferrous alloys; rolling, milling, spinning, stamping, cupping and drawing plants, etc. In addition to the inspection of material in various stages of construction, this division must be kept in touch with the whole field and it is constantly called upon to give advice on and to decide matters which, if decision is not rendered, delay the production of material which is urgently needed. As a sidelight on this part of the work the record of 12 days' work last March shows some interesting data. In addition to routine letters, which count up in any office, this branch wrote 408 letters deciding some



A 75 mounted integral with its means of locomotion. The speed with which this gun can be brought into position, fired and again be under way is astonishing.

matters at issue (known as "judgment" letters) and took part in 890 conferences on matters pertaining to the work of the branch. The record of the Metallurgical Division in reference to steel shells, for example, begins with the furnace and gives the heat number, code number, date poured, date fractured, size and weight of ingot, number of blooms accepted and rejected, number of bars accepted and rejected, amount of the top and bottom discard, additional discard for chemical and physical reasons, kind of fracture, kind of surface and mill loss. These records have enabled the different mills to know exactly what they were doing, and in some cases to improve the quality of their output. The shell inspection is complete and gives the heat treatment of every lot, number of pieces in the heat, dimension of the test piece, elastic limit and ultimate strength, elongation and reduction of area, fracture bending test, Brinell reading and maker's chemical analysis.



An 8-in. coast-defense rifle equipped with an improvised mount for field service. Very high velocities and long ranges are obtained with this defense rifle.

Personals from the Ordnance Department

Gen. Guy E. Tripp, formerly chief of the Production Division of Ordnance, who separated from the service on Nov. 21, 1918, and returned to his duties as chairman of the board of the Westinghouse Electric and Manufacturing Co., 165 Broadway, New York, is a director in the American Surety Co., S. R. Avis & Sons, Inc., Bryant Electric Co., Canadian Westinghouse Co., Ltd., Chase National Bank, Interborough Consolidated Corporation, Interborough Rapid Transit Co., Krantz Manufacturing Co., the Morris Plan Co. of New York, New England Westinghouse Co., R. D. Nuttall Co., Pennsylvania Electric Co., Penn Barrel Co., Pittsburgh Meter Co., 145th Street Crosstown Railroad Co., J. Stevens Arms Co., Wabash Railway Co., Westinghouse, Church, Kerr & Co., Inc., Westinghouse Electric and Manufacturing Co., Westinghouse Electric Export Co., Westinghouse Gear and Dynamometer Co., Westinghouse Lamp Co.; chairman of the board of Westinghouse Metallfaden Gluhlampenfabrik Gesellschaft m.b.H., Vienna, and chairman of the board of Westinghouse Metal Filament Lamp Co., Ltd., of London. He is a member of the following clubs: American Yacht, Bankers' Club of America, Crow Point Golf, Economic Club of Boston, Economic Club of New York, Engineers Club of Boston, Exchange Club of Boston, Greenport Car, Greenwich Country, Hingham Yacht, India House, Lotos, Metropolitan Club of New York, Railroad Club of New York, Union League Club of New York, University Club of London and Wompatuck, Hingham, Mass. He is also a member of the Business Federation of America, Chamber of Commerce of the State of New York, Chamber of Commerce of the United States of America, Council on Foreign Relations, Greenwich Casino Association, Inter-Racial Council, Japan Society, Jovian Order, National Geographic Society, National Marine League, National Security League, New York Board of Trade and Transportation and Philippine Society.



Equipped with two Ford engines this two-man baby tank will negotiate at speeds that are surprising. The skids at the rear prevent back somersaults.

Officers in the Ordnance Department who have served in the American Expeditionary Forces are being returned to this country in considerable numbers. When the armistice was signed almost exactly one-third of the officers of the department were overseas and others were going at the rate of about 1 per cent. a week.

Nearly all of the officers returning are being discharged and as many of them serving in America as can be spared. Up to Jan. 28, 1591 had been discharged, or more than a fourth of the whole number.

Most of the officers who were recruited for work with mobile ordnance repair shops and who were not attached to tactical organizations or sent overseas have been discharged. These officers had intensive training in repair and maintenance of motor equipment and ordnance matériel. They are thoroughly familiar with machine-shop practice and operation. There were over 200 of these officers, and practically all will return to their former homes in the automobile centers of the Middle West.

Among the officers recently discharged is Capt. Robert C. Davis, who was for a long time a member of the Washington Examining Board. He had just returned from 11 months' service overseas on important work.

First Lieut. Lloyd B. Duntley of Minneapolis, Minn., who was employed by the Emerson-Brantingham Co., before entering the service, was discharged on Jan. 29.

Maj. Joseph G. Woodbury, who was formerly with the Remington Arms Co., Bridgeport, Conn., was discharged recently. He is also a veteran of the Spanish War.

Capt. Samuel W. Burford,

who has just returned to civil life, was formerly with the Cleveland Mining Co., Cleveland, Ohio, as mining engineer.

Capt. Walter M. Ruby of Oneida, N. J., has been discharged. He was in the service nearly 20 months and was promoted to a captaincy in June, 1918. He studied at Massachusetts Institute of Technology and was for a time with the H. H. Franklin Manufacturing Co., Syracuse, N. Y.

Second Lieut. S. N. Kellogg, who was recently discharged, was formerly with the Packard company at Newark, N. J. He was promoted from the ranks and became an instructor at the Motor Instruction School at Raritan Arsenal.

Lieut. Robert C. Black of Lima, Ohio, had over a year's service at Rock Island Arsenal. In civil life he was a mechanical engineer engaged in locomotive construction with A. R. Ayers of Cleveland, Ohio.

Maj. William C. Rogers, who has been discharged, was for many years connected with the New York Department of Labor. He served as Deputy and Acting Commissioner of Labor and chairman of the State Industrial Board. His work in the departemnt has been on industrial problems.

Lieut.-Col. Bernard T. Converse, discharged Jan. 29 after 14 months' service, was promoted to that grade in August, 1918. Before entering the service he was with the Baldwin Locomotive Works at Philadelphia.

Lieut.-Col. Egbert Moxham was recently discharged. He entered the service as major in January, 1918. Before being commissioned he was president of F. B. Foster & Co., Philadelphia, and was previously vice president of the Ætna Explosives Company.

Lieut.-Col. E. Tyden, general factory manager of Rock Island Arsenal, returned to civil life after two years of active service in the Ordnance Reserve Corps. A retired business man of unusual ability and perception he was brought to the Rock Island Arsenal from Washington, D. C., through the urgent request of the late Colonel Hillman at the time of the latter's appointment as commanding officer. As general factory manager he has had much to do with speeding up production at Rock Island Arsenal during the war.

Col. Harry B. Jordan, Ordnance Department, U. S. A., succeeded the late Col. L. T. Hillman as commanding officer at Rock Island Arsenal. Colonel Jordan is a native of Kentucky, being born Feb. 26, 1876. When the expeditionary forces of the United States were sent to France Colonel Jordan was one of the first ordnance officers sent abroad, where he was placed in charge of the construction of arsenals. For more than one year he was at this work, and was then brought back to the United States with the rank of colonel and placed in charge of the artillery section in the office of the Chief of Ordnance.

Expansion of Rock Island Arsenal

For some time prior to the outbreak of the war in 1914 the employees at Rock Island Arsenal totaled approximately 1800 men and 175 women, the latter all office workers, typists and stenographers. From that time until the spring of 1916 there was little tendency to increase the number of workers, but at that time the disturbance on the Mexican border started increased activities here, and by July 1, 1916, there had been added to the force about 100 men and 25 women, the latter still being confined to clerical positions. From that time until the United States entered the war employees were added at the rate of about 200 a month, and on Apr. 6, 1917, there were employed 3600 men and 300 women office workers. High speed and maximum production then became the watchword and employees were added at a rate of about 250 to 300 a month. On Dec. 31, 1917, the total was 6100 men and 376 women office workers. On May 31, 1918, this total was increased to 8926 men and 450 women office workers. About 100 women shop workers had also been employed. The first of the women shop workers were employed May 20, 1918, and when the armistice was signed about 1500 women were employed in the shops. The following table shows the increase in the number of employees during the war period:

	Men	Women
August, 1914	1800	175
July, 1916	1900	200
April, 1917	3600	300
January, 1918	6100	376
May, 1918, (office 100) shop	8926	450
July, 1918	10,268	572
August, 1918	11,244	722
September, 1918	11,899	902
October, 1918	12,342	1227
November, 1918	13,361	1417

Applications of Electroplating

Electroplating played an important part in war work. Zinc plating furnished an excellent and, in many cases, the best protection against the corrosion of steel parts, such as airplane and seaplane fittings, fuse parts, hardware on ammunition boxes, etc. Black nickel plating was very extensively used for producing the so-called "government bronze" finish on brass hardware and saddlery equipment. Lead plating proved valuable in the lining of gas shells and for bringing up to standard weight shells which were underweight. In connection with these problems a number of investigations were conducted at the Bureau of Standards, whose experts made frequent visits to munition plants to advise upon the best methods of securing the desired results.

Appropriations have been requested by the Department of Commerce to permit more exhaustive study by the Bureau of Standards of plating problems and their application to various manufacturing industries. Electroplating is an industry which while not itself of great magnitude is often of fundamental importance to larger industries. Thus electroplating is essential to the manufacture of tools, builders' and saddlery hardware, plumbers' supplies, gas and electrical appliances, automobiles, silverware, jewelry, stoves, household utensils, mechanical devices, such as phonographs, cash registers, sewing machines, adding machines, typewriters, cameras and other optical and scientific instruments and in fact almost every industry in which finished metal articles of any description are produced. Progress in the art of electroplating will bring about corresponding improvements in all such industries.

Pending the appropriation of funds adequate to conduct extended or exhaustive investigations on electroplating, arrangements have been made by the Bureau of Standards to obtain by inquiries addressed to platers reliable information regarding the kinds and methods of plating now in commercial use. From such a preliminary survey it is hoped to get much information that can be made immediately available.

ARMY ORDNANCE NEWS



The award of the Distinguished Service Medal to Maj.-Gen. C. C. Williams on Jan. 18 comes as a fitting recognition of the services of a soldier, engineer and executive who made good on both sides of the Atlantic during the war. For General Williams, as chief ordnance officer of the A. E. F. from May, 1917, to April, 1918, was the man who built and guided the tremendous machine that kept Pershing's boys supplied at all times with ordnance materials.

After the emergency machine abroad was built and running General Williams was sent to Washington to apply his experience and skill to the completion of the gigantic ordnance organization in America. Far less romantic was the work at home, and possibly it was harder work too, but the importance of it was emphasized by Secretary Baker when he made the following remarks accompanying the award of the highly prized medal:

"When we think of war we usually think of the battle front, and in this war we usually think of the trench, and its dangers are known to us all. The other side, however, does not come in for as ready appreciation and as full comprehension, and therefore I am particularly glad on this occasion to have an opportunity of saying a word about the other side. There is no rivalry of merit between the soldiers who were obliged to perform their services here and the soldiers who performed theirs abroad. They were all soldiers, and the first maxim of the soldier's calling is that he shall do his duty to the best of his ability where those charged with the responsibility of final direction designate his duty to lie. That errors are made in those designations goes without saying and it may very easily be that some men went abroad who might better have served at home, and that some served at home who could have served abroad with greater skill; but in the exercise of as impartial and uncolored judgment as was possible in the War Department the best interest of the nation was always the guiding principles, and as the result of our judgment a very large number of officers of the Regular Army of large experience were designated to do duties in this country. I perhaps more than anybody else am qualified to speak with authority of the splendid spirit with which those orders were accepted, the superb energy, skill and devotion with which those duties were performed."

The citation of General Williams reads as follows: "Maj.-Gen. C. C. Williams, U. S., Chief of Ordnance.

"For exceptionally meritorious and distinguished services. An officer of high professional attainments, who rendered particularly valuable services in the organization of the Ordnance Department of the American Expeditionary Forces and exhibited unusual ability in arranging for the procurement of ordnance material and ammunition for the American Army in France."

General Williams was born in White County, Georgia, his father being Capt. J. H. Williams of the Confederate Service. Captain Williams moved to Washington, D. C., when his son was 14 years of age. Here young Williams attended public school and graduated from high school in the class of 1889. He then entered West Point in 1890, graduating fourth in his class in 1894. From 1894 to 1896 he was at Fort Henry, Baltimore, Md., having been assigned to the Fourth Artillery stationed there.

General Williams, besides being a man's man, is a very modest gentleman, and it is very probable that the reserve officers who served under him and the manufacturers who coöperated with him know comparatively little about his personal history.

In 1896 he entered the Artillery School at Fort Monroe, leaving in April, 1898, to join the Sixth Field Artillery stationed at Washington Barracks. In May, 1898, he joined the Astor Battery, which was commanded by the present Chief of Staff, General March. He accompanied the Astor Battery to the Philippines, and in September, 1898, was made an aide on the staff of General MacArthur. In the latter part of 1898, he was transferred to the Ordnance Department and ordered back to the United States to take station at the Rock Island Arsenal. He remained at the Rock Island Arsenal until May, 1899, when he was ordered to the du Pont Powder Co., Wilmington, Del., for service lasting two years.

He then served a "tour" in the Ordnance Office, went again to Rock Island Arsenal for another "tour" of duty, and from there went to the Bethlehem Steel Co., where he was stationed from September, 1906, to September, 1908.

His next station was at the Watertown Arsenal where he remained until November, 1914.

Sent to England in 1912

While stationed at the Watertown Arsenal he was sent to England in January, 1912, for the purpose of studying the Hadfield methods of making shell. The Hadfield patent rights had been purchased by the Ordnance Department and General Williams was sent to the Sheffield Works of the Hadfield company to study these methods in anticipation of them at the Watertown Arsenal.

In November, 1914, General Williams was ordered to Germany as a military observer. The party of military observers remained in Germany from December, 1914, to April, 1915. During this time they visited the German lines at various points between Strassburg and Bapaume; also Antwerp, Louvain, Malines, Brussels and a number of other Belgian cities, and the eastern front in Poland at several places.

After his return from Germany General Williams was detailed for duty with the Ordnance Board at Sandy Hook, where he remained from May, 1915, to June, 1916, when he was detailed to the Southern Department as the chief ordnance officer. This was the time of the mobilization of the National Guard on the Mexican border and the future Chief of Ordnance gained considerable experience in the supply of ordnance material to troops at this time.

In March, 1917, he was ordered to the Ordnance Office in Washington and appointed a member of the machine-gun board which selected the Browning machine gun and the Browning machine rifle as the service weapons for the United States forces.

In May, 1917, General Williams was detailed as chief ordnance officer of the American Expeditionary Forces and accompanied General Pershing to France, where he was chief ordnance officer until ordered home in April, 1918. He was then designated Acting Chief of Ordnance and remained until appointed Chief of Ordnance July 16, 1918.

"Locating Knocks in Motors"

By Benjamin F. Miessner

My attention has been called to an article on page 107 of the *American Machinist* entitled "Locating Knock in Motors," by B. Z. Reiter, and I feel impelled to make some comment on the device therein described.

With all due regard to the genius and well-meaning of Mr. Reiter I think that it must be perfectly plain to anyone versed in either the science of acoustics or of electricity that the device in question cannot but fail completely to function for the purpose Mr. Reiter describes. Perhaps I will be pardoned for calling this fact to the attention of your readers before they become too interested in the device as described.

It would be instructive to know by just what channel Mr. Reiter proposes to transmit vibrations of the steel point to the telephone earpiece, assuming that the steel point is pressed against a vibrating portion of a gas engine.

Flexible telephone cords with a tinsel conductor certainly will not transmit the vibrations unless the cord be maintained in tension between the earpiece and the collar, which, it appears, is not intended nor would it be efficient. If this be the case, why is an electrical device—the telephone receiver—used?

If, on the other hand, the device is supposed to operate electrically it is difficult to understand why the telephone terminals are connected together and attached to the collar, inasmuch as the telephone is thereby short-circuited, so that even if by some magic method an electric current could be set up in the locating tube it could never reach the telephone windings and produce sound.

It is really a remarkably novel idea, and it would certainly be interesting to know whether Mr. Reiter has ever actually constructed and tried the scheme as illustrated.

Another Gage Joke

By James H. Follen

Dixie's gage joke on page 1172, Vol. 49, of the *American Machinist* goes to show how some men in responsible positions look on the problem of gaging work, but sometimes the joke is on the workman.

Way back in the dark ages when everyone was building bicycles Ole had a job turning hanger axles to a snap limit gage. The job being piecework Ole was running two lathes and making them "step lively," with the result that the pieces were not very accurate.

Ole being a firm believer in the well-known shop adage, "You can take off but you can't put on," rather leaned to the oversize idea, and on going over a pan of finished work representing quite a few dollars on his pay check found practically all of them larger than the go limit. He was somewhat worried, but hit on a happy solution. Picking out the largest axle he went over to the toolroom and succeeded in grinding out the go gage without anyone noticing him.

The work on going through the inspection room was of course rejected and the foreman on comparing Ole's gage with the master plug wanted to know "Howinell that gage got so large," whereupon Ole cheerfully admitted having ground it out and tried to square himself by saying, "Ay tank it bane a lot quicker to grind the gage dan to turn dam axles down all over again."

The "Coverage" of the Compensation Acts—I

By CHESLA C. SHERLOCK

The "coverage" of the workmen's compensation acts is a matter of paramount importance to all employers of labor, no matter what their immediate business may be. Under the term "coverage" many points of mutual interest arise and to determine what is the "coverage" of the acts is to determine who are employers, who are employees and what injuries are to be compensated.

COMPENSATION acts generally have had to be optional, or partly so, on account of the constitutional or judicial limitation placed on the right of the state to deprive employers of their old common-law defenses.

Under the optional acts, an employer may, within a certain specified time, either accept or reject the terms of the acts, but in either case he is deprived of the old common-law defenses of contributory negligence, assumption of risk and the fellow-servant rule. If he comes under the terms of the compensation acts his liability is certain and fixed, being determined by the schedule annexed to the acts; if he elects to remain under the common law his liability will depend on the ability of the injured workman to recover in an action for damages.

Not every person employing labor or using the services of another is deemed in law an employer, so it is important to determine just who are employers in order to fix the "coverage" in given cases.

The various acts themselves attempt to define the status of employers, but most of these definitions mean nothing until judicial interpretation has been obtained. Many times the courts have so distorted the evident meaning of the legislature or have so modified the definition that it has assumed a different meaning.

When Is an Employer an Employer?

For instance, if a man is conducting a shop employing less than five workman, is he an employer in the meaning of the compensation acts? In some states he is; in others he is not. Or, if a machine shop takes an order which places the proprietor in the position of an independent contractor for that particular work, does he become an employer under the act? This question of the independent contractor will arise again when we come to consider who are employees, so the distinction must be kept in mind.

The business in which the employer is engaged has a great deal to do with determining his status under the compensation act. A man may own a machine shop and employ 50 laborers to work for him. If he has not rejected the terms of the compensation act he is deemed an employer under the act and bound by its provisions, but if he is engaged in farming he will not ordinarily be deemed an employer under the compensation act and cannot be bound by its provisions.

Evidently the legislatures did not wish to impose liabilities of compensation on farmers, both from an economical and political standpoint, but this reluctance served only to impose the greater hardship by excluding him from the benefits of compensation, for an injured farm hand may obtain judgment in court by other means.

This example shows that not all who employ labor are employers within the technical meaning of the law. It has been said on good authority that if the act fails to specifically mention a certain class of employers they are deemed to be within the "coverage," and must be insured against liability. Employers specifically excluded by the terms of the act are excused from heeding its provision, and it is on them the choice of coming within the act or staying out falls, unless they happen to be doing business in one of the states having the so-called compulsory law.

Farmers Not "Employers"

In Illinois a machinist was employed by a farmer to take a threshing machine to a shop and have it repaired. On the way, he fell off the machine and was run over and killed. The Industrial Board held that the farmer was not liable because, being a farmer, he was not an "employer" under the Illinois act. The same board held that one injured while operating a threshing machine was not entitled to compensation for the same reason.

In Ohio the term employer includes every person, firm, private corporation and public-service corporation that employs five or more workmen.

It is advisable to keep in mind one important feature of the compensation acts, which is that the injured workman can come under the operation of the compensation acts only when his employer has become bound; otherwise his only remedy is to bring civil action for damages. Bringing the employer under the terms of the acts automatically throws the mantle of protection over all of his employees, unless an employee desires to reject the acts, which right he ordinarily has after the employer has exercised his right.

In Ohio the owner of a shop that occasionally employed five workmen was held to be an employer. The Ohio act does not specifically mention the word "partnership," but it was held that a partnership employing five or more workmen is an employer. This decision is quite universal. The mere fact that the employer is a partnership will not excuse it from the terms of the compensation act.

The Washington Act

The Washington act includes contractors, subcontractors, owners, agents and municipalities, but it does not include the United States. The state has the right to impose the compensation legislation on all public corporations and make it compulsory, but it has no right to impose the system on the United States Government. The federal government, however, adopted a compensation act of its own in 1917.

The status of one as an employer does not finally depend on the definition set out in the acts so much as on the relation between employer and employee being in existence. Subject to those excluded any person who

stands in the relation of employer to other persons who stand in the relation of employees will be deemed an employer for the purposes of the acts. In this connection it has been held that if the owner of a business dies and an administrator is appointed such administrator is deemed an employer and must pay compensation to a workman who is injured while engaged in the duties of his employment.

If a creditor takes over a business to operate it in order to discharge its debts, he is deemed an employer and is liable for the payment of compensation.

The same is true of a receiver who has assumed control of a business.

The Status of Third Parties

An employer cannot escape the payment of compensation on the ground that the workman was hired and paid through a third party, such as an agent. The agent stands merely in a representative capacity and his employer is the one deemed to be the employer under the compensation acts.

An employer cannot dispose of his liability by contracting it away. If the owner of a machine shop should make a contract, specifying that the party for whom he was doing the work should pay all compensation claims arising in performing the work, he cannot say to his men: "Your employer is the man for whom I am doing this work. He has agreed to pay your compensation. Go see him." The employer must pay the compensation, no matter where the liability falls.

It often happens where there is cordiality between employers that one will temporarily "lend" some of his workmen to another. If the workmen so "lent" are injured while in the other's employ, who is the employer when it comes to collecting the compensation? The courts have said that an employer cannot escape liability under the acts by such temporary "loans" of his employees. However, if an employer says to one of his workmen: "Go over to Jones' shop next week and help him out; he will pay you a bonus of $10, and when he gets through with you, come back to your old job here," if he should be injured in the meantime compensation will not be chargeable to Jones.

Where two or more employers are involved in cases such as the foregoing, some interesting situations arise. The test usually applied is not who has the authority to discharge the workman or who exercises supervision over his work, although these are important, but whether the act is done in the business where the person in control is the proprietor and has the right to stop or continue the work or determine the way it is to be done.

The situation may be reversed. A workman may have more than one employer at the same time. Will this prevent him from receiving compensation? For instance, business men owning property in proximity frequently hire one watchman to make the rounds of all of their establishments, and each employer contributes a part to his wages. In case of injury, who must pay the compensation? A case is recalled where a watchman so employed was killed on the premises trying to beat off robbers. It was held that the employer upon whose premises the man was killed should pay the compensation and that the rate of payment should be determined by the wages received from all his employers.

It is generally held that where the accident occurs when the workman is doing work for several employers he cannot be denied compensation because of this dual employment and that he has the right to elect the employer he will proceed against.

A deputy sheriff who was hired by a private employer to watch his premises while so engaged was stabbed by a prowler. It was held that although he could not recover compensation as a deputy sheriff he was entitled to relief from his employer. This case was decided in New York.

Ordinarily the owner is deemed the employer, but it was held in Wisconsin that it was not the intention of the compensation act to render the owner of the premises liable in compensation to the employees of his tenant, and no doubt this construction of the act would obtain elsewhere.

The California Act

The California act provides that the principal as well as the employing contractor shall be liable for the payment of any compensation the contractor might be liable for, and it has been expressly held that where a contractor is liable the principal is also liable, although the work done was not in the course of the usual business of said principal. The English act makes a similar provision, but makes the test of liability depend upon whether or not the principal would have been liable had the injured workman been in the principal's employ at the time of the injury. This distinction is worth knowing because many of our compensation acts are copied bodily from the English act.

If the employer is an independent contractor he is deemed the employer for the purposes of the compensation act and is liable for the payment of compensation to his injured employee. Where he is not an independent contractor, but merely stands in a representative capacity or acts as agent for another, he is not liable as an employer.

Where the case involves principal and agent practically the same rules apply. If the agent unknown to the employee hires a workman and the workman is injured the agent is not deemed the employer, and where the principal knows of it and does nothing he is held as ratifying the acts of his agent and is liable.

Question of Whom Work Was Benefitting

In questions entailing agents and principals the test is to determine whom the work was benefiting and whom it was for. If for the agent then the agent is the employer; if for the principal then the agent is not the employer, although he is the one hiring the workman and exercising supervision over him.

Where individuals or quasicorporations may in fact be the employer they are not given recognition in law as having sufficient entity to occupy that status in the technical sense, but the Illinois board has held the trustees of the University of Illinois liable for an injury occurring in the college buildings.

Another matter under this point, which is more important than all the others, is that employers often assume that as soon as they obtain a policy of compensation insurance and pay the premium on it they have discharged their full liability to their employees and can no longer be held for payment; but the fact

one or more forms. In some states he pays his premium into a state fund; in others he insures his liability in a private corporation or association, but if the corporation or association becomes insolvent or the state fund exhausted the workman may proceed against the employer. The liability of the employer is never extinguished as long as the injured workman is unpaid.

Meeting of Crane Manufacturers and Government Representatives

A meeting was held Jan. 22 at Cleveland, Ohio, between locomotive-crane manufacturers and representatives of the Government charged with the disposal of surplus machinery and materials.

Lieut. Col. A. LaMar represented the Director of Sales. There were also present Maj. W. W. Houston, representing the Director General of Military Railways; Sheldon Carey and William H. Waite of the Browning Co., Cleveland, Ohio; Alexander Brown and Melvin Pattison of the Brown Hoisting Machine Co., Cleveland, Ohio; Benjamin Dixon, Industrial Works, Bay City, Mich.; H. G. Steinbrenner, Orton & Steinbrenner, Chicago, Ill.; C. F. Michael, Ohio Locomotive Crane Co., Bucyrus, Ohio; F. W. Lovell, McMyler Interstate Co., New Bedford, Ohio; and R. P. Shimmer, Link Belt Co., Chicago, Ill.

A statement of the policy of the office of the Director of Sales was made by Colonel LaMar, and the agreement which was made with the Machine Tool Manufacturers' and Dealers' Association was referred to. The suggestion was made that the surplus-equipment menace, which affected the machine-tool industry, also affected the crane-manufacturing industry, and it was proposed by the crane manufacturers that the same agreement made with the machine-tool manufacturers would be advisable in this case.

Wants Government to Take Surplus

The crane manufacturers believe that an effort should be made to induce the Railway Administration, the Navy and other Government departments to take over as many of the Government-owned surplus cranes as can be used before any effort is made to induce the manufacturers to take the cranes back.

After considerable discussion the crane manufacturers decided not to approve or disapprove at this time the Government proposition as adopted by the machine-tool manufacturers and builders. It was agreed that individual manufacturers should make a statement of the value of his cranes to other governmental departments and to the railways. This is necessary because a considerable portion of the surplus cranes is not such as would be readily marketed in the United States under present conditions. The statement, among other things, will show the estimated cost of modifications which would be required.

A meeting of the crane manufacturers will be held in Cleveland on Jan. 30, at which time this statement will be coördinated and forwarded to Washington for information and action.

It was suggested at this meeting that the crane manufacturers are anxious to coöperate with Government representatives in disposing of this property, and they will be glad to furnish any information which they can obtain, or they will help in the disposal of the property to other departments if desired

Twenty-four 9-ton cranes, type 29, 8-wheel, 40-ft. boom (equipped with French draft rigging and 16 M. C. B.); manufactured by the Osgood Co.; price paid, $12,400.

Forty-seven 15-ton cranes, type B, 8-wheel, 48-ft. boom, M. C. B. standard appliances; price paid, $18,250; 14 of the above to be equipped with magnet and generator and single-sheave block; price paid, $19,900; manufactured by Brown Hoisting Machinery Company.

Ten 15-ton cranes, 8-wheel, 45-ft. boom, M. C. B. standard appliances; manufactured by Bucyrus Co.; price paid, $20,680.

Two 15-ton cranes, 8-wheel, 50-ft. boom, French draft rigging; manufactured by Link Belt Co.; price paid, $18,566.

One 15-ton crane, 8-wheel, 48-ft. boom, French draft rigging; manufactured by Brown Hoist Co.; price paid, $17,075.

Three 15-ton cranes, 8-wheel, 45-ft. boom, M. C. B. standard appliances; manufactured by Ohio Locomotive Crane Co.; price paid, $19,800.

Five 15-ton cranes, 8-wheel, 40-ft. boom, French draft rigging; manufactured by Orton & Stein; price paid, $15,566.

Ten 15-ton cranes, type E, 40-ft. boom, M. C. B. standard appliances, 7½-kw. generator sets; manufactured by Industrial Works; price paid, $21,453.

Thirty-four 15-ton cranes, type E, 40-ft. boom (12 to have M. C. B. standard appliances and 22 to have French draft rigging); manufactured by Industrial Works; price paid, $19,870.

Two 20-ton cranes, type G, 8-wheel, 40-ft. boom, French draft rigging; manufactured by Industrial Works; price paid, $22,402.

Four 20-ton cranes, type G, 8-wheel, 50-ft. boom, French draft rigging; manufactured by Industrial Works; price paid, $21,730.

Three 15-ton cranes, No. 8, 8-wheel, 50-ft. boom, French draft rigging; manufactured by Browning; price paid, $19,415.

One 20-ton crane, No. 8, 8-wheel, 46-ft. boom, French draft rigging, magnet and generator; price paid, $22,135.

One 20-ton crane, No. 8, 8-wheel, 50-ft. boom, French draft rigging; price paid, $18,985.

Five 20-ton cranes, 8-wheel, 50-ft. boom, M. C. B. standard appliances; manufactured by Joliet Bridge and Iron Co.; price paid, $21,000.

Two 20-ton cranes, 8-wheel, 50-ft. boom, French draft rigging; manufactured by Browning; prices paid, $19,080 and $19,420.

Seven 25-ton cranes, type H, 8-wheel, 50-ft. boom, French draft rigging; manufactured by Industrial Works; price paid, $24,718.

Eight 25-ton cranes, type H, 8-wheel, 45-ft. boom, pile-driver attachment (four equipped with French draft rigging and four with M. C. B. standard appliances); manufactured by Industrial Works; price paid, $28,012.

Three 30-ton cranes, model F, 8-wheel, 50-ft. boom, M. C. B. standard appliances, sister hooks; manufactured by Ohio Locomotive Crane Co.; price paid, $25,700.

Two 35-ton cranes, type L, 8-wheel, 40-ft. boom, French draft rigging, wrecking tools with spare parts; manufactured by Industrial Works; price paid, $27,240.

Nine 35-ton cranes, type L, 8-wheel, 45-ft. boom, magnets and generators, outriggers (two equipped with French draft rigging and seven with M. C. B. standard appliances); manufactured by Industrial Works; price paid, $34,132.

Three 15-ton cranes, type C, M. C. B. standard, 15-ton capacity, 8-wheel, 45-ft. boom; manufactured by Ohio Locomotive Crane Co.; price paid, $19,800.

Eighteen 50-ton wrecking cranes, type P, M. C. B. coupler and trucks, pump and fire hose, lighting equipment (17 are without booms and can be equipped with long booms for erecting purposes, 3 are equipped with curved booms); manufactured by Industrial Works; price paid, $32,865.

Nine 15-ton cranes, 2.4-m. (7-ft. 10½-in.) gage, hinge of boom 17 ft. above track, 48-ft. 3½-in. boom, self-propelling, double drum; manufactured by Variety Iron Co.; price paid, $20,300.

Fifteen 10-ton cranes, 2.4-m. (7-ft. 10½-in.) gage, hinge of boom 17 ft. above track, 48-ft. boom, self-propelling, double drums; manufactured by Brown Hoisting Machinery Co.; price paid, $16,884.

Six 5-ton cranes, 2-boom, electric cargo unloaders, 65-ft. booms, span of gantry 44 ft. center to center of rails, operated by 3-drum electric hoist; manufactured by Clyde Iron Works; price paid, $30,100.

Great Britain's Import Restrictions

After March 1, 1919, except by special license, no machine tools, metal-working machinery or wood-working machinery will be allowed to enter Great Britain

The list specifically includes the following: Machine tools and machinery driven by power and suitable for use in cutting, stamping or working metal, including lathes, grinding machines, milling machines, boring and turning mills, drilling machines, power presses, planing, punching and shearing machines, shaping and forging machines, screw machines, cutting-off machines, chucking machines, gear-cutting machines, boring machines, centering machines, and slotting machines; machinery driven by power and suitable for use in cutting, working or operating on wood, including sawing machines of all descriptions, general joining, mortising, tenoning and boring machines, lathes and rounding machines, box and cask making machines, and all machines accessory thereto; scraping and sandpapering machines, wheelwright machinery, firewood making and bundling machinery, wood, wood-fiber and pulp machinery, saw sharpeners and setting machines, saw stretchers and brazing apparatus, and machines for grinding, planing or molding iron.

The general English editorial comment ascribes the motive for this restriction to the widespread lack of employment and a desire to encourage hand labor as an antidote for this lack of employment. This would hardly be as logical a reason, however, as would the natural desire to protect English machine-tool builders as much as possible. The handwriting on the wall points unmistakably to protective-tariff restrictions in many lands and on many articles formerly exempt.

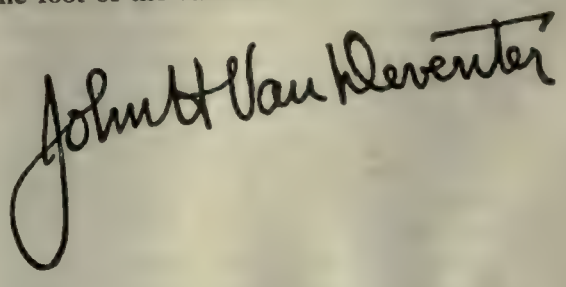
Whatever the reason for Great Britain's restriction on the importation of labor-saving machinery there are two comments that seem to be timely. The first is that labor-saving machinery is the embodiment of human intelligence in metal. Labor-saving machinery is the medium through which and only through which human brains and mechanical genius can increase or create wealth at a faster rate than it is consumed.

Thoughts, no matter how good they are, do not benefit mankind until they are put into motion. Labor-saving machinery puts the best of the world's industrial thought into motion. A general embargo on machinery is a general embargo on brains. No nation can afford to adopt the exclusion of brains as a national policy.

The encouragement of hand work as a cure for unemployment is not a wise move. We say this in a spirit of friendliness, because from the standpoint of selfish competition America will be the gainer and not the loser through the effects of this act. The hand cannot compete with the machine.

The second is that American machinery builders who are seeking export trade should not bank too heavily on the export field. They should go after it by all means with all the ability and the energy that they possess, but they should remember that this restriction by Great Britain is an indication of some of the obstacles that they will meet.

Give some of your thought and energy to the development of our own home markets. Between the Mississippi and the Rockies lies a vast territory filled with virgin industrial possibilities that as yet remain almost untouched. Encourage by all the means in your power the development of this territory as a national policy, for with it will come an enormous market for American-made goods. The pot of gold is sometimes nearer than the foot of the rainbow.





SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Jones Superior Gear-Hobbing Machine

A new and powerful gear-hobbing machine has recently been brought out by the Jones Superior Machine Co., Chicago, Ill. It is designated as the company's No. 48 and was originally planned to handle gears up to 48 in. in diameter with face widths up to 20 in. However, the actual results have been such that it is used to cut gears as large as 72 in. in diameter. The minimum diameter of gear that may be handled in the machine is approximately 10 in., depending somewhat on the diameter and pitch of the hob. This relatively small diameter of work handled is obtained by undercutting the column, as indicated at *A*, Fig. 1, in such a manner that the table may be fed in until it swings beneath the ways for the hob saddle. The column has a total depth of 34 in., so that notwithstanding this undercutting it extends far enough to the rear of the machine to afford a sufficiently firm base to take care of the heaviest cut without vibration.

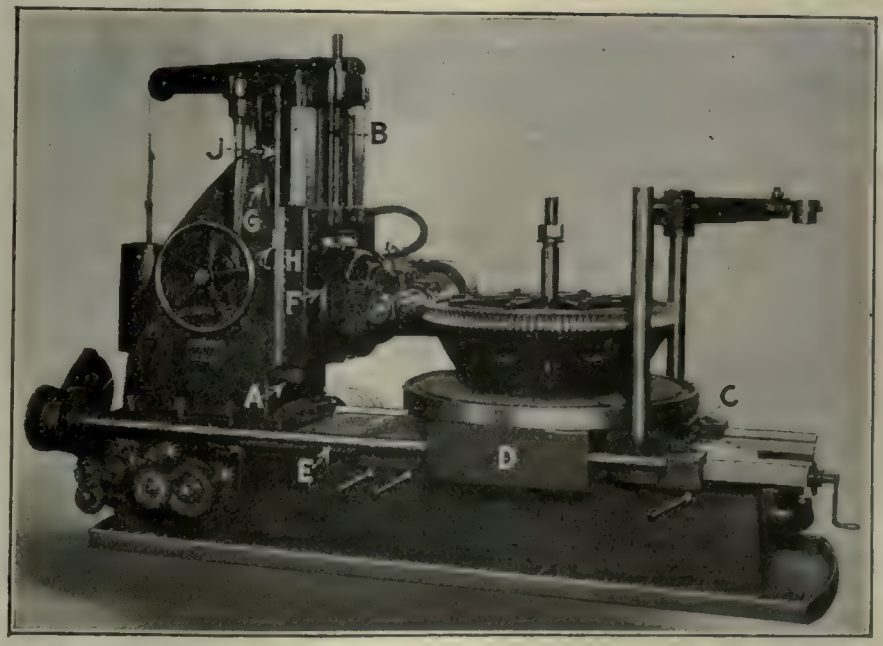


FIG. 1. OPERATING SIDE OF SUPERIOR NO. 48 GEAR-HOBBING MACHINE

Rated size of gear-hobbing machine, to cut gears 48 in. diameter by 20 in. face; actual capacity, 72 in. maximum and 10 in. minimum diameter; weight, 14,200 lb.; floor space, 121 in. long by 64 in. wide; base, 14 ft. 2 in. long by 36 in. wide; total height, 80 in.; table diameter, 45 in.; standard work arbor, 2⅜ in. diameter and 18 in. long; standard hob arbors, 1¼ in. and 1½ in. diameter; countershaft speed, 350 r.p.m.; countershaft pulley, diameter 16 in., 4½ in. face; cone pulley diameters 16, 14¾, 13½ and 12¼ in. by 4½ in. face; spindle speeds using back gears, 38 to 115 r.p.m.

The base of the machine is heavy and it has been reinforced where possible to obtain rigidity. The unusual width of the square table ways will be noticed. These are 5 in. wide, with correspondingly wide sides. The well for the storage of the cutting oil is located in the interior of the base and is cast as an integral part. It is of the two-chamber type separated by a perforated screen to remove the chips before the oil flows into the chamber from which the pump draws. Provision has been made for the removal of chips and dirt accumulations from the settling chamber by a door in the side of the base. A centrifugal pump is supplied for handling the coolant, and its flow is regulated by a valve which may be closed completely without danger to the pump. Four ways have been provided to insure adequate bearing surface for the column saddle; the two outside ways are 4 in. square, while the two narrow inside ways *B* give additional firmness and support. The table has eight T-slots, and is surrounded by a wide groove for catching the coolant. The table is 45 in. in diameter and is driven by a worm gear located at the outside diameter of the table beneath its edge and just inside of the housing *C*. The design is planned to place the worm where the smallest errors in indexing the

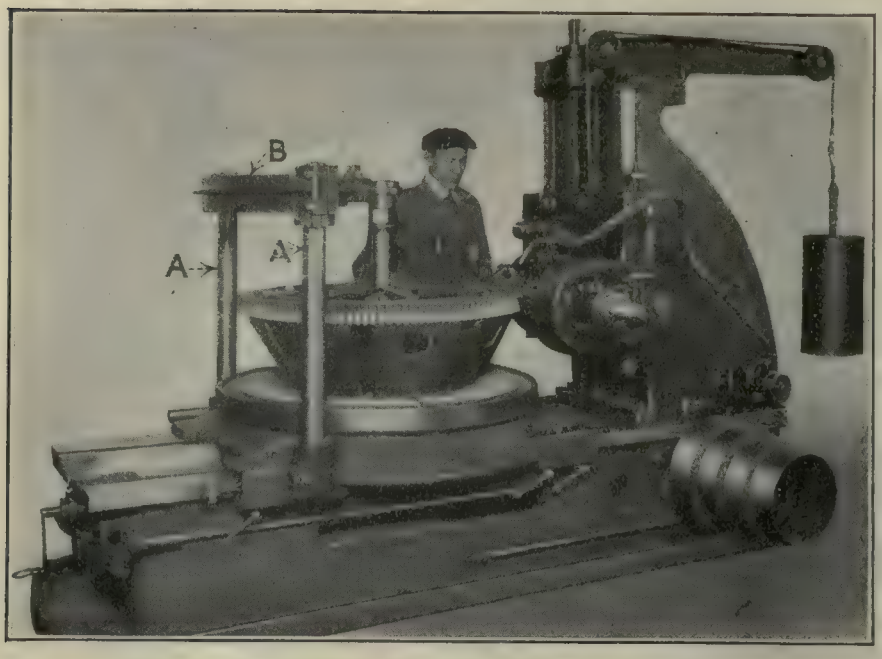


FIG. 2. BELT-DRIVE SIDE OF HOBBING MACHINE

table will result. In this respect the plan contrasts with that of using a small worm gear of much less diameter than the table, which would multiply any errors in indexing. The table drive worm is located in the housing *D* and is driven by the shaft *E*. This crucible-steel worm is 10 in. in length and has a large wearing surface. The worm shaft *E*, which projects through both sides of the worm housing, is driven through change gears. The worm is splined to the shaft so that it may slide back and forth with the table. The table is supported by a combination flat and taper bearing so arranged as to prevent any motion between the table and the saddle. The heavy cast-iron table brackets which are used to support the gear are standard equipment on all machines.

A heavy work arbor is located in the center of the table, this being $2\frac{3}{4}$ in. in diameter with a working face of 18 in. The lower end of the arbor is tapered to fit in a heavy flanged collar, which is bolted to the face of the table. This collar is provided with the nut by which the arbor may be pulled into place.

The two corner supports *A*, Fig. 2, are 3 in. in diameter and are held at the top by the casting *B*, which supports the upper end of the work arbor and binds all together in a substantial manner. The upper end of the work arbor runs in a bronze bushing. This arrangement is only used for supporting the arbor when heavy cuts are being made and need not be removed from the machine when not in use, for by loosening a cap at one end it may be swung out of the way as shown in Fig. 1.

Two hob arbors are furnished. These are $1\frac{1}{4}$ and $1\frac{1}{2}$ in. in diameter and are ground to fit the crucible-steel spindle to which they are keyed. The spindle has a front bearing $2\frac{3}{4}$ in. in diameter and a rear bearing $2\frac{3}{8}$ in. in diameter and runs in special bronze-composition bushings which are adjustable for wear. The spindle drive is through a set of wide-faced herringbone gears which are used to give smooth action. The arbor head is of the swivel type and may be set to the desired angle by means of the hand-driven wormwheel *F*.

All gears are cut. The shafts are ground and run in bronze bearings. A sheet-metal dust case is provided to inclose the gears, but this was not in place when the photograph for the illustration was taken.

The standard machine is belt driven to a four-step cone pulley with a large step 16 in. in diameter and small step $12\frac{1}{4}$ in. in diameter. The cone faces are $4\frac{1}{2}$ in. wide From the pulley drive shaft the drive is backgeared so that eight spindle speeds are obtained, ranging from 38 to 115 r.p.m. with the countershaft running at 350 r.p.m. A feature of the design is the centralized control After being started the machine is automatic and the feed is disengaged when the operation is completed, thus making it possible for one man to operate several machines. The column feed control is thrown into service by means of the hand lever *G*, Fig. 1, which causes a worm to engage with the drive gear; a stop *H* is then set for the proper height on the rod *J*, and when the stop on the column saddle meets this the rod is drawn down and the worm is positively disengaged by a spring-operated device. The column saddle is counterweighted, as will be noticed.

Both the head and table feeds are operated by either hand or power and are automatically disengaged when desired. The table feed varies from 0.005 to 0.060 in. and the head feed from 0.010 to 0.120 in. per revolution of the table. A set of change gears is furnished for the feed and division mechanisms, together with charts showing the method of procedure in attaching them.

A Shattered Ideal

By James H. Follen

Back in the halcyon days of Big Bicycle Business an amount of gray matter was expended in developing the "chainless" bicycle that viewed in the light of present-day problems seems unwarranted.

I well remember working in the toolroom of one large factory where such a machine was developed, and the "engineer" was so proud of his conception that he caused a model to be made with gear cases and tubes partly cut away to show its construction, and this was mounted on a suitable base, like a piece of statuary, and placed on exhibition in his office.

It was the custom of this particular factory to designate one day each week as "visitors' day" when parties of tourists and sightseers as well as really interested people would be piloted through the shop by duly qualified guides who took good care that the "guests" didn't see anything they ought not to.

On one such occasion the before-mentioned engineer was proudly demonstrating the model of his pet idea to a group in which were several representatives of the rural districts when he received a severe psychological shock as one of the farmers turned to a companion and said: "Gosh, Jim! She's cogged up jest like your one-hoss mowin' machine."



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft - Motor Trucks - Tractors



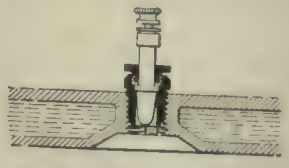
Original research work in airplane construction is being undertaken by the Department of Mechanical Engineering at the University of Toronto, Canada. An air tube, the first of the kind made in Canada, 4 ft. in diameter and 60 ft. in length has been constructed and will be used in the experiments.

Announcement has been made by Glenn H. Curtiss, president of the Curtiss Engineering Corporation, Garden City, L. I., for a daily Curtiss airplane line to be operated next spring from New York to Atlantic City. This may possibly be extended to Newport News and Charleston, S. C. Both passenger and small-package freight service is proposed for this transportation line.

Orville Wright, in an article, "The Future of Civil Flying," published in *Aviation and Aeronautical Engineering*, sets forth the characteristic features regarding the safety of airplanes, saying: "In order to create a real sport it will be necessary to provide means for cross-country flying without risk. There are several ways in which this can be accomplished: (1) The perfection of the flying machine and motor to that degree where forced landings will never be necessary; (2) the establishment of distinctly marked and carefully prepared landing places at such frequent intervals that one could always be reached in case of sudden stoppage of the motor and (3) the development of airplanes of such design as will permit landing in any ordinary field encountered in cross-country flying."

The center of interest in the airplane industries at present is directed toward commercial aerial transportation, and activities, such as locating aerial lines for commercial transportation and developing a type of airplane which will solve successfully the scientific and technical problems of an undertaking of this kind, are noticeable almost in every country of the world. The wonderful records of long-distance flights, such as the London-Cairo of 2900 miles; Cairo-Calenta, 3900 miles; London - Constantinople, 2000 miles; San Diego (Cal.)-Mineola (L. I.), 4000 miles, etc., are showing a very promiseful future for aerial transportation. Still, as a successful business proposition, it has to deal first with assuring the public of the safety of this means of transportation.

The type and the location of a spark plug are important factors in the kerosene-burning tractor engine because the spark plug is one of the common sources of preignition. A plug with a heavy metal body and heavy wire electrodes presents a large heating surface to the burning charge and often becomes red hot, causing excessive pre-



ignition. The plug should preferably be located in the center of the cylinder head in a well-water-jacketed position, so as to be cooled as much as possible. The proper location for a spark plug is shown in the illustration. A spark plug placed in a valve cap, especially over a hot exhaust valve, cannot be cooled, and will burn up and cause preignition when kerosene is used as fuel.

Reports are rife in financial circles that unusually large orders for farm machinery have been placed by France and Italy. This has had the effect of steadying the demand for agricultural machinery. As a result of the war American machinery, having already a considerable prestige abroad, is coming into high continental favor, especially in the allied countries. The greater part of the Italian orders for farm machinery was booked by the J. I. Case Threshing Machine Co., which is preparing for very large trade in the farm-tractor line.

The question of lengthwise stability of tractors demands the serious consideration of the designers. It is very well known that in a tractor, when the power is applied to the drive, weight is automatically shifted from the front to the rear wheels and the machine has a tendency to "rear." Under ordinary operating conditions the turning moment due to this torque reaction is not equal to the opposing weight moment around the rear axle, and there is no other result than that the steering may become somewhat erratic owing to the front wheels being pressed insufficiently against the ground. As the rearing is closely connected with the distribution of weight and with the wheelbase it seems to be preferable to use a fairly long wheelbase and to place an ample amount of weight forward.

The cost of operating the United States Post Office Department motor-truck service during the year ended June 30, 1918, was $292,024. Ford trucks in the service were run at a cost per truck per hour of 81c. in New York, 40c. in Boston and 36c. in Washington. For the White ¾-ton truck the costs were 59c. per hour in Boston and 49c. in Washington. The net income for three months from July 1 to Sept. 30 was $89,861. The Post Office contemplates operating 600 routes with 2000 trucks, which will cost $8,794,000.

The Loening two-seater fighting monoplane constitutes one of the most interesting developments in fighting airplanes of original American design. In its official tests at McCook Field, Dayton, Ohio, the machine flew at a speed of 145 miles with a military load of two men, four machine guns and 2000 rounds of ammunition, climbing 10,000 ft. in 8 min. and maintaining its speed well up to high altitudes. The ceiling of the machine is 25,000 ft. Eliminating all the common monoplane-wing wire stays and using large bracing struts of combined steel tubing and



wood are supposed to explain the remarkably low 4.5-to-1 aspect ratio, giving a span of 32 ft. by 7 ft. chord for the monoplane. The body is very deep and built up of a series of veneer bulkheads much on the order of a hydroplane boat or a torpedo-boat destroyer. It is driven by a Simplex-Hispano 300-hp. motor and the whole power plant is a unit construction and may be easily moved from the body of the plant. The plane stores sufficient fuel for 3½ hours, weighs 1300 lb. and carries practically the equivalent of its entire weight in live load. The seats are so arranged as to give the pilot 50 per cent. more range of vision than in any other machine, and is due to the manner in which the wing has been mounted on a level with the pilot's eyes. During the tests stability and control in maneuvering have been found so satisfactory that it may be said to be one of the first load-carrying machines that can be maneuvered like the smallest single seater. The machine has a very low landing speed, having a 100-m.p.h. speed range, showing another important feature if comparing its low landing speed with the 8-lb. load per square foot of wing surface.



Sparks from the

Some Information Concerning Ocean Freight Rates

A Cincinnati Machine Company Receives Letter on Difficulties in Handling Foreign Trade

Some definite information on ocean freight rates as one of the difficult factors in handling foreign trade is contained in a letter received by Arthur C. Pletz, general manager of the Morris Machine Tool Co., Cincinnati, Ohio, from the company's London representatives, A. A. Jones & Shipman, Ltd. In reply to a letter from the Morris company regarding shipments in future the London company said:

"We are in receipt of your letter of Dec. 7, with further reference to the question of your lathes to be delivered at the rate of three or four a month. We are certainly interested in this proposition and would have cabled our acceptance of your offer only we are prevented from doing this by the uncertainty of the freight situation.

"As you are probably aware, during the past two years we have been importing machines on government-controlled space at the government freight rates. In other words, the shipping companies had to carry machines and tools as well as other government essentials at a maximum freight rate which during the past six months has been $20 a ton. A fortnight ago the restrictions on the shipping companies were removed, and we are informed by the Ministry of Munitions that we now have to import at open-market freight rates. The prevailing freight rates are $6.50 per 100 lb., which you will readily see figures out seven times more than the government rates. We also would say that the freight basis for your lathes is cubic measurement, reckoning 40 cu.ft. to the ton. If you figure out you will observe that the percentage of freight rates to the actual cost is enormous, and candidly we dare not import the machines until we are certain that the freight market is more satisfactory.

"We have taken the matter up with the government department and also the manufacturers' and exporters' associations to which we belong, and we hope pressure will be brought to bear, insisting that there is an immediate reduction.

"We quite appreciate that you have not advanced your prices to any unreasonable extent, but when we have to calculate a freight charge alone of $750, apart from other shipping expenses, such as cartage, handling charges, insurance, storage, etc., you will quite understand that the situation bristles with difficulties.

"We are hopeful that the action taken will have an early effect. In the meantime if it is possible for you to bring pressure to bear on your own government with a view to getting its influence at work on this matter we shall be glad if you will do so."

In the view of the obvious bearing of this situation upon the entire machinery trade Mr. Pletz has brought the matter to the attention of other Cincinnati manufacturers, and it is possible that it will result in some action to obtain government intervention, as suggested in the last paragraph quoted.

* * *

Screw Thread Commission Will Meet This Month

The National Screw Thread Commission it is reported will call a public meeting in New York this month for the purpose of discussing with engineers and manufacturers its findings regarding screw-thread standardization. A great deal of information has been accumulated by means of public meetings and correspondence covering various screw-thread practices, including screw bolts of various forms of threads, machine screws, hose couplings, brass tubing, pipe threads, basis of fit of screw and nut, and classification and tolerance for various forms of fit.

The commission is composed, by an act of Congress, of representatives of the Army and Navy, Bureau of Standards, American Society of Mechanical Engineers, Society of Automotive Engineers, and has its headquarters at the Bureau of Standards, Washington. It was appointed Sept. 21, 1918, for a period of six months.

* * *

Watches Designed for Blind Soldiers

Watches with elevated numbers on the dials and with minute bell systems which ring the hour, half hour and quarter hour have been presented to many blind soldiers in Italy by a committee of women organized for the purpose. Special watches have been designed and made which enable those blinded to know the time by using either their sense of touch or hearing or both. The originator of the idea is a resident of Como, Italy, who wishes to remain incognito.

* * *

Italian Machinery Imports

An association has been formed at Milan by the most important firms in Italy carrying on an important trade in industrial machinery and machine tools from allied countries. Its purpose is the study, protection and promotion of all those interests appertaining to the importation of the articles mentioned.

Labor Department Sends Investigators Abroad

An employers' commission has been designated by William B. Wilson, Secretary of Labor, to study labor conditions and governmental labor policies in Great Britain and report thereon to the department.

The commission consists of Dorr E. Felt, Chicago, connected with the machinery industry; R. J. Caldwell, New York, the textile industry; W. H. Ingersoll, New York, watch industry; Eldon B. Keith, Boston, shoe-manufacturing industry; R. R. Otis, Atlanta, building industry, and E. T. Gundlach, Chicago, publishing industry. Mr. Gundlach was connected with the war service of the Department of Labor during the war, but returned last month to his private business.

The commission will be accompanied by an economic adviser, Dr. Royal Meeker, Comissioner of Labor Statistics, and by James R. Hawkins of New York as fiscal agent, George E. McIlwain of Boston as secretary, and Benjamin M. Squires of New York, Edgar N. Phillips and John A. Witt of Chicago as assistants.

* * *

Portable Wooden Houses to Be Used in France

The technical service of reconstruction has placed orders with private contractors throughout France for about 25,000 demountable wooden houses with two rooms and a shed in each case, costing $700 to $1000 each, and for 10,000 demountable wooden farm buildings to cost $150 to $800 each.

Between 3000 and 4000 of these had been set up at the Somme, at the Aisne and the Oise before the German advance last spring, all of which were lost. To date there are between 1000 and 2000 of these demountable buildings either in the newly liberated regions or on their way there, the great difficulty being to get transportation and the necessary labor for mounting them. Since the armistice, however, the labor problem is being solved rapidly.

To prepare for eventual full reconstruction the technical service of reconstruction of the Government is organizing a bureau to purchase building material in advance. It is expected that a credit of $60,000,000 will now be voted to this bureau, $20,000,000 to be available to house and feed workmen in the devastated regions while they are starting reconstruction. Materials and housing from the Government storage yards will be allocated to coöperative groups of contractors according to priority rules.

World's Industrial Forge

By E.C.Porter, News Editor

Suspension of French Iron and Steel Consortium

According to a cablegram of Jan. 16, 1919, from the clerk to the American commercial attaché at Paris the French Ministry of Industrial Reconstruction has announced that the control of the Iron and Steel Consortium over imports was withdrawn from Jan. 2, 1919, and stocks on hand are being liquidated. The consortium will continue to exist solely for the liquidation of stocks of iron and steel now held in various parts of France. Hereafter applications for license to import iron and steel should be addressed direct to the Ministry of Industrial Reconstruction, Raw Materials Section, Bureau of Importations. Refusal or approval of applications for licenses will be given within three days. It is understood that American firms and their affiliations will be given the same consideration in the matter of granting licenses as is given French firms.

* * *

Electric Welding in Shipbuilding

The subject of electric welding in connection with the building of steel ships by the American Government was discussed at some length by Comfort A. Adams, president of the American Institute of Electrical Engineers, in the course of an address which he gave before the Chicago engineers on Dec. 30, 1918. Both the processes of spot welding and arc and electric welding are applied to shipbuilding. A committee appointed by the A. I. E. E. to make an investigation of the subject concluded that the operator is the principal factor in arc-welding, the type of current regulation being of relatively small importance compared with his skill in manipulating the arc. In a test of 15 different makes of arc-welding appliances no appreciable difference in the strength of the weld was found, all showing a strength of at least 94 per cent. of that of the plate itself.

The test showed also that the strength of the weld was increased to a certain degree as a stronger current was used and that apparently it made no difference whether the current was alternating or direct.

Another point that was deduced from the test is that it apparently makes no difference in the results whether the electrode used is of absolutely pure iron or of an iron containing small impurities, since the characteristics of the metal change in going across the arc.

Particular investigation as to the effect of vibrations in producing fatigue of the metal of the welds was made, and in one set of tests alone the committee used 20 tons of samples. The relative strength of 94 per cent. of the value of the plate as produced by arc-welding can be appreciated when compared with that of a riveted joint, which ranges from 50 to 70 per cent., depending upon whether one, two or three rows of rivets are used.

Spot-welding as compared with arc-welding has the disadvantage that very heavy machinery is required. For welding a ½-in. plate the machine will weigh about 3 tons and consume a large amount of electric current. It, however, requires less time and labor, and the reason for the heavy weight is the necessity for producing a pressure of approximately 25 tons when ½-in. plate is being welded. For spot-welding, the power requirements range from 400 to 700 kw. in the commercial machines, and a machine is being used experimentally which is rated at 2000 kilowatts.

The Classification Committee of the Underwriters, which passes on metals before they are insured, has approved of arc-welding for the minor parts of ships, of which there are about 500,000 on each vessel produced in yards like that at Hog Island.

A 125-ft. barge has been built as an experiment in which all the plates were joined by electric-welding, a saving of about 20 per cent. resulting over riveted barges of the same character built in the same yards.

* * *

Three Billion Meals Eaten by Soldiers During the War

Food stores for the Army on hand in the United States, its possessions, France and in transit to France on Jan. 1, 1919, were valued at $300,000,000. At the time of the signing of the armistice approximately 10,000,000 lb. of food were being consumed by our troops in France each day, and there were on hand in France at that time 1,000,000,000 lb. of food in reserve. All this food had been transported on an average of 5000 miles.

It is estimated by the Subsistence Division that 3,000,000,000 meals were served to the Army during the 19 months of warfare with Germany.

* * *

Encouraging Mechanical Skill

Everyone is interested in the continuance of American industrial prosperity. The announcement contained in the single-page insert in this issue tells about the biggest step that can be taken to safeguard the industries of America by the fostering of American mechanical skill.

National Service Committee in Washington Office

Engineering Council Establishes Service for Engineers—Names of Members Announced

In order more completely to provide for united action on matters of common concern to engineers the Engineering Council has recently organized a National Service Committee and has established an office in the national capital. This action was based on a tentative plan for representation of engineers at Washington submitted to the council at a special meeting on Nov. 21, 1918, by Philip N. Moore of the American Institute of Mining Engineers. (See the December *Proceedings* of the American Society of Civil Engineers.) The present member societies of the Engineering Council are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the United Engineering Society and the American Society for Testing Materials.

The Engineering Council, through this National Service Committee and its Washington office, intends to accomplish the following general purposes, this committee acting always under the direction of the council and within limitations fixed for it:

1. To discover public services which may best be performed by engineering societies and, when desired, to offer the proper men for such services.

2. To speak authoritatively for the Engineering Council before committees of Congress and departments of the Government on all public questions of common interest to engineers within such limitations as the council may set from time to time.

3. To give promptly wide circulation among engineers to authentic information regarding pending legislation and executive actions which may affect the interests of engineers in any way.

4. To gather opinions of engineers on these matters.

The Engineering Council's aim is disinterested usefulness to the nation and the profession—not advocacy of any selfish ends—by giving unbiased information and counsel on technical matters, chiefly when asked. A modest start is being made. The work will be enlarged only as a real demand for services develops.

The members of the National Service Committee have been chosen so as to represent different parts of the country. The appointees are the fol-

lowing: Chairman, M. O. Leighton, M. Am. Soc. C. E., Washington, D. C.; C. B. Burdick, M. Am. Soc. C. E., Chicago, Ill.; George F. Swain, M. Am. Soc. C. E., Boston, Mass.; Philip N. Moore, M. A. I. M. E., St. Louis, Mo.; L. D. Ricketts, M. A. I. M. E., Warren, Ariz.; Andrew M. Hunt, M. Am. Soc. M. E., San Francisco, Calif., and New York; Andrew M. Lockett, M. Am. Soc. M. E., New Orleans, La.; W. C. L. Eglin, M. Am. I. E. E., Philadelphia, Penn.; Bancroft Gherardi, M. Am. I. E. E., New York.

The Washington office is located at 502 McLachlen Building, 10th and G Streets.

* * *

Invention of Ball Bearings Credited to Chinese

Like many other inventions, China is now claimed to be the originator of ball bearings. The use of these, it is said, goes back to a very early date, regardless of the claim that the first commercial steel balls were made in the United States and that the original ball-making machines for the plant of the largest foreign maker were designed and built in America.

The swiftest airplane and the fleetest automobile now depend on ball bearings for their speed, and according to a British authority the use of steel ball bearings has increased so greatly in the last decade that they are now employed in machines where plain bearings were formerly considered good enough.

* * *

Conference of Employers and Employees

The second of a series of conferences arranged by the New Jersey State Chamber of Commerce between employers and employees was held at the Railroad Club, 30 Church St., New York, on Tuesday, Jan. 28, 1919.

The subject discussed was the self-government of industrial establishments through some form of congress in which employer and employee are represented. Invitations were extended to many establishments and organizations throughout the eastern section of the country, which have in operation some system of employee's representation, to send delegates from both employers and employees.

The object of the conference is to correlate such knowledge as may be available through experience with the various systems now in operation, with a view to disseminating this information for the benefit not only of the organizations represented but of industry in general.

The services of the Bureau of Industrial Research of the Chamber of Commerce are to be available for the purpose of gathering information relating to the various phases of the subject, and a committee of eight was appointed by the conference to determine more fully the lines along which the research work should be directed.

Business Items

Hill-Clarke & Co., Chicago, Ill., are erecting a two-story brick building at 647 West Washington Blvd., to be used as a display room and office. The estimated cost of construction is $40,000.

The W. G. Runkles Machinery Co., Trenton, N. J., has been incorporated for $125,000 to manufacture machinery. The incorporators are W. G. Runkles, Trenton, N. J.; Charles T. Clarke, Trenton, and C. C. Klockner, Fallsington, Penn.

The Beckwith Machinery Co., Pittsburgh, Penn., has opened an office and warehouse at 1227 West Ninth St., Cleveland, Ohio, where it will handle a complete line of construction equipment. The office will be in charge of E. G. Stoner, who will be assisted by C. Z. Dally.

The Manufacturers' Hardware Corporation, Milwaukee, Wis., has been incorporated with a capital stock of $100,000 to manufacture and sell machinery, accessories, supplies, etc. L. E. Beeman, head of the Universal Manufacturing Co., New York, is one of the incorporators.

H. W. Reed and F. A. Hickernell have formed a sales organization under the name of Reed & Hickernell, engineers, with offices in the Munsey Building, Washington, D. C. They are representing manufacturers of products purchased by the Government and the Southeastern railroads.

Personals

William K. Swift, has become a member of the sales department of the Bound Brook Oil-less Bearing Co., Bound Brook, N. J.

Capt. Roy T. Middleton, formerly Detroit manager of the Steel Products Co., has become general representative of the Standard Steel Casting Co., Cleveland, Ohio.

John W. Sadler, tool engineer of the ordnance department of David Lupton's Sons Co., Philadelphia, Penn., has been made supervisor of the tool and machine shop of the company.

Herbert W. Gladhill, formerly sales engineer at the Philadelphia office of the Shepard Electric Crane and Hoist Co., has been made district manager of that office.

Theodore F. Oechole, formerly supervisor of the tool and machine shop of David Lupton's Sons Co., Philadelphia, Penn., has recently become consulting engineer of that company.

Edward A. Cordes, formerly master mechanic of the Fairbanks-Morse Manufacturing Co., Beloit, Wis., has become superintendent of the Standard Steel Car Co., ordnance department, at Hammond, Ind.

H. P. Eilers, who for the past 17 years has been in the machinery business in New York, has taken up the same work on his own account in Los Angeles, where he intends to make his permanent home.

Margaret A. Gerrity, 548 Orange St., New Haven, Conn., formerly with the Marlin-Rockwell Corporation, New Haven, Conn., is now representing Flint & Chester, Inc., New York, dealers in machinists' supplies, in Connecticut, Rhode Island and vicinity.

Capt. Edward E. Ashley, Jr., for many years consulting mechanical and electrical engineer of Starrett & Van Vleck, architects, New York, has resigned his commission in the Air Service of the United States Army to accept an appointment as sales engineer of the Mercury Manufacturing Co., Chicago, Ill., manufacturer of electrically driven tractors.

Obituary

Adelbert E. Ellis, president of the Hart-Parr Co., died Jan. 12 at his home in Charles City, Iowa, in his 70th year.

Col. Benjamin Adriance, president of the Adriance Machine Works, Inc., Brooklyn, N. Y., died at Miami, Fla., Jan. 3, 1919.

Henry C. Barteld, head of the electrical department of the Honolulu Iron Works, died on Jan. 11, 1919, at the home of his mother, 177 Hancock St., Brooklyn, N. Y. He was a graduate of Adelphi Academy and of Columbia University.

Eugene C. Mergenthaler, second son of Ottmar Mergenthaler, inventor of the Linotype machine, died Jan. 4, 1919, in Baltimore, from pneumonia. He was 33 years old and received his college education at Cornell and at Karlsruhe (Germany). He followed the lead of his father into the mechanical and inventive fields and was president of the Mergenthaler Co., manufacturer of reamers, etc., and president of the Simplex Protective Stopper Co. at his death. For the past two years he had been almost wholly occupied in Government work.

J. J. McCabe of the J. J. McCabe Lathe and Machinery Corporation, New York, well known in the machine-tool industry as a dealer and manufacturer, died on Jan. 17, 1919. As a dealer he handled the agency in New York from time to time for such concerns as Schumacher & Boye, Smith & Mills Co., Charlton Machine Tool Co. and G. A. Gray Co. He designed and manufactured under his patents for a number of years the "2-in-1" double-spindle lathe. Mr. McCabe was a pioneer in the used-machinery business, having succeeded the old New York firm of E. P. Bullard Co. nearly 35 years ago. A few years ago he founded

the present J. J. McCabe Punch & Shear Co. with a plant at Chattanooga, Tenn. He is survived by a widow and four children. Two of his sons—J. J., Jr., and Raymond J.—have been associated with him in business for a number of years and will continue the organization of the J. J. McCabe Lathe and Machinery Corporation and the J. J. McCabe Punch and Shear Company.

BURT O. GAGE, widely known as an inventor and pump expert, died at his home in Warren, Mass., Jan. 9, 1919, after a few days' illness of bronchial pneumonia. He was in his 76th year. Mr. Gage had been associated nearly all his life with the pump industry, entering the employ of the Knowles & Sibley Co., manufacturer of steam pumps, in 1867. For about 40 years he was associated with this concern and its successors, the George F. Blake Manufacturing Co. of Warren and Boston, during which time he patented many useful and practical ideas in pumping machinery. In 1905 he became associated with the Warren Steam Pump Co., Warren, Mass., as superintendent, which position he held at the time of his death.

Trade Catalogs

Stock List. The Advance Tool Co., Cincinnati, Ohio. Catalog. Pp. 14; 8½ x 11 in. Here are given illustrations and specifications of small tools made by this company, including counterbores, cutters, mills, mandrels, reamers, collets, gages, etc.

Multiwhirl Cooler. The Griscom-Russell Co., 90 West St., New York. Catalog. Pp. 12; 6 x 9 in. The uses, construction, specifications and advantages of this product are given, together with halftone illustrations showing interior and exterior views.

Link-Belt Equipment for the Handling and Preparation of Coal at the Mine. Book No. 333. Link-Belt Co., Chicago, Ill. Pp. 88; 6 x 9 in. This shows the various types of coal-mine equipment furnished by the Link-Belt Co. There are many halftone illustrations of complete installations.

Metal Cutting Tools. Lovejoy Tool Co., Inc., Springfield, Vt. Catalog. Pp. 16; 6 x 9 in. Here is described and illustrated this company's line of patented inserted-cutter tools, including left and right hand turning and facing tools, boring or facing bars and shaping and planing machine tools.

Star Safety Friction Clutch. Carl G. Westlund Co., Worcester, Mass. Catalog No. 10. Pp. 15; 5½ x 7½ in. Price lists and specifications of bushings, friction clutches, cutoff couplings and split clutches, together with illustrations and a description. The last two pages give illustrations of the Westlund engine lathe.

Buildings: Industrial and Commercial. The Gaylor W. Feaga Co., Cleveland, Ohio. Catalog. Pp. 24; 8½ x 11 in. Presenting information on the ability and experience of this company of constructing engineers and telling about industrial construction, the organization and standardization of factory buildings, records of construction and some reminiscences of pioneer construction.

The Grand Rapids Drill Grinder Book. Grand Rapids Grinding Machine Co., Grand Rapids, Mich. Pp. 32; 8½ x 11 in. This book is just off the press and portrays the Grand Rapids line of drill-grinding machines in an adequate manner, giving many line drawings and halftone illustrations. Pages 27, 28 and 29 give some helpful hints on the care and use of twist drills and should make the book valuable to any drilling-department or tool-crib foreman. A copy may be obtained by interested parties on request.

New Publications

The Internal Gear: Its Design and Application.—Ninety-four 6 x 9-in. pages; 56 illustrations, 7 tables. Published by the Fellows Gear Shaper Co., Springfield, Vermont. Free to those interested in gears.

In the preface the compilers of this book say: "The development of various forms of reduction gear drives where compactness is an essential factor has brought the internal gear into prominence. While it is generally conceded that the internal gear has certain limitations it is also known that it has several advantages over the external gear, especially from the standpoint of efficient tooth action. Its good features, however, stand out more prominently when compared with other forms of drives used for reduction purposes. It is not the object of this treatise to deal extensively with the various forms of reduction-gear drives, but to explain in the simplest possible terms advantages and limitations of the internal gear. Many of the so-called limitations can be easily overcome by a proper understanding of the conditions that must be met. One so-called limitation of the internal gear was the difficulty of cutting." This last limitation is of course not valid since a gear shaper will cut an internal as easily as an external gear.

The chapters of the book are: Definition and Advantages of the Internal Gear, Design of Internal Gears, Graphical Analysis of Tooth Action of Internal Spur Gears, Internal Helical Gear Design, Cutting Internal Gears and a Variety of Applications of the Internal Gear. Altogether the book contains a large amount of data, especially on the cutting of internal spur and helical gears, and it will make a valuable addition to the library of anyone interested in gears.

Graphical and Mechanical Computation.—By Joseph Lipka, Ph.D. Two hundred and sixty-four 5¾ x 9-in. pages; 110 charts and illustrations; bound in cloth boards. Published by John Wiley & Sons, Inc., New York. Price, $4.

This book embodies a course given by the author in the mathematical laboratory of the Massachusetts Institute of Technology where he is assistant professor of mathematics. It is intended as an aid in the solution of a large number of problems which the engineer as well as the student meets in his work. In the first chapter the construction of scales leads to the discussion of the principles upon which the construction of various slide rules is based. The next chapter develops the principles of a network of scales, showing their applications to the use of various kinds of coördinate paper and to charting of equations in three variables.

Engineers have long recognized the value of graphical charts in lessening the labor of computation. Among charts devised none is more rapidly constructed or more easily read than the alignment or nomographic type. Chapters III, IV and V aim to give a systematic development of the construction of alignment charts. The methods are fully illustrated by charts for a large number of well-known engineering formulas. Many formulas in the engineering sciences are empirical, and the value of many scientific and technical investigations is enhanced by the discovery of the laws connecting the results. Chapter VI is concerned with the fitting of equations to empirical data. Chapter VII considers the case where the data are periodic, as in alternating currents and voltages, sound waves and so on, and gives numerical, graphical and mechanical methods for determining the constants in the equation. When empirical formulas cannot be fitted to the experimental data, these data may still be efficiently handled for purposes of further computation—interpolation, differentiation and integration—by numerical, graphical and mechanical methods developed in the last two chapters. Numerous illustrative examples are worked throughout the text, and a large number of exercises for the student is given at the end of each chapter. Additional charts in the back of the book serve as an aid in the construction of alignment charts. The specific chapter headings are: Scales and the Slide Rule; Network of Scales; Charts for Equations in Two and Three Variables; Nomographic or Alignment Charts (three chapters); Empirical Formulas—Nonperiodic Curves; Empirical Formulas—Periodic Curves; Interpolation; Approximate Integration and Differentiation.

Industrial Engineering. A Handbook of Useful Information for Managers, Engineers, Superintendents, Designers, Draftsmen and Others Engaged in Constructive Work. Vol. 1.—By William M. Barr, Six hundred and nineteen 6 x 9-in. pages, numerous tables and illustrations; bound in brown cloth boards. Published by the W. M. Barr Co., Inc., 116 West 39th St., New York. Price, $4.

In the preparation of this book the author attempts a systematic arrangement of a large volume of information for engineers which has not previously been readily available. There is considerable data relating to specifications of the chemical and physical properties of most of the materials entering into Government engineering work. Not only are these data valuable to those engaged on Government work, but they are useful to those in every department of industrial engineering. The nature of the data is very practical, a feature made possible by the free use of working drawings. These drawings are used throughout the book and in many cases are accompanied by tables of working dimensions. The author's aim has been to so arrange these data that the principal dimensions given in any table may with suitable adaptations be used directly in the preparation of shop drawings without the labor of recalculation. The data relating to the strength of materials are those wholly obtained by direct experiment, mainly in testing machines owned and operated by the Government.

There will be noticed throughout the book a tendency toward steam-engine details, due no doubt to the author's long familiarity with this subject. The present volume is the first part of what is intended to be a two-volume series. The second volume, to follow shortly, will deal more with machinery, fittings and equipment in general than does this volume.

As an engineering and a general reference book this volume will prove of considerable value. The chapter headings, which only hint at the very large range of subjects, are: Units and Standards; Weights and Measures; Mensuration and Mechanical Tables; Properties of Some Materials Used in Engineering; Steel Bars, Plates, Shapes, Bolts, Rivets; General Specifications for Inspection of Material, Navy Department; Iron and Steel Castings; Iron and Steel Forgings, Carbon and High-Speed Steels, Heat Treatment; Nonferrous Metals and Alloys; Machine Details, Principally Those Relating to Steam Engines and an Index.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 42, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37 60	$37 60
Northern Basic	34 80	34 80
Southern Ohio No. 2	35 80	35 80
NEW YORK, Tidewater delivery		
Penna. 2X	39 55	39 15
Virginia No. 2	41 70	41 70
Southern No. 2	41 70	41 70
BIRMINGHAM		
No. 2 Foundry	34 00	34 00
PHILADELPHIA		
Eastern Pa. 2X	39 15*	38 85*
Virginia No. 2	40 50†	40 50†
Basic	36 90*	36 60*
Grey Forge	36 90*	36 60*
Bessemer	39 10*	38 80*
CHICAGO		
No. 2 Foundry Local	34 50	34 50
No. 2 Foundry Southern	39 00	39 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35 40	35 40
Basic	34 40	34 40
Bessemer	36 60	36 60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named.

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4 07	$4 27	$4 20	$3 97	$4–4 04	$4 07	$4 20
Soft steel bars	3 97	4 17	4 10	4 07	4–4 04	3 97	4 10
Soft steel bar shapes	3 97	4 17	4 10	4 07	4 14	3 97	4 10
Soft steel bands	4 57	4 77					
Plates, ¼ to 1 in. thick	4 27	4 52	4 45	4 47*	4 39	4 27	4 20

* For ⅜-in. plates.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3 50	$3 50
Warehouse, New York	4 75	4 70
Warehouse, Cleveland	3 90	4 98½
Warehouse, Chicago	4 10	4 10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Carloads	New York Less Carloads	Cleveland Carloads	Cleveland Less Carloads	Chicago Carloads	Chicago Less Carloads	Cleveland Carloads	Cleveland Less Carloads	Chicago Carloads	Chicago Less Carloads
*No. 28 black	4 70	6 22	6 52	6 445	5 75	6 45	6 22	6 445			
*No. 26 black	4 60	6 12	6 42	6 405	5 65	6 35	6 12	6 405			
*Nos. 22 and 24 black	4 55	6 07	6 37	6 295	5 60	6 30	6 07	6 295			
Nos. 18 and 20 black	4 50	6 02	6 32	6 245	5 50	6 25	6 02	6 245			
No. 16 blue annealed	4 10	5 37	5 72	5 645	4 95	5 65	5 37	5 645			
No. 14 blue annealed	4 00	5 27	5 62	5 545	4 85	5 55	5 27	5 545			
No. 10 blue annealed	3 90	5 17	5 52	5 445	4 75	5 45	5 17	5 445			
*No. 28 galvanized	6 05	7 57	7 77	7 695	7 15	7 70	7 57	7 695			
*No. 26 galvanized	5 75	7 27	7 47	7 395	6 85	7 40	7 27	7 395			
No. 24 galvanized	5 60	7 12	7 32	7 245	6 70	7 25	7 12	7 245			

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages, for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25 50–30	$15 00
Cleveland	20 00	15 30
Chicago	16 50	15 00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
⅛, 5/32, 3/16, ¼, 5/16, ⅜, No. 8, 7/16 and No. 10	25.50 to 33.00	¼ by 12 in. long	14 00
No. 12		¼ by 19 in. long	12 00
7/16, No. 14 and ½		¼ by 19 in. long	9 00
No. 18		¼ by 21 in. long	6 00
No. 20			
		⅛	33 00
		5/32	27 00
		3/16	21 00

* Very scarce. * Special Welding Wire.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8 00	8 00	7 50
Spring steel (light)	10 00	11 25	11 75
Coppered bessemer rods	9 00	8 00	7 07
Hoop steel	4 77	4 75	4 77
Cold-rolled strip steel	8 02	8 25	8 57
Floor plates	6 27	6 00	6 25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh basing card of No. 6, 1917, for steel pipe and for iron pipe.

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	47%	26%	⅛ to 1¼	36%	20%
½	51%	30%			
¾ to 3	54%	40%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	⅛ to 1¼	36%	21%
½	46%	33%			
¾ to 1¼	52%	39%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36%	2½ to 4	32%	20%
4½ to 6	47%	36%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	43%	27%	45%	26%	41 1%	26 1%
3½ to 3 in. steel lap welded	38%	29%	39%	23%	37 1%	23 1%

Malleable fittings, Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	29 00	26 00	23 50
Tin in 5-ton lots	71 50	72 00	85 00
Lead	5 30	7 05	6 50
Spelter	7 10	8 60	8 00
ST. LOUIS			
Lead	5 00	6 75	6 35
Spelter	6 75	8 25	7 55

At the places named, the following prices in cents per pound prevail for 1 ton or more:

	New York Carloads	New York Less Carloads	Cleveland Carloads	Cleveland Less Carloads	Chicago Carloads	Chicago Less Carloads
Copper sheets, base	29 00	38 00	31 00	31 00	32 50	32 00	35 00
Copper wire (carload lots)	28 00	35 00	32 00	32 00	28 50	28 50	34 00
Brass sheets	29 00	39 75	30 75	32 00	35 00	29 00	35 00
Brass pipe	37 00	46 00	36 50	38 00	40 00	37 00	47 00
Solder (half and half) (case lots)	41 00	55 00	48 00	44 00	45 25	39 00	41 50

Note—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c., polished takes 1c. per sq.ft. extra for 20-in. widths and under, over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill 100 lb. and over, warehouse 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$26 00	$25 00
New York	27 40	50 00
Cleveland	30 00	54 00
Chicago	28 50	37 00

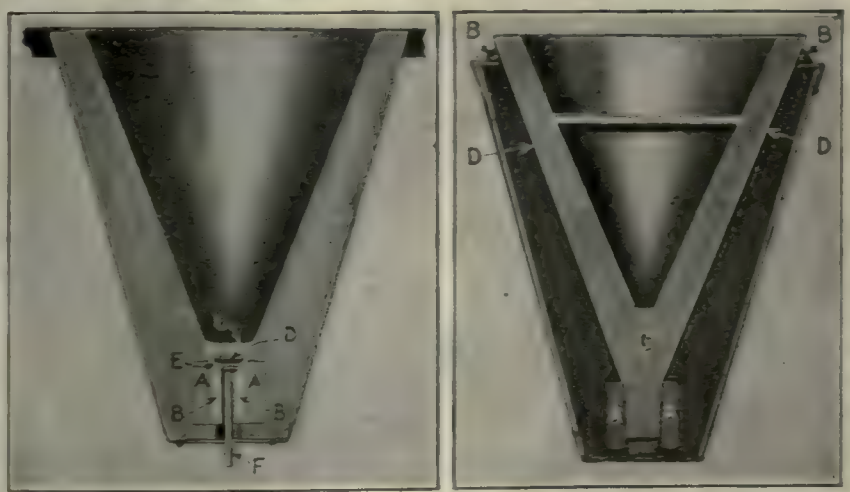
February 13, 1919 American Machinist Vol. 50, No. 7



II. Fusion Welding of Heavy Sections With Thermit*

The welding of heavy sections with Thermit is an entirely different proposition from that of welding pipe. This article clearly shows the difference in methods and apparatus used.

THE method of welding heavy sections and castings, or the fusion method, differs considerably from that used for welding pipe joints. For one thing the parts to be welded must be preheated to a red heat and also another type of crucible is needed. The type of crucible used is shown in Fig. 7. This is a conical-shaped, sheet-metal receptacle, or shell, with an opening in the lower pointed end. In use this is suspended or supported above the gate of the mold by means of a tripod, bracket or other support. The metal receptacle is lined with magnesia tar, a hard-burnt magnesia stone being set in as shown at *A*. This has a tubular opening in it into which a small magnesia thimble *B* is pressed. This thimble provides a channel through which the liquid Thermit steel is poured into the mold. The object of making the crucible so that it may be tapped from the bottom is to prevent the slag from entering the mold, which is directly opposite to the procedure for welding pipe. The hole in the bottom of the crucible is closed previous to putting in the Thermit mixture by means of the tapping pin *F*, the asbestos washer *E*, the metal disk *D* and the refractory sand *C*. This sand is put up in small bags for the purpose by the company selling the mixture. When everything is ready the Thermit is put into the crucible and ignited exactly as described for pipe welding. After the reaction the tapping pin is pushed up as shown in Fig. 8 and the molten steel allowed to run out into the mold.



FIGS. 7 AND 9 SECTIONAL VIEW OF THERMIT AUTOMATIC CRUCIBLE AND METHOD OF LINING IT

Fig. 7—AA, magnesia stone; BB, magnesia thimble; C, refractory sand; D, metal disk; E, asbestos washer; F, tapping pin. Fig. 9—Method of lining a crucible—AA, magnesia stone; BB, lining of fire clay; C, cast iron crucible cone; D, layer of wrapping paper or newspaper.

*For the author's forthcoming book: "Modern Welding and Cutting." All rights reserved.

The crucible and the thimble through which the metal runs after the reaction are two of the most important factors in the whole process. The high temperature,



FIG. 8. TAPPING A CRUCIBLE

together with the violent ebullition of the molten metal during the reaction, necessitates a lining that is not only mechanically strong but of a very high refractory substance. It has been found that magnesia-lined crucibles are the only ones that satisfy these conditions.

Life of Lining Prolonged by Patching With Magnesia Tar

As refractory as this material is, however, the crucibles that are used to any extent must be relined. Sometimes the life of a lining may be prolonged by patching with magnesia tar where needed and then baking it. While any good mechanic can scheme out ways to line a crucible in an emergency and may use fire clay on occasion the following method is given as the best way:

The magnesia-tar lining material should be heated until it becomes plastic. A few handfuls are then placed in the bottom of the crucible shell and a magnesia stone imbedded in this material, as shown in Fig. 9, and centered over the hole. More magnesia tar is then rammed around the stone to hold it firmly in place. The cast-iron crucible cone should then be placed in position with the small projection set into the hole in the magnesia stone. The upper part is next centered in the shell by means of wedges inserted at equal distances along the circumference. The magnesia tar is then

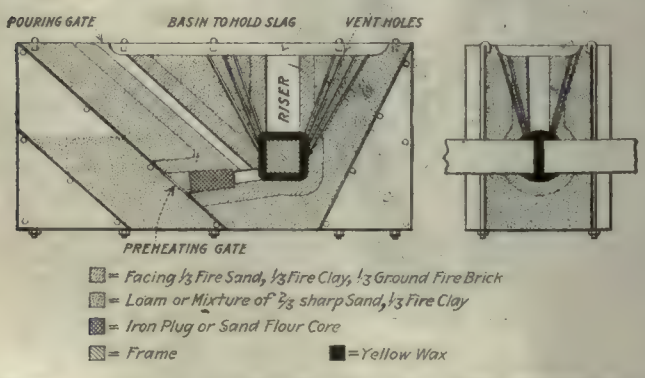


FIG. 10. TYPICAL THERMIT MOLD FOR HEAVY SECTIONS

rammed into the space between the cone and the shell a little at a time and tamped hard. On the density or hardness of the lining depends the life of the crucible. Special iron tamping tools with flat ends should be used. The rammer should be pounded well with a good-sized hammer when ramming in the lining. Better still is a pneumatic bench rammer.

Do not put in the material too rapidly, and let it be remembered that the better and more uniform the tamping the longer the crucible will last.

As the mass nears the top the wooden wedges should be removed as the lining already in place will hold the cone in position.

The Crucible Ready for Baking

When completely filled and tamped a mark should be made with a piece of chalk on the cone and the point opposite to it on the lining, so that when the cone is withdrawn it may be replaced exactly as before. Then take the cone out, exercising care not to disturb the lining, place a layer of wrapping paper or newspaper over the tar lining, then replace the cone carefully, so that the marks previously made come opposite to each other. After this put on the crucible ring and lute carefully around the top with fire clay to protect the upper part of the lining from the heat in baking. It is also well to place damp fire clay around the bottom

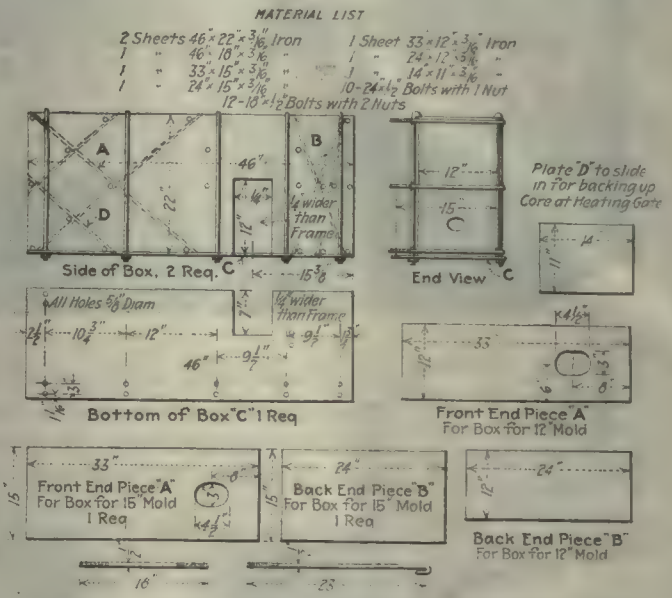


FIG. 11. DESIGN AND MATERIALS REQUIRED FOR STANDARD MOLD BOX

of the crucible and inside of the stone for the same purpose.

The crucible is now ready for baking, and for this purpose it should be placed in a suitable oven. The heat should gradually be raised until the cast-iron cone becomes red hot and should be held at that temperature until all the fumes stop coming off from the tar, after which it can be allowed to cool gradually before removing from the oven. If the crucible is baked too long the lining will appear crumbly and the life of the crucible will be very much shortened. Baking for too short a time will leave some of the tar in the lining and cause a violent Thermit reaction. When cool the clay luting may be removed, the cone taken out and the crucible is ready for use.

Thimbles

The portion that has to withstand the most severe strain of all is the part at the bottom of the crucible, or walls of the hole through which the metal is tapped. It has to stand the wash and pressure of the weight of the moving liquid metal and slag under great heat.

The magnesia stone which is centered in the bottom of the crucible and around which the material for lining is packed has a tapered hole in the center. The thimbles are of the same taper as the hole in the magnesia stone and are set into the latter. When the thimble is used up (either through enlargement of hole or by splitting) it can be knocked out and replaced with a new one, so that the full life of the crucible may be utilized. Thimbles should be wrapped with one layer of uncreased paper before being placed in position.

Since various amounts of Thermit must be used for different sized welds the crucibles used must vary accordingly, although it is possible on occasion to use more than one crucible at a time for a given melt. This is not advisable, however, unless necessary. For lining these various sized crucibles the Thermit company makes magnesia stones and thimbles in certain sizes designated by numbers. The metal cones as well as crucibles of a given capacity are also numbered. All of the ordinary sizes, as well as the amount of magnesia tar needed, are shown in Table III.

TABLE III. DETAILS OF AUTOMATIC CRUCIBLES, LINING MATERIALS, CONES, STONES AND THIMBLES

Size of Crucible	Capacity in Pounds of R. R. Thermit	Gross Shipping Weight of Crucibles Pounds	Outside Diameter at Top, Inches	Height, Inches	Size of Magnesia Stone for Relining	Size of Magnesia Thimble to be Used	Size of Plugging Material to be Used	Weight of Magnesia Tar Required for Relining, Pounds	Size of Crucible Cone Corresponding to Size of Crucible	Shipping Weight of Cones, Pounds
No. 1	6	40	8½	8½	No. 1	No. 1	No. 2	8	No. 1	50
No. 2	8	60	10	10	No. 1	No. 1	No. 2	20½	No. 2	50
No. 3	15	110	12½	13½	No. 2	No. 2	No. 2	42	No. 3	75
No. 4	25	125	14½	15	No. 2	No. 2	No. 2	61½	No. 4	125
No. 5	35	150	16½	15	No. 2	No. 2	No. 2	87	No. 5	150
No. 6	70	250	20	21	No. 2	No. 2	No. 2	141	No. 6	225
No. 7	140	450	25½	25	Nos. 1 and 2	No. 2	No. 2	216	No. 7	375
No. 8	210	525	28	28	Nos. 1 and 2	No. 2	No. 2	258	No. 8	375
No. 9	280	650	30½	29½	No. 3 and 3 Spec.	No. 3	No. 3	327	No. 9	600
No. 10	400	775	34	34	No. 3 and 3 Spec.	No. 3	No. 3	408	No. 10	600

NOTE.—Four magnesia thimbles and five packages of plugging material are supplied with each new crucible.

We have described in detail the construction of automatic crucibles to be used in connection with Thermit welding, and it might be well to include a few words on the proper care of these crucibles.

They should be very carefully handled, as the lining is apt to crack or fall out under rough treatment. It is also always important that they be stored in a dry place, as the lining, being porous, will absorb moisture, and a moist lining will cause violent Thermit reaction.

After a crucible has once been used, it is not necessary to clean it of the slag adhering to the inside, as this is a very refractory material itself and can do nothing but help preserve the crucible if left on. At the bottom, however, in the vicinity of the stone and thimble, the slag has to be removed so as to clear the opening of the thimble or permit of an old thimble being knocked out and a new thimble inserted.

With the construction and method of using the automatic crucible in mind we will next take up the welding of heavy or solid sections in detail. In order to make this clear a typical Thermit mold is shown in Fig. 10. With this illustration to refer to the following directions will be readily understood:

We will suppose that the parts to be welded are those of a broken frame. It is best to put tram marks on the two sections far enough back from the fracture to be outside the mold box when it is in place. These are convenient to measure from when allowing for the contraction of the Thermit steel as it cools. Next cut along the lines of the fracture so that an opening of from 1 to 1½ in. is provided. The amount of the opening depends on the size of the sections to be welded, but in no case should it be less than an inch. If it is a diagonal fracture it is usually best to cut it so as to make as near a vertical opening as possible.

There are various ways of cutting away the metal for the opening, such as sawing, drilling and chiseling, but the best way is to use an acetylene and oxygen cutting torch. In any case the opening should be clear enough to allow the free flow of the Thermit. Now clean the ends of the sections thoroughly for at least four inches from the opening, so as to expose the good, bright metal. Be sure to remove all dirt or grease as far back as the mold box will reach, so that when the mold is rammed up and heat applied there will be no grease to burn out and leave a space between the mold and part to be welded.

If the oxyacetylene torch is used for cutting be sure to remove all oxide or scale left on the parts by the operation. Next make allowance for contraction by setting the parts away from each other a sufficient amount to make up for the contraction of the Thermit steel and adjacent parts in cooling. This should be varied from ⅛ in. to ¼ in., depending on the size of the weld. In many cases it is necessary to obtain this increased space by

forcing the sections apart with a jack or other mechanical means. In other cases, such as the welding of a double-barred locomotive frame, it will be necessary to heat an opposite member by means of a flaming burner attachment on a double-burner preheater or by using a basket fire. It is sometimes advisable to construct a small fire-brick or sheet-iron furnace around such a section in order to confine the heat or

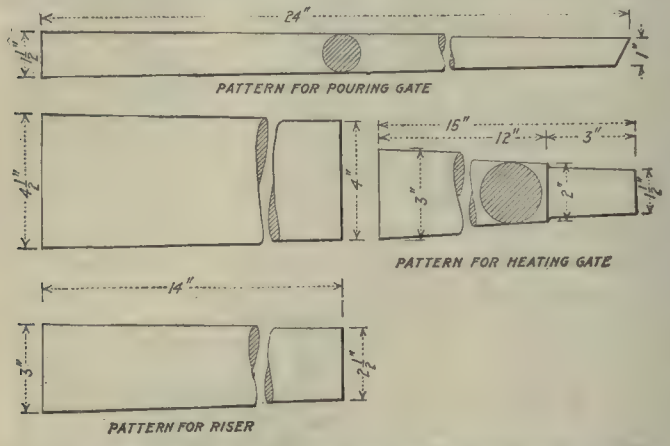


FIG. 12. WOODEN PATTERNS FOR POURING GATE, RISER AND HEATING GATE OF MOLD. THESE ARE LARGE ENOUGH FOR WELDS UP TO 5 x 7 IN. LARGER WELDS REQUIRE PROPORTIONATELY LARGER PATTERNS

protect other parts from the flame. This, however, is done only at the time of preheating.

With the parts lined up and proper allowance made for contraction they are ready for the wax mold.

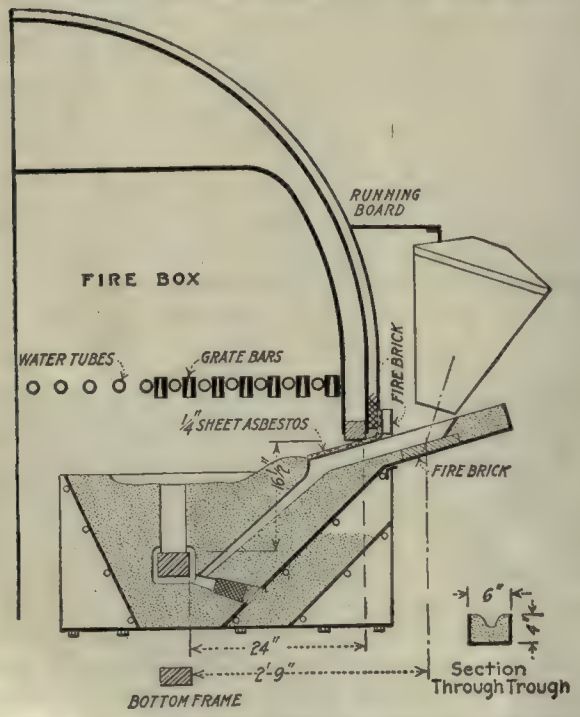


FIG. 13. METHOD EMPLOYED IN MAKING WELDS IN INACCESSIBLE PLACES

The wax-pattern molds are made of yellow wax, as indicated in the illustration of a typical mold. This wax is placed in a pan and warmed until it becomes plastic or else melted entirely and then allowed to cool until plastic. This wax is then shaped around the parts to be welded in the form of a collar as shown. The opening between the ends should also be filled with wax, and it is necessary to provide a vent hole through the wax extending from the location of the heating gate to the riser. The best way to do this is to imbed a piece of good stout twine in the wax, which can be pulled out after the pattern is formed.

The mold box, details of which are shown in Fig. 11, should then be placed in position and securely blocked up so that all weight will be removed from the sections to be welded.

We are now ready for the molding material. This should consist of one part fire clay, one part ground fire brick and one part fire sand. This is used for the facing of the mold or the part that comes in contact with the Thermit steel. If it cannot be obtained in the vicinity it can be ordered from the Thermit company. This material should be well riddled, mixed dry and then moistened with just enough water so that it will pack well.

In ramming up the mold place a small amount of molding material in the box and ram with a small ram-

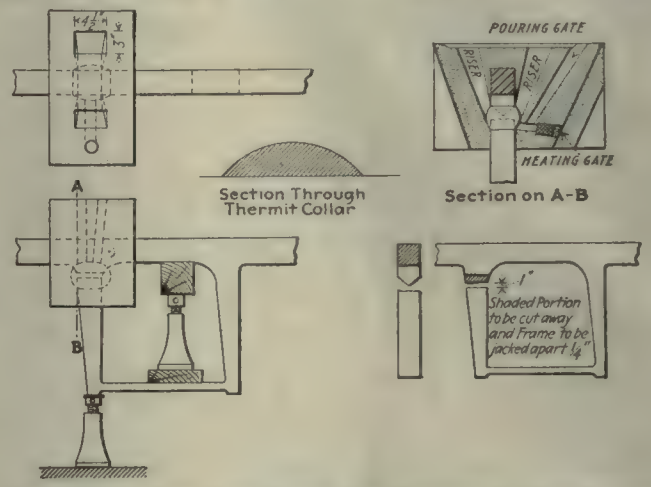


FIG. 15. METHOD EMPLOYED IN WELDING LOCOMOTIVE FRAME BROKEN IN LEG

mer around the edges and working toward the center, keeping the mold level, and *ram hard.* Too much emphasis cannot be laid on this point, for in the construction of the mold depends the safety of the entire welding operation. See to it that the material is well rammed underneath the pattern. There should be a wall of molding material at least 4 in. thick between the wax pattern and the mold box at all points, as the Thermit steel is intensely hot and ample material must be provided to hold it. A wooden gate pattern for the preheating opening should be set at the lowest point of the wax pattern and leading out to the front of the mold box, where an opening is provided for it. Where the sections to be welded together are of the same size this preheating gate should be set directly in the middle of the lowest part of the wax pattern so as to heat both sides of the frame equally. Sometimes, however, it is necessary to weld a light frame section to a heavier one, in which case the preheating opening should favor the heavier section, which will require a longer time to heat than the light section.

With the preheating gate provided for, set another wooden gate pattern directly above it and one inch away from the wax pattern and have it properly shaped for the pouring gate. Drawings for these various patterns are shown in Fig. 12.

Be sure that the molding material is well rammed around these patterns so that it will not "cut out" under the blast of the preheater.

At the highest point of the wax pattern place the riser pattern. If there is more than one high point, place a riser pattern over each, as the function of a riser is to hold a supply of steel which will remain liquid for a considerable period of time, and take care of all shrinkage, so that when a "pipe" is formed, due to shrinkage, this pipe will appear in the riser and not in the weld. Also the riser acts as a depository for loose sand or other foreign matter that may be washed into it by the Thermit steel in passing through the mold and prevents this material from clogging in the weld. It sometimes happens that welds are made at a point where a wooden riser pattern cannot be withdrawn conveniently. In such cases a piece of jacket-iron pipe may be used and left in the mold after ramming up. The Thermit steel will flow into this opening and simply melt the iron pipe and amalgamate with it.

After the mold is all rammed up, hollow out on top so as to form a basin in which the slag may collect so as not to overrun the mold box. Then vent the mold thoroughly by making holes with a vent rod made from 8 to 10 gage steel wire, so that all gases in the liquid metal will have a chance to escape, as shown in the typical mold. This is important.

Now lightly rap the gate, riser and preheating opening patterns and draw them out carefully, wiping away any loose sand that might tend to fall into the holes. A molder's slick, trowel and lifter are very useful in this connection. Then cover the various openings so that nothing will fall into them and adjust the crucible in position with the bottom about three inches above and directly over the center of the pouring gate. Where this cannot be done, construct a runner, as shown in Fig. 13, to lead the steel into the pouring gate of the mold.

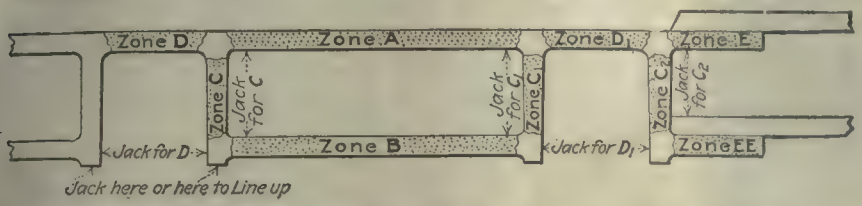


FIG. 14. METHOD OF PREVENTING UNEQUAL STRESSES WHEN WELDING LOCOMOTIVE FRAMES BROKEN AT VARIOUS POINTS

Fracture Location	Remarks
Zone A*	Heat zone B to get $\frac{1}{16}$ in. expansion and hold 2 to 3 hours after welding. Preheater or basket fire.*
Zone B*	Heat zone A to get $\frac{1}{16}$ in. expansion and hold 2 to 3 hours after welding. Preheater or basket fire.*
Zone C, C1 or C2	Jack $\frac{3}{16}$ in. at C, C1 or C2; keep jack in place 2 to 3 hours after welding and then remove entirely.
Zone D or D1	Jack $\frac{3}{16}$ in. at D or D1; keep jack in place 2 to 3 hours after welding and then remove entirely.
Zone E	Cut out unfractured member of splice to clear collar.

*When heating either Zone A or Zone B the adjacent pedestal brace or braces should be put in place before commencing to heat so as to distribute the expansion and not upset or distort the leg.

The mold is now ready for preheating. Set the burner of the preheater so as to point into the heating gate of the mold and about one inch from the opening; then apply the blast. It is best to start easily at first, as too much of a blast would tend to "cut" the mold. The wax will burn out, leaving a perfect mold the shape of the wax pattern. Keep the heat going until the mold is thoroughly dried out and the parts to be welded are brought up to a good, red, workable heat such as would be required if the frame was to be hammered.

While the preheating is in progress the charge of Thermit and additions should be placed in the crucible, which is first plugged in accordance with the directions previously given. It is important to put in a few handfuls of Thermit first before dumping in the rest of the charge, so as not to disturb the plugging material. Mix the Thermit charge thoroughly before putting in the crucible. No ignition powder should be added until the Thermit charge is ready to be ignited. If the Thermit charge when leveled off comes closer than 2 in. to the top of the crucible or if the crucible has to be tipped slightly it is best to build up the crucible by means of a ring. This ring should be less in diameter than top of crucible so it can set in the crucible about 1 in. It should be from 8 to 10 in. high and made from ¼-in. stock. Lute with fire clay between ring and crucible.

TABLE IV. WELDING PORTIONS FOR WELDING RECTANGULAR SECTIONS

Width of Section, Inches	Depth of Section, Inches	Width of Thermit Steel Collar, Inches	Thickness of Thermit Steel Collar at Center, Inches	Quantity of Railroad Thermit Required for Weld, Pounds
3	2	4	1	40
3	2½	4	1	40
3	3	4	1	45
3	3½	4	1	50
3	4	4	1	55
4	4	4	1	65
4	4½	4	1	65
4	5	4	1	70
4	5½	5	1¼	75
4	6	5	1¼	75
4½	4½	5	1¼	70
4½	5	5	1¼	75
4½	5½	5	1¼	75
4½	6	5	1¼	80
5	5	5	1¼	75
5	5½	5	1¼	80
5	6	6	1½	85
5	7	6	1½	90
5½	5½	6	1½	85
5½	6	6	1½	90
5½	7	6	1½	110
6	6	6	1½	100
6	6½	6	1½	120
6	7	7	1⅝	130
6½	6½	7	1⅝	130
6½	7	7	1⅝	150
6½	8	7	1⅝	160
7	7	7	1⅝	155

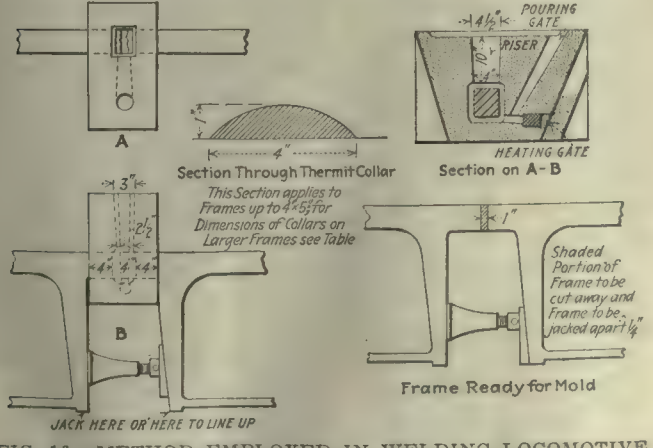


FIG. 16. METHOD EMPLOYED IN WELDING LOCOMOTIVE FRAME BROKEN IN JAW



FIG. 19. THERMIT WELD ON MUD RING

When it is assured that the frame is at a good workable heat quickly remove the preheater and direct it down the riser so as to blow out any sand or dirt that may be in the mold. If the riser is difficult of access direct the burner down the pouring gate. Then plug the preheating hole with a piece of fire brick ground to fit or an iron plug inserted as shown in Fig. 10. Back this up with several shovelfuls of molding material between the mold box and steel plate provided for the purpose and then pack the sand down hard with a rammer. This will prevent any possibility of the Thermit steel running out through the preheating opening. All heating apparatus should be removed to a safe distance while the Thermit reaction is in progress.

Place one-half teaspoonful of ignition powder on top of the Thermit in the crucible (Thermit will not ignite from the heat of the preheater and the reaction cannot be started without ignition powder). Ignite this with a parlor match, applying the same immediately after striking, or else ignite with a red-hot iron; this often is the easier method. It is important that ample time be allowed for the completion of the reaction and for the entire fusion of the punchings, which are mixed with the Thermit. It is best to wait at least 35 sec. before tapping the crucible. This is accomplished by knocking up the tapping pin which sets in the bottom of the crucible, using for the purpose the tapping spade or a flat piece of iron 1½ x ¾ in. by 4 ft.

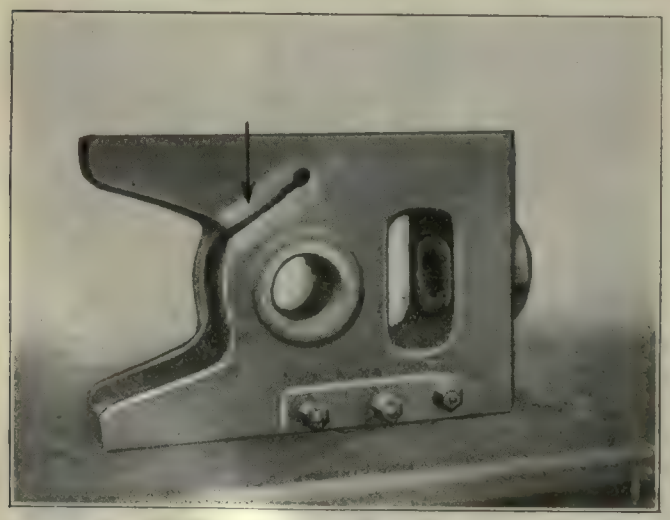


FIG. 20. FRACTURE IN CROSSHEAD CUT OUT FOR WELDING

Hold up the expansion on the parts with a jack or preheater until the metal in the weld has set and shrinkage commences to set in; then remove the jack or shut off the heat. This should be usually done about two or three hours after the weld is made, but depends largely on the size of the section and length of preheating.

The mold should be allowed to remain in place as long as possible, preferably over night, so as to anneal the steel in the weld. In no case should it be disturbed for at least six hours after pouring.

After removing the mold, drill through the metal left in the riser and pouring gate and knock these sections off, or else cut them off with an oxyacetylene torch.

The amount of Thermit needed for welding sections of different sizes can be derived from Table IV, which contains the proper proportions of manganese, nickel and punchings. These amounts are given on the supposition that the Thermit collar or reinforcement is made in accordance with the dimensions published in the table.

It is better practice, however, to calculate the amount of Thermit needed for a weld from the weight of wax

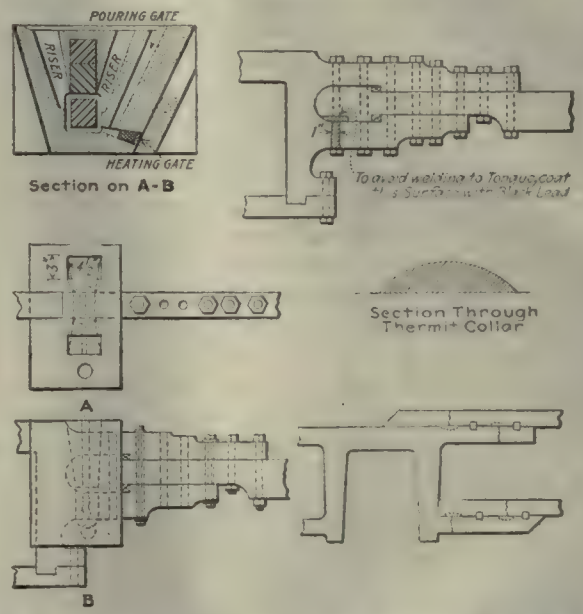


FIG. 17. METHOD OF WELDING FRAMES BROKEN IN SPLICE. LOWER DRAWING SHOWS HOW TO DRILL AND CUT THE UNBROKEN MEMBER

used in the pattern and it is advisable anyway to make this calculation as a check.

Where the quantity of Thermit is calculated from the wax great care should be taken to see that the entire space which is to be filled with Thermit steel is filled with wax so that not only the collar but the space between the sections is filled with wax. Then, by weighing the wax before and after the completion of this operation, the difference will be the quantity of wax used, and this weight in pounds multiplied by 30 will give the proper amount of railroad Thermit for the weld.

It is recommended that railroad Thermit be used in all cases, as it is ready mixed with 1 per cent. pure manganese, ⅝ per cent. nickel shot and 15 per cent. mild-steel punchings. This has been found to give the best results for welding wrought iron and steel. For convenience railroad Thermit is supplied in waterproof paper bags holding 29½ lb. of the mixture, so that one bag to the pound of wax is sufficient for a weld. This

rule provides ample Thermit steel not only for the weld proper, but also for the pouring gate and riser.

In case the user has only plain Thermit on hand he should then allow 25 lb. of plain Thermit to the pound of wax, and should mix with this amount of plain Thermit 1 per cent. pure manganese, $\frac{5}{8}$ per cent. nickel shot and 15 per cent. mild-steel punchings. In other words, to every 100 lb. of plain Thermit add 1 lb. pure manganese, 10 oz. nickel shot and 15 lb. mild-steel punchings. These punchings must be clean and free from grease or dirt of any kind and not more than $\frac{3}{8}$ in. in diameter by $\frac{1}{8}$ in. thick.

These rules apply only to welds requiring less than 300 lb. of Thermit. For welds requiring more than 300 lb. of Thermit the usual mixture takes 20 per cent. mild-steel punchings with the other additions the same. If railroad Thermit is used add $3\frac{3}{4}$ lb. of punchings to each bag. In special cases it is sometimes advisable to make up a special mixture in order to produce a Thermit steel of essentially the same analysis as the steel in the parts to be welded. Where the amount of Thermit calculated comes to ten bags or more, one of these bags may be dispensed with; that is, instead of using ten bags use nine, or instead of using 20 bags use 18, and

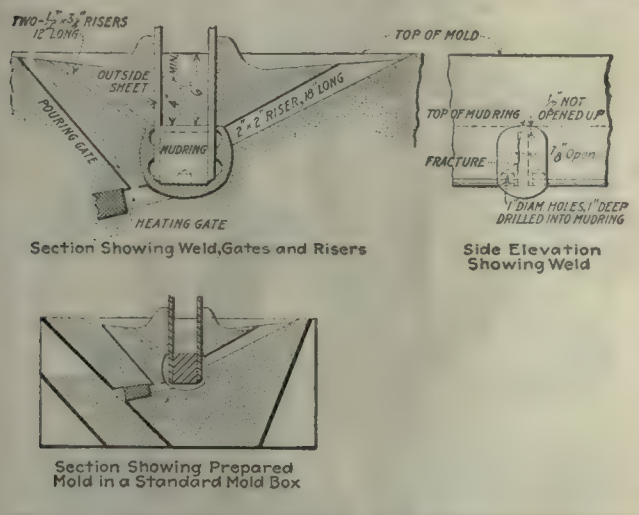


FIG. 18. MOLD FOR WELDING MUD RINGS WITHOUT CUTTING SHEETS

so on, as the smaller percentage of metal required for gates and risers makes it unnecessary to use so much of the mixed Thermit.

Where it is desired to calculate in advance the amount of Thermit required for a weld it is first necessary to estimate the number of cubic inches in the space to be filled with Thermit steel, i.e., the space between the ends of the sections to be welded together and the cubical contents of the Thermit-steel collar or reinforcement fused around the weld. Allow $\frac{3}{4}$ lb. of railroad Thermit to the cubic inch, and this will be sufficient not only for the weld proper but will provide ample metal for pouring gate and riser. In estimating the cubical contents of the collar the simplest method is to multiply the width by the greatest thickness (i.e., the thickness at the middle part); then multiply this product by 0.7. This will give the average area of the cross-section of the collar. If this is then multiplied by the total length of the collar around the outside of the frame and if all measurements are taken in inches the result will be the number of cubic inches in the collar.



FIG. 21. WELD COMPLETED AND CROSSHEAD IN SERVICE

The foregoing directions refer to the general run of wrought-iron or steel repairs, but with only slight variations the same method is followed for locomotive-frame work. The principal difference is in placing the mold or allowing for contraction in various members and not in the use of the Thermit itself. In order to make it clear where stresses are liable to be set up in a locomotive frame the diagram shown in Fig. 14 has been made. By a careful study of this and the application of the principles illustrated a welder should be able to figure out his work so as to produce satisfactory results.

The illustrations will be of assistance in planning the work on various parts of a locomotive frame. Fig. 15 shows how to place the mold and jacks for welding a broken frame leg. With the pouring gate and risers as indicated they permit of a good washing action for the Thermit steel, so that any slag or sand that might be in the mold will be carried into the risers.

Fig. 16 shows how to weld a frame broken in the jaw.

Fig. 17 shows how to weld a frame broken in the splice. In this it is best in making the repair not only to weld the broken sections together, but also to cut out a piece about 1 x 5 in. of the unbroken member, so the

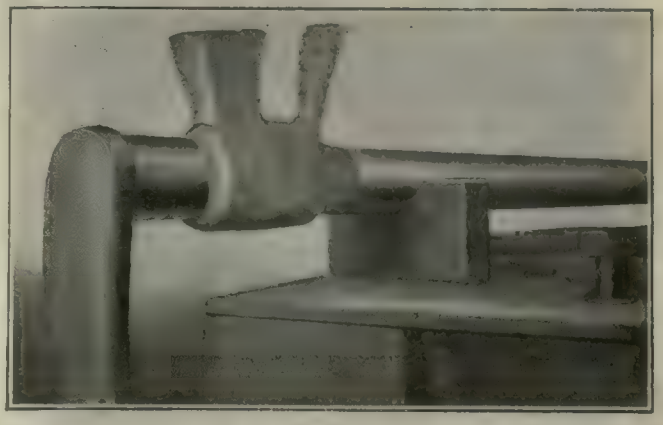


FIG. 22. WELD ON BROKEN ROCKER SHAFT BEFORE MACHINING

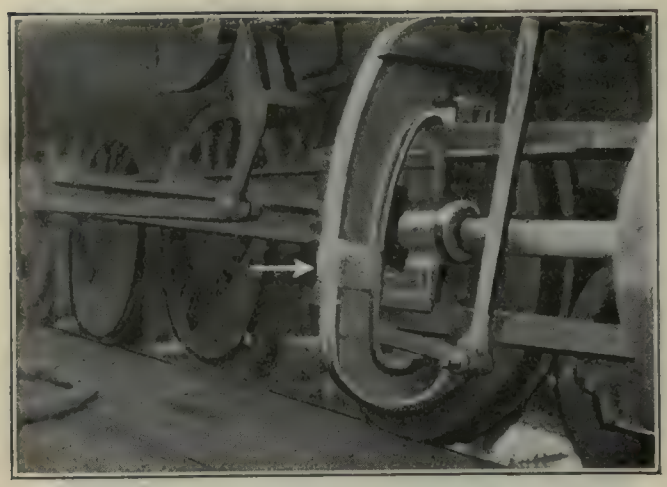


FIG. 23. REPAIR ON BROKEN GUIDE YOKE

Thermit will flow entirely around the broken sections. By making the repair in this manner a good, strong job is assured, and if the bolt hole is welded up and the two members welded together future breakage at these particular points is practically eliminated.

The only objection that can be raised against this practice is the trouble of separating the members in case the splice is to be removed or in order to take out or renew a cylinder. This objection, however, is not serious because it is only necessary to drill a line of small holes where the parts are welded together and the member can then be removed. When replacing it is best to cut a keyway where the frame is cut out and then bolt together in the same way as when the frames were originally assembled.

Fig. 18 shows how to weld locomotive mud rings without cutting the sheets. This method has proved entirely satisfactory and many such welds have been completed and are giving good service.

Fig. 19 is that of a finished mud-ring weld, in which the sheets are not cut.

Fig. 20 shows a fracture in a crosshead cut out for welding.

Fig. 21 shows the weld completed and the part in service.

Fig. 22 shows a weld on a broken locomotive rocker shaft before machining.

Fig. 23 shows a repair on a broken guide yoke.

Fig. 24 illustrates two welds in an engine splice.

Fig. 25 is a repaired driving-wheel center.

Fig. 26 shows details of a crucible holder for frame welds.

No attempt has been made to make the list of repairs on locomotive parts complete, but enough has been shown to serve as a guide for practically everything that is apt to confront the practical man. For superheater work, or pipe work of any kind, the directions given under the heading of pipe welding will cover all that is necessary.

As a sort of recapitulation of the foregoing directions, it will be well to keep the following "don'ts" in mind when getting ready for all locomotive Thermit-welding work.

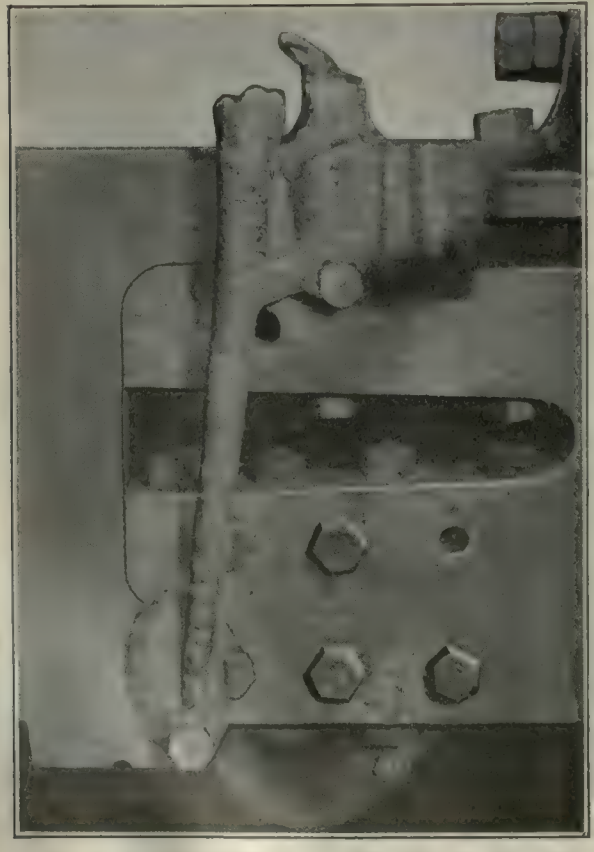


FIG. 24. TWO WELDS IN SPLICE OF FRAME

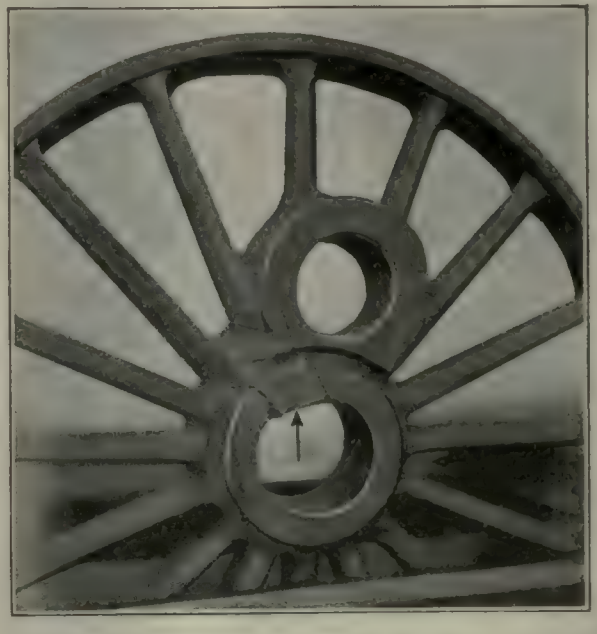


FIG. 25. WELD ON DRIVING-WHEEL CENTER

Don't keep your material and appliances in a damp place. Better store them all in a good, dry room under lock and key, the foreman in charge of the Thermit work to have the key. Better still construct a tool wagon and keep all Thermit material in it.

Don't start to make a Thermit weld unless you have all the necessary materials and appliances and the latter in good condition.

Don't neglect to clean the frame thoroughly. Be sure to remove all the grease, paint, etc., and have as good clean metal as possible to work on.

Don't neglect to take care of the contraction that is bound to be set up as the metal in the weld cools. If this cannot be allowed for by spreading the sections with a jack or other mechanical means heat the opposite

unbroken member with the other burner of a double-burner preheater fitted with a flaming-burner attachment. If this is not available hang a basket fire of charcoal or coke about the unbroken member and heat until proper expansion is obtained, holding up the heat for two or three hours after the weld is poured. It is advisable to expand the frame $\frac{3}{16}$ in. on the average. Cut out the frame along the fracture so as to make a clean opening 1 in. wide. Proportion your wax pattern to the size of the frames as shown in the table.

Don't use pin grease or wood in place of wax for the collar. Pin grease has some sulphur in it and we all

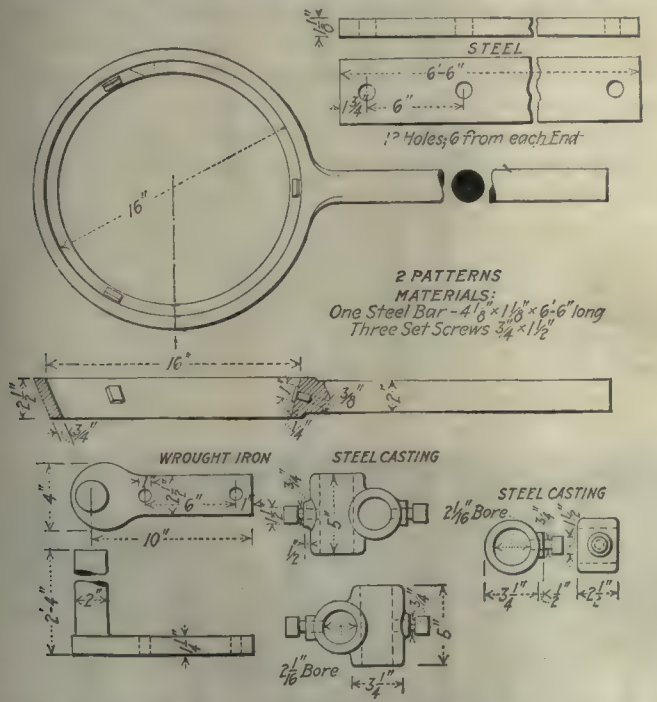


FIG. 26. DESIGN FOR CRUCIBLE HOLDER FOR LOCOMOTIVE-FRAME WELDS

know how undesirable the presence of sulphur is in iron or steel. Pin grease and wood of course burn out in the preheating, but they leave a carbon deposit that will not burn off but will bake on.

Don't vary the dimensions of the wax collar. Make collars of uniform width and thickness on all sides, thus insuring an even distribution of heat. In the case of welds on pedestal legs cutting down the thickness of the collar is poor policy. Remember that the weld is the object and the weld will not be perfect if the dimensions of the collar are not the same on all sides.

Don't moisten the molding material too much. Have it damp enough to bind under the natural pressure exerted in closing the hand.

Don't use a molding material that runs to slag in the course of preheating; if it will not stand the preheating torch it surely will break down to slag, as the Thermit steel flows into it, and a mixture of slag and steel is not at all desirable and furthest from a perfect weld.

Don't forget to support the frame and mold box by means of blocks or jacks, as the weight of the rammed mold is considerable and sag the frame.

Don't start off the preheater with too strong a blast. Take it easy at the start and increase the air and gasoline as the moisture is driven out of the molding material. In this way the mold will not be cut out and a clean-looking job will be the result, with no lumps.

Don't pour the Thermit on a black-hot frame; heat it to a good workable heat.

Don't use crude or fuel oil to preheat the frames. In starting the burner of a heater using either, carbon is deposited on the frame and prevents a good weld. Heat preferably with gasoline and compressed air. If gasoline is forbidden use kerosene, but under no circumstances use crude oil or fuel oil.

Don't be careless in plugging the crucible. Careless plugging results in premature tapping, and this latter might lead to ugly looking or defective welds due to the imperfect separation of slag and steel.

Don't guess how much Thermit to use. Consult the table of instructions and you will not go astray.

Don't use anything but railroad Thermit for welding a steel or wrought-iron section. For cast-iron sections use cast-iron Thermit.

Don't add the ignition powder to the charge in the crucible until ready to start the reaction. It is advisable to suspend the crucible in place, charged with Thermit, before starting to preheat. Everything will then be ready for pouring at the proper time.

Don't tap the crucible too soon after starting the reaction. On an ordinary frame weld taking from 65 to 100 lb. of Thermit permit 35 to 40 sec. to elapse between starting the reaction and tapping the crucible. This to insure good separation of steel and slag.

Don't release the spreading bar or jack or take off heat too quickly after pouring. It is best to hold up the expansion for two to three hours before removing jack or shutting off heat.

Don't remove the mold box too quickly after the pour. Let it remain in place over night; it will insure the frame cooling off slowly and naturally.

Don't forget to gather up all the materials and appliances after completing the work. Take them to the room that you ought to have for the storage of this material and it will be at hand when you want to make use of it again.

Don't get excited—keep cool.

Don't take a chance. Be sure everything is right as you go along. There is no such thing as luck.

Also remember that the riser must be 2½ x 4 in. at the bottom and 3 x 4½ in. at the top and not less than 14 in. high where clearances will admit. In the case of welds on vertical members two risers should be used, but their total capacity need not be greater than the riser for which dimensions have been given. The pouring gate must be not less than 1 in. in diameter at the bottom, 1½ in. in diameter at the top and 30 in. long. Mold boxes should be made of $\frac{3}{16}$-in. sheet iron, allowing for at least 4 in. of molding material on all sides of the Thermit steel.

A Remarkable Feat of Engine Assembling

SPECIAL CORRESPONDENCE

The triple-expansion marine engines here shown were recently assembled in record time at the Wetherill shops of the Sun Shipbuilding Co., Chester, Penn.

Each engine weighs about 400,000 lb., and is 25 ft. high, 25 ft. long and 14 ft. wide. The cylinders are 27 in., 45½ in. and 76 in. respectively in diameter by 51

in. stroke, operating under a pressure of 190 lb. per square inch.

The work of assembling was started one morning at 10:30 o'clock. The components of the engines, such as the bedplates, columns, cylinders, bearing caps, crankshaft, rods, etc., were lying on the floor in various parts of the shop just where they had been dropped when the machine and floor hands had finished work on them.

The machine and hand work had been completed on all the parts except the piston and pump rods. These were finished with the exception of cutting them to length, which could not be accomplished until the cylinders were in place.

By 12 noon of the same day the crankshafts were in place and all the bearing caps were fitted and adjusted. Besides this all the housings, except two, were in place and bolted down, these two being the back housing on the low-pressure engine of the one set and the front housing on the high-pressure engine of the other set.

The first night the men worked overtime till 10 p.m., by which time all the connecting-rods on both sets of engines and all the valve gears were in place. During the first day there were two lunch periods.

On the second day work was resumed at 7:15 a.m., when the cylinders were placed, and as each one of them was set and bolted down the crank under it was turned to top position so that the length of the piston-rod coul be measured. While the other cylinders were being set the piston-rods were turned to length. For this work three lathes and three extra men were used, each of the men doing the work on two of the rods.

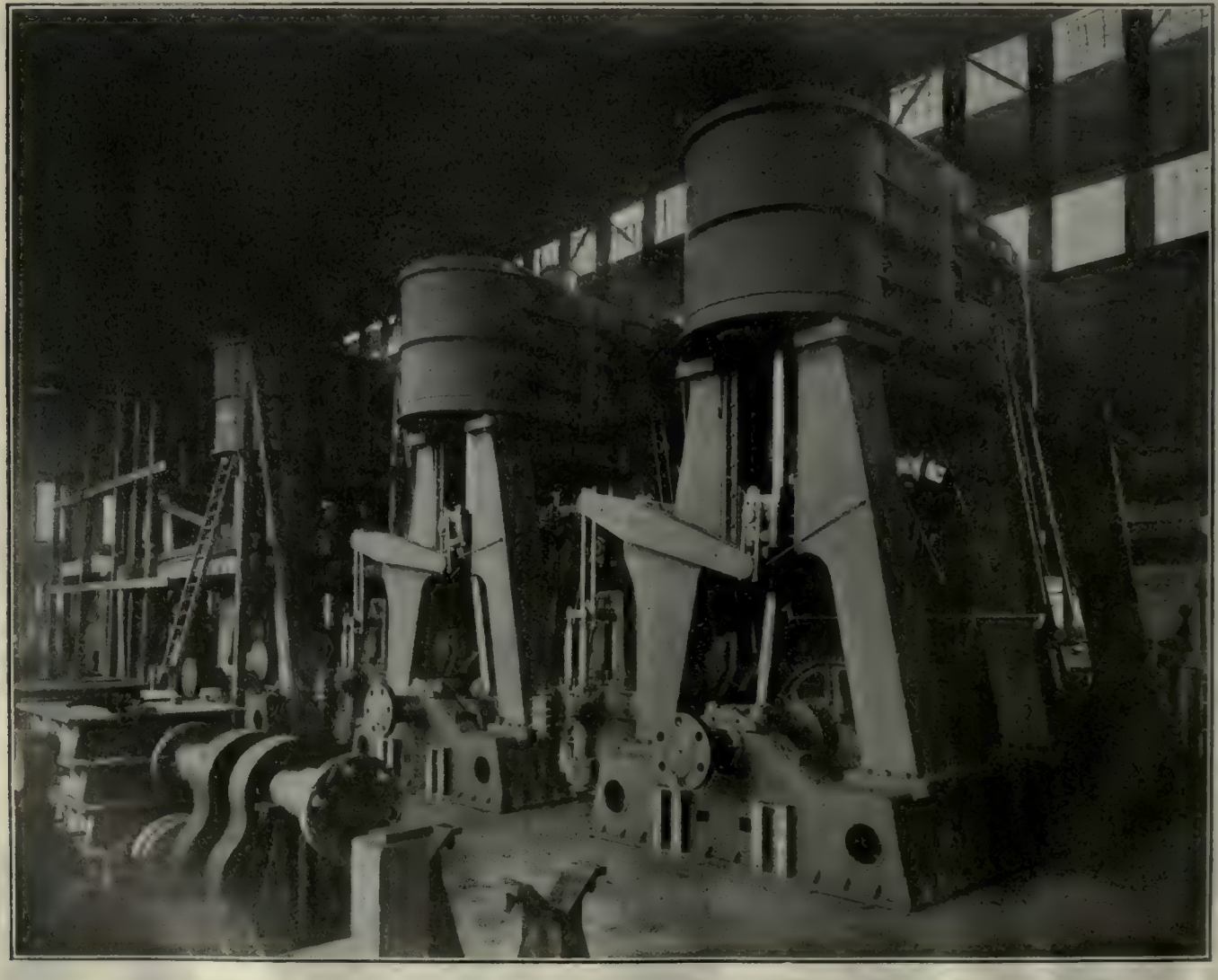
The valves were next put in and set, and the handling, reversing and turning gears and the air pump were installed and the latter connected up with the levers. On this day there was no overtime.

Work was begun at 7:15 on the third morning and the entire work of assembling both engines was completed by 5:45 p.m. that afternoon.

The total time consumed in assembling the two sets of engines was 30½ hours, and the force employed on the job, exclusive of the three lathe hands, who worked part time only, was 15 men.

During practically the whole of the time the usual routine work of the shop was carried on and the single traveling crane served the entire shop.

This work is not usually accomplished in this way, the assembling of marine engines being a somewhat prolonged series of operations, depending on the number of men and finished parts available, but as a basis for comparison under ordinary shop conditions and usage three weeks would not be considered unreasonable to assemble each of these engines.



PAIR OF 3000-HP. TRIPLE-EXPANSION MARINE ENGINES ASSEMBLED BY 15 MEN IN 30½ HOURS

Teaching Thrift Through Thrift Stamps

BY LUTHER D. BURLINGAME
Industrial Superintendent Brown & Sharpe Manufacturing Co.

The sale of Liberty bonds and stamps taught many lessons in saving. Whether the habit of thrift is to become permanent largely depends on how the future sales are handled. The suggestive value of Mr. Burlingame's article is great and deserves careful study.

DURING the war employees in the industries have learned much in lessons of thrift, but now that the war is ended there is great danger of a reaction and a return to old habits, especially among those who have previously been habitual spenders. This danger exists even where saving has been fully voluntary either from patriotic motives or with a purpose of laying up for future needs, but especially where saving has been somewhat under compulsion due to the force of public sentiment or pressure from shop-

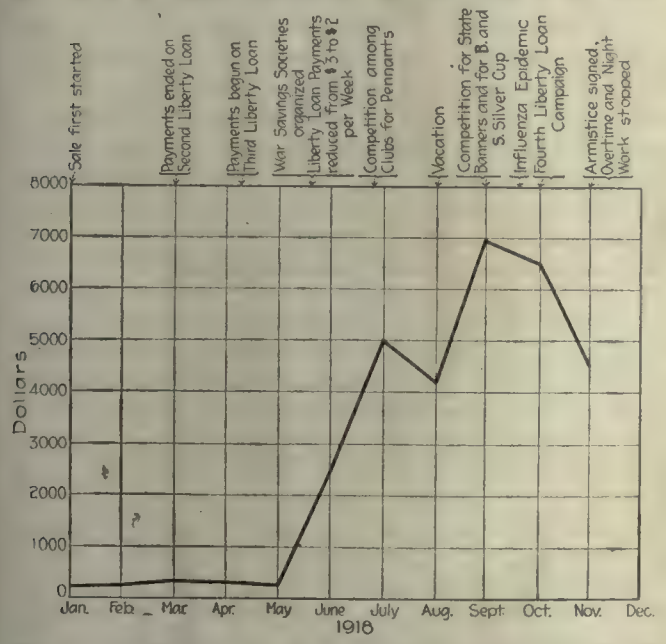


FIG. 1. MONTHLY SALES OF WAR-SAVINGS SOCIETIES. BROWN & SHARPE MANUFACTURING CO.

mates or foremen. There is a prospect that unless rightly guided there will be not only a giving up of the habit of saving, but of going to the other extreme and dissipating what has already been saved.

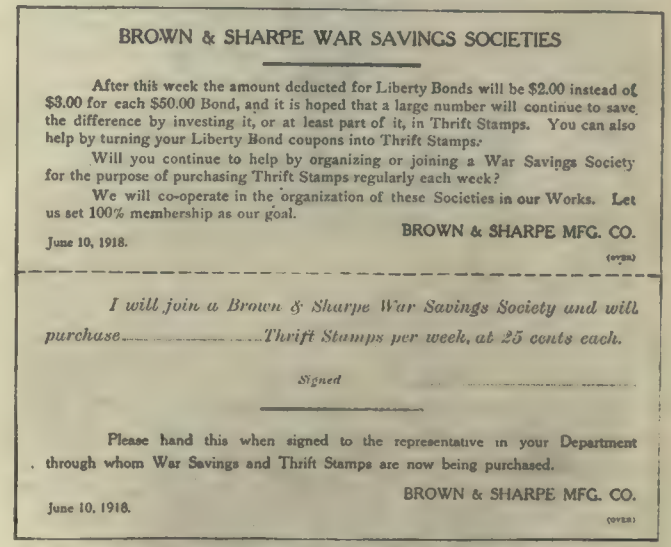
There is therefore special need at this time on the part of those having the interests of the employees of American industries at heart to take prompt and constructive measures to conserve what has proved one of the greatest assets of the war—the development of thrift.

In the critical time during the transition from war to peace an index of whether the gains in thrift which have been made can be held will be found in the continuance of interest in the purchase of War-Savings stamps of the issue of 1919, and whatever can be done to stimulate such an interest will be a direct factor in strengthening the fiber of our national economic life. The organizing and maintaining of War-Savings societies in industrial plants can be an important aid in attaining the desired end.

To aid those manufacturers who seeing this need are willing to do their part to meet it, but who have not as yet worked out successful methods of so doing, a detailed account of a plan in operation at the works of the Brown & Sharpe Manufacturing Co., Providence, R. I., is here given. This plan has brought gratifying results during the past year.

A year ago when the sale of Thrift stamps was first introduced in these works arrangements were made to have responsible men in each department take orders and secure stamps for the employees through a central distributing headquarters in the cashier's office. To inform employees of this plan a notice pointing out the financial advantages of this form of investment and appealing to the workman's patriotism as well as his self-interest was put in each pay envelope.

With about 7000 employees this brought a response of but a few hundred dollars a week. Even this was felt at the time to be a fair showing as compared with



BROWN & SHARPE WAR SAVINGS SOCIETIES

After this week the amount deducted for Liberty Bonds will be $2.00 instead of $3.00 for each $50.00 Bond, and it is hoped that a large number will continue to save the difference by investing it, or at least part of it, in Thrift Stamps. You can also help by turning your Liberty Bond coupons into Thrift Stamps.

Will you continue to help by organizing or joining a War Savings Society for the purpose of purchasing Thrift Stamps regularly each week?

We will co-operate in the organization of these Societies in our Works. Let us set 100% membership as our goal.

BROWN & SHARPE MFG. CO.

June 10, 1918.

(over)

I will join a Brown & Sharpe War Savings Society and will purchase..... Thrift Stamps per week, at 25 cents each.

Signed .....

Please hand this when signed to the representative in your Department through whom War Savings and Thrift Stamps are now being purchased.

BROWN & SHARPE MFG. CO.

June 10, 1918.

(over)

FIG. 2. FRONT AND BACK OF SLIP INCLOSED IN THE EMPLOYEES' PAY ENVELOPE

what other shops were doing, because deductions of $3 a week were then being made for Liberty bonds from the pay envelopes of a large proportion of the working force.

When in March the payments had been completed on the Second Liberty bonds and there was a short period before the next bond issue was floated, a second appeal for the purchase of Thrift stamps was made, also through the pay envelopes. This brought a slight increase during the month, as is shown by the graphic diagram, Fig. 1, but the results still showed no general response and indicated a lack of vital interest in this plan of saving as it had been presented.

The purpose of this article is not, however, to describe such plans, which gave at best only small returns, even though to an extent paving the way for later success, but to show how when the matter was really taken



FIG. 5. CERTIFICATE GIVEN WINNING CLUB AND PENNANT AWARDED WEEKLY

up in earnest, and with sufficient attention to formulate and carry out in detail a comprehensive plan, the returns at once jumped to more than 20 times what had previously been received, putting this saving system on a stable basis, which has since shown a healthy growth.

It is believed that the secret of success lay first in arousing individual interest through personal responsibility, and second in exciting a keen spirit of rivalry through competition.

In order to bring about interest through a feeling of individual responsibility it was decided to organize War-Savings societies, each having a comparatively small number of members, with its own president and secretary. These societies were grouped so that members would be as far as possible in the same department or subdepartment. In some cases the women in a department were in one club and the men in another.

In order further to give the clubs a feeling of individuality and permanence certificates were filled out, each with the name of the club and also the names of the officers, and these were passepartouted with a glass front and eyelets at the back so that they could be conveniently hung in plain sight. (One of these certificates is shown above the pennant in Fig. 5.) The good effect of these framed certificates was at once evident, as they formed a rallying point of interest for each club and tended to dignify the movement and show that it was being taken up in earnest.

Each of the clubs selected its own name, the interest aroused over the selection of these names being the first indication of real enthusiasm which showed itself and it is believed had a marked influence in making the members of the clubs feel a personal interest in their success and in getting them thought about and talked about among the employees. Some of the striking names which were given were: "Victory," "100 Per Cent. American," "Over the Top," "General Foch," "Anti-Kultur," "Baby Bond," "Kaiser's Koffin," "On to Berlin," "Uncle Sam's Nieces," etc.

Many of the clubs were named for shopmates in the service and several were named for shopmates whose lives had been sacrificed for their country. With such names to live up to there was an added stimulus for response to the extent of sacrifice in turning in funds.

The division into clubs with a comparatively small number of members secured the two advantages already pointed out as essential to success—one to give responsibility and arouse interest by having a large number holding official positions; the other organizing homogeneous units for purposes of rivalry.

In order that there shall be the least interference with regular shop work it is important to have as the officers of the clubs those whose duties will not be seriously interfered with when giving time to this work. For this reason it is well not to have those who are engaged in production work as officers, especially as secretaries, but subforemen, department clerks and even messengers can often fill these offices successfully. In most cases it will be found advisable for foremen or officials to make suggestions almost equal to appointment of the desired officers that the clubs may be started and carried on in harmony with the shop management. If this is done diplomatically, however, it need not offset the advantages which come from the cultivation of a feeling of responsibility on the part of these officers.

THRIFT-STAMP CLUBS

The returns show that there will be a very large increase in the amount of money handled each week for Thrift stamps, and in order to save time the money should be placed in the bag or envelope sent herewith with a slip stating the amount, and this can be exchanged at the office for the required number of Thrift stamps without waiting at the time for the money to be counted, that being left until a later time when it will cause less delay.

The secretaries of the clubs should turn in their money as early as possible each Tuesday, so that you can report to Mr. Blank before 12 o'clock the number of stamps required for that day. When you receive the stamps they should be distributed to each secretary, who in turn will give them to the men in his club.

We send herewith a number of cards (Fig. 8) for distribution to secretaries of the clubs reporting to you, so that they can keep a record of the amounts paid in each week, from which the standing of the clubs can be secured at any time. We also send some old envelopes, the larger of which can be used for keeping the secretaries' record of payments and the smaller for money paid in by the members.

We have 100 per cent. cards for departments where every employee is a member of a club, and will be pleased to furnish you these on written request. The foremen should be consulted in such cases in order to avoid misunderstanding as to which are 100 per cent. departments.

Whenever a member of a club is transferred to another department of the shop his name should be transferred to the club in that department where payments can be made most conveniently.

Please see that this information, as far as it applies to the secretaries of the clubs, is transmitted to them.

BROWN & SHARPE MFG. CO.

June 18, 1918.

FIG. 3. FIRST NOTICE SENT OUT SUGGESTING THE ORGANIZING OF WAR-SAVINGS SOCIETIES

WAR-SAVINGS AND THRIFT STAMPS

Mr. (Adressed to all foremen):

In order to stimulate a further interest among our employees in saving by the purchase of War-Savings and Thrift stamps it is desired that WAR SAVINGS SOCIETIES be organized in the various departments throughout the shop, these societies to consist of about twenty employees each, each of which will have its own name and elect its own president and secretary, and the members of which will agree to purchase one or more Thrift stamps each week, the money for these to be collected by the secretary and exchanged for Thrift and War-Savings stamps in accordance with the present plan or they can be purchased by the members through any outside source.

After the pay received June 10 the amount deducted for Liberty bonds will be $2 instead of $3 for each $50 bond, and it is hoped that those paying for bonds will as far as possible continue to save the difference by investing it, or at least a part of it, in Thrift stamps. Dividends now due on Second Liberty bonds, and those which will be due on First Liberty bonds June 15, if also turned into Thrift stamps, will increase the earnings from the first investment, and employees should be encouraged to use their coupons in this way.

In order to assist in organizing these WAR SAVINGS SOCIETIES you are asked to appoint a representative (preferably the one who now handles the collections for Thrift stamps) who will be responsible for this work in your department under your supervision. He is asked to be at a meeting at the Apprentice Building on Friday, May 31, at 11 a.m. in order to be instructed as to the details and method of carrying out the plan.

The leaflet herewith gives some general information. There will be a charter, certificate of membership, pins to be worn by the members and other features which should appeal to workmen and tend to create a spirit of interest and rivalry. It is hoped that full coöperation will be given by the foremen themselves becoming members and striving to have as far as possible every employee enroll in one of these societies.

May 28, 1918.

BROWN & SHARPE MFG. CO.

FIG. 4. INSTRUCTIONS TO REPRESENTATIVES AS TO THEIR DEALINGS WITH THE CLUBS

The plan for organizing the clubs was launched by inclosing slips as per Fig. 2 in the pay envelopes. The representative referred to in these pay-envelope slips had been appointed by the foreman of each department, a notice (Fig. 3) having previously been sent to the foreman.

After the appointment of these representatives, and after a meeting for organization, they were sent a special notice, Fig. 4, explaining in some detail the methods to be followed. Following the sending out of the notices in the pay envelopes the representatives made a thorough canvass for membership of the employees in their department who had not already joined. This materially added to the number subscribing. It may be noted that a personal canvass always has a much greater value than either bulletin-board notices or those distributed through the pay envelope. It has been recently estimated by authorities on the subject, after comparing savings-banks deposits which are not solicited with forms of investment and deposit which are solicited, that "personally solicited thrift increases 35 times as fast as unsolicited thrift," and experience in connection with shop insurance and investments seems to confirm this view.

Even with such personal solicitation on the part of the representatives the percentage of membership in some departments was still below what it was thought might be obtained. In order to still further increase the interest a spirit of rivalry was aroused by means of competition between the departments. This was done by posting on the bulletin board throughout the shop the percentages of employees of each department who had become members of the War-Savings societies. The departments having 100 per cent. membership were further recognized by having special certificates to that effect posted in prominent places. It was thus made evident which departments had made a good showing, and which were lagging, and both foreman and workmen in the lagging department were pressed to bring their department up to a better showing.

At this time competition was started between the various clubs by the offer of pennants, shown in Fig. 5, the competition being between comparatively small groups of clubs such as between each group of clubs in the same department or in the same building, or where some other natural division grouped ten or so of the clubs together. It is believed that this was one of the greatest incentives in arousing a real spirit of interest and of competition among the clubs.

PENNANTS INEXPENSIVE

These pennants were inexpensive, costing less than $1 each. There are about 35 of them in competition among the 246 clubs grouped as already pointed out. They are made in bright colors, with small silk American flags fastened at the top, the lettering being stenciled on cambric and having one of the War-Savings societies' buttons pinned within the circle. It is, however, the sentiment and not the intrinsic value of the pennant which counts, and it is believed that they have proved their value to the extent of bringing in thousands of dollars in investments each week, which would not otherwise have been received. This was due to the interest and spirit of rivalry they have aroused, and after months of use the competition has not grown to be an old story and lagged, but still remains keen as to which department will hold the pennant for the coming week.

The conditions of competition for these pennants are



FIG. 6. SILVER CUP AWARDED TO DEPARTMENT WITH THE HIGHEST STANDING

THRIFT STAMP CUP CONTEST.

STANDING OF DEPARTMENTS FOR SEPTEMBER, FIGURED ON A HANDICAP BASIS. HARDENING ROOM, WINNER FOR SEPTEMBER.

DEPT.	% MEMBER-SHIP.	SEPT. TOTAL AMT.	AMT. PER WEEK PER MEMBER.	RATING
*#1 Engineering	100	$890.05	$13.91	1.891
Hardening	100	3068.71	4.95	1.328
Mfg. Grind. Mach.	74	3119.37	2.63	1.024
Gear Dept.	98	1361.19	1.97	.816
Mill. Machine.	87	1949.40	1.34	.772
#1 Draft.	98	573.69	1.82	.747
*Industrial.	100	105.00	2.02	.744
Small Tool	93	2613.22	.97	.743
Foundry	88	1582.43	1.10	.717

Total Number of Clubs, 246.
Total Average Membership, 5,664.
Total Amount Received, $26,944.71
Oct. 9, 1918.

COMMITTEE.
.....
.....
.....

*Not competing.

FIG. 7. MONTHLY RECORD OF STANDING OF VARIOUS DEPARTMENTS

outlined in the following notice, which was sent to the foreman, showing that here again "home rule" and responsibility were encouraged. In order to stimulate personal interest each department determined in detail its own conditions of competition. The notice reads:

Mr.....

The pennant sent herewith is the one to be awarded from week to week to the society in your department having the highest rating or standing. It is suggested that it be hung directly under the certificate of the society winning it for the week.

While the method of figuring the rating and of awarding the pennant is left with you and your representative it is recommended that the rating be based on the Tuesday returns of each society, thus encouraging prompt payments on the part of the members.

If two societies have all or an equal number paid up in full, advance or over payments can be counted as determining the winner for the week.

The following are the societies that are to compete in your department:

.....
.....
.....
.....
.....
.....
.....
.....
.....

In case some of these are under other foremen and representatives the Industrial Department will aid in arranging for the contests.

BROWN & SHARPE MFG. CO.

June 25, 1918.

An illustration of the method of working out rules in local departments is shown by the following seven rules adopted by the grinding department for the pennant competition among its eleven clubs.

1. Only 100 per cent. clubs eligible for pennant.
2. For Day Men—All orders for the following week must be in before 6 p.m. of the Thursday previous.
   For Night Men—All orders for the following week must be in before 7 a.m. of the Friday previous.
3. All Thrift-Stamp books to be exchanged for War-Savings stamps to be turned in Wednesdays, and balance over four dollars ($4) to count for week following.
4. All orders to be sent in sealed envelope with name of club and secretary's name *only* written on the outside.
5. Envelopes to be opened only when witnessed by foreman of department or whom he may appoint.
6. The largest order when paid for on Tuesdays decides the winner.
7. Any infraction of these rules will cause the pennant to be forfeited to next highest club.

The stimulating influence of this local competition for pennants during the months of June and July is shown in the chart, Fig. 1. In the month of August,



FIG. 9. BANNER GIVEN WINNING CLUB IN MONTHLY STATE CONTEST

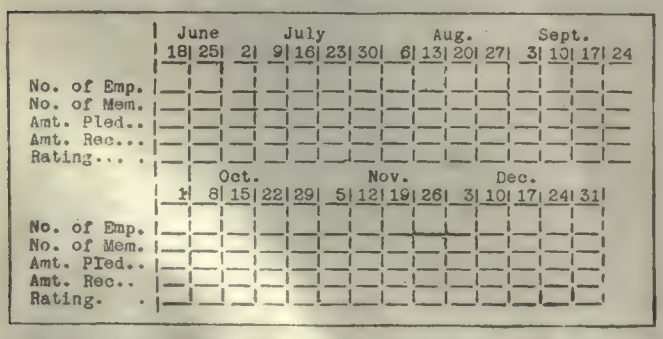


FIG. 8. CARD SHOWING STANDING OF CLUBS EACH WEEK

when the shop shut down for its annual vacation week, there followed a reduction, as would be expected; but after vacation a new form of competition was in full swing, this being a competition between departments for a silver cup (Fig. 6) offered by the company for the department in the shop having the best standing.

The chart, Fig. 1, shows how this competition, together with competition for banners offered by the state committee, increased sales until the time of the Fourth Liberty loan, when with the emphasis placed on that form of saving the investment in Thrift and War-Savings stamps naturally dropped. Still later when the

armistice was signed the stopping of overtime and night work brought a still further reduction, all of which are graphically shown.

A committee was appointed to arrange for the cup competition and handicap rules were announced, so as to be fair for large and small departments. To maintain the interest additional rivalry was encouraged by having the cup held each month by the department winning it the previous month. Notices were posted on the bulletin boards announcing the standing of the departments at the end of each month (Fig. 7).

The collection, counting and handling of five or six thousand dollars a week, besides the exchange of Thrift stamps for War-Savings stamps and the distribution of these stamps to more than five thousand members of the clubs, required thorough systematizing in order that it might not become a burden. As the plan was worked out in practice various measures were taken in order to reduce unnecessary work. Some of these measures are explained in the following notice sent out to the representatives:

Mr.....

In order to simplify as far as possible the work of collections from members of the War-Savings societies it is proposed to carry out a plan by which the stamps can be delivered to members of the clubs when they pay the money.

A requisition, as per sample herewith, for the stamps which it is expected will be required the following week should be sent to the paymaster at the general office on or before 9 a.m. Friday of each week. Stamps will then be secured and will be delivered to you early Tuesday morning and through you as representative in your department to the secretaries of the clubs (if there are several) who can then collect from the men.

Collections should be made so as to turn in the completed account with the money, including any stamps which are left over, on Tuesday before 5 p.m.

If there is any considerable amount of money to be held over the noontime this can be deposited in the office safe in the bag you have had provided and the money collected in the afternoon can be added to this amount when settling.

Any stamps which are wanted other days than on Tuesday can be secured as heretofore at the designated hour in the afternoon. This plan should be put into operation so that the first requisition will be handed in by you before 9 a.m. Friday of this week.

BROWNE & SHARPE MFG. CO.

June 20, 1918.

In order to have a complete record from which the standing of each department can be figured, entries are made of each club's standing on cards (Fig. 8) and from these the required data are obtained.

Beginning in September further competition was stimulated by the offering on the part of the State Director of awards for the highest subscriptions per member in clubs throughout the state, and of "Distinguished Service" ribbons for individual members of clubs making the greatest personal sacrifice in purchasing Thrift stamps. The club awards were in the form of silk banners (Fig. 9), and the great degree of interest which had been aroused among the 246 clubs at the works of the Brown & Sharpe Manufacturing Co. is shown by the fact that in the month of September 10 out of the 25 awards to societies in the state came to Brown & Sharpe clubs, and even a larger number in the month of October (the last as yet reported).

The form of report rendered to state headquarters by the secretary of each society in this competition is shown in Fig. 10.

STATE COMPUTATION WAR SAVINGS SOCIETIES

MONTH OF DECEMBER, 1918.

Society Name..... No. of Members.....

Dept..... Foreman.....

Actual Money received at B. & S. $.....

" " value of outside purchases $.....

Total Amount $.....

Amount per Member per Month $.....

Total Number of War Savings Stamps purchased at B. & S.....

Special cases, "Individual making greatest Sacrifice" for Distinguished Service Ribbon.

..... Secretary.

FIG. 10. FORM OF MONTHLY REPORT TO STATE HEADQUARTERS

To show the amount of thought which was given and interest which was aroused among workmen in these various contests a cartoon, which was made by a member of one of the clubs, is here reproduced (Fig. 11). This shows a circus striker, with the names and relative standing of the 11 clubs in the cartoonist's department indicated on the backboard, with one of the workmen who had invested $126 in one week, represented as wielding the beetle, ready to give the Kaiser (pictured as the striking block) a finishing blow. The foreman of the department is shown in the upper right-hand corner holding up the prize silver cup and encouraging his men to strive to secure it. At the right is shown a workman who held out against joining a club until the last, but eventually "surrendered"—"Kamerad." At the left one of the workmen is pictured as selling his automobile to invest in War-Savings stamps, and telling one of the "boys" whom he has previously taken home in his machine at noontime that hereafter he will have to walk.

Where the workmen show such a spirit of interest as

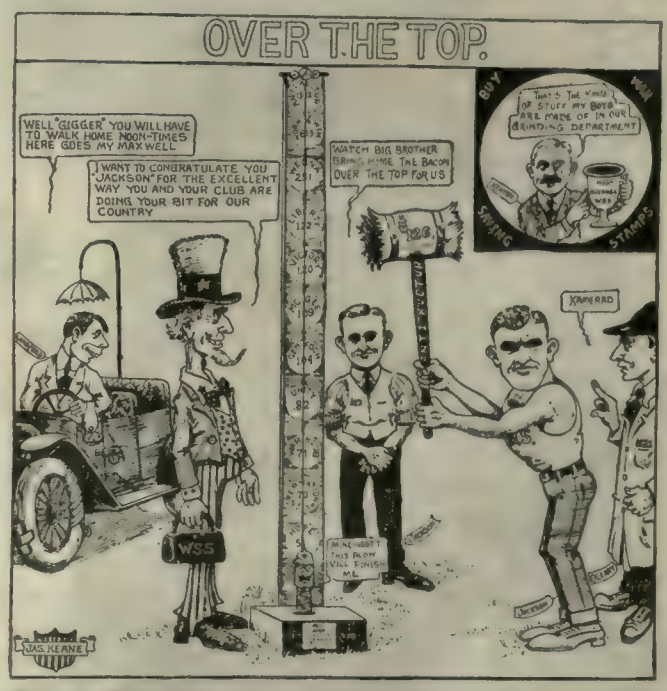


FIG. 11. CARTOON BY AN EMPLOYEE WHICH LIVENED UP THE CONTEST

is indicated by this cartoon the project which they are undertaking is bound to succeed. The results are far more satisfactory to the employees themselves and in their relations to the company than if pressure were brought to bear, which would make them feel that they were being forced.

It is believed that important results have been reached through War-Savings societies in addition to the mere saving of money, these results being in the cultivation of thrift and the development of an *esprit de corps;* thrift in that employees are taking a more personal interest in saving, because by this method they see the results visualize and grow more tangibly under their eyes than by other methods; *esprit de corps* in that there has been developed a sense of team work and department spirit, with an ambition to stand well or excel, thus developing a feeling of responsibility on the part of those conducting and aiding the local clubs.

The 1919 issue of War-Savings stamps can through the aid of employers be made an increasingly popular form of investment for factory workers. With such help on the part of the employers during the coming year this plan of saving should become so well established and of such recognized value that it will be made permanent by the Government as a part of our industrial life because of being the best means so far devised to make saving easy and popular with small investors.

Jottings of a Journeyman

By F. L. Ess.

"Speaking of Garabed," said the boss to me one day, "reminds me of an experience I had in the old bicycle days before the automobile was invented.

"One day when I was out a woman came into the shop with an idea on bicycles which she thought would be a great thing and which she wanted developed. She was accompanied by a man who was to pay the bills.

"She had been sent in by the proprietor of a neighboring shop where we had had work done; in fact he came in with her himself to introduce her to me, a favor which she seemed to greatly appreciate. He said that he was too busy himself to do the work for her. (Strange how busy people can be sometimes.)

"The lady's idea was to have the weight of the rider drive the bicycle ahead by some sort of mechanism to be operated by a falling seat, each descent driving the bicycle ahead about four hundred feet. During the latter part of the descent the weight of the rider was to compress a spring which on being released at the last moment was to throw him up to the starting point again, when he would be ready for another four hundred feet. She said that she did not believe in perpetual motion, but thought her idea had something in it worth while. The foreman was not greatly impressed with the idea, but did not like to take the responsibility of turning her down, so he sort of kept her on the string until I came in.

"Perhaps I was rather more abrupt with her than I should have been had my chivalrous instincts been stronger, but the idea of the machine's giving the rider a shoot in the stern to start him on his new descent was a little too much for me.

"The woman seemed to take my rebuff a good deal to heart and I never saw her afterward, but the funny part of the whole business to my mind was that Jones, the proprietor of the neighboring shop, came in the next day and gave me a regular call-down for what I had done.

"'You don't want,' he said, 'to tell people right out that their ideas are no good even though you may know that they are not. You want to sort of lead them on and let them think that they have got something worth while. It makes business good.'

"The morality of this sort of policy did not impress me much more favorably than the woman's bicycle idea had done, but as he was considerably older than I, I did not say much.

"I have since wondered though," the boss continued, "just how far one should go in either criticising or approving a customer's ideas. I have had customers



whose ideas seemed good but which afterward proved worthless. One such case in particular I have in mind where for the sake of the business which I thought it might bring me I made certain suggestions to a customer in the way of perfecting his invention, which he adopted, but though my improvements were in themselves all right the thing as a whole was no good, and the man was out perhaps a thousand dollars, for which I felt in part at least to blame.

"At other times I have had customers whose ideas seemed so poor that I made free to criticise them, with the result that they were offended and took their work elsewhere and showed that they knew what they were about by making good.

"So on the whole," the boss continued, "I have given up either approving or criticising customers' ideas and confine my suggestions wholly to details of construction. But when it comes to anything savoring of perpetual motion I want the man to have his drawings fully made."

Tracing by Transmitted Light

By G. E. Michaels

Having occasion recently to work up data from some old blueprints that were so faint as to be untraceable I rigged up a transparent topped table by making a wooden frame on top of an ordinary table and setting in the glass from a blueprint frame. There was space enough between glass and table top to introduce an electric lamp which could be moved about as desired.

Stretching the faded blueprint face down over the glass, the tracing cloth on top of it, and working by transmitted light, the tracing was an easy and expeditious job.



Manufacturing the Caterpillar Tractor

By

Frank A. Stanley

VI. Cylinders, Pistons and Crankshafts

This article describes and illustrates the boring of cylinders with cutters that are remarkably long lived and that hold the bore to dimensions within very close limits so that subsequent grinding operations are accomplished with facility. The turning and grinding of cylinders, pistons, pins and crankshafts are also described in this article.

THE cylinders of the "Caterpillar" tractor engines built by the Holt Manufacturing Co. in its Stockton plant are bored and faced in the manner indicated in Fig. 50, where a 6½-in. cylinder for a 75-hp. motor is illustrated in place in a boring mill with the cutter head and facing arm in operation. Four of these cylinders are required for each motor, and they are therefore manufactured in very large numbers. The length of bore proper in this size of cylinder is 12 in. and the counterbore is 2½ in. deep, so that the total length of machined surface through the casting is 14½ in. The high and low dimensions to which the cylinder boring is held are respectively 6.488 in. and 6.483 in., leaving from 0.015 to 0.020 in. for grinding, the five-thousandths limit of accuracy in the boring process being reduced in the grinding to a limit of one thousandth inch only. The figures for the latter are as noted in Fig. 51, 6.504 and 6.503 inches.

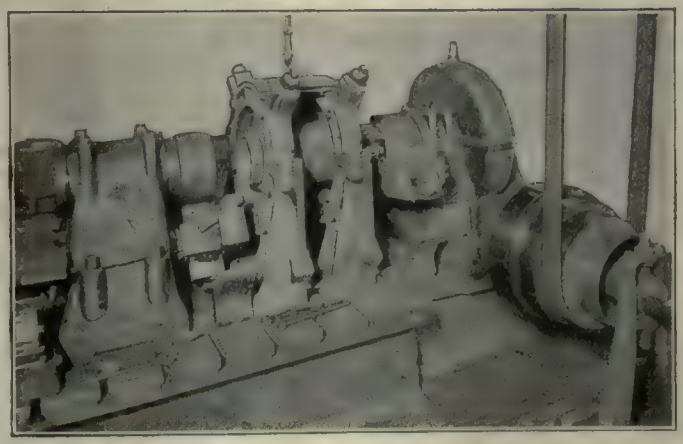


FIG. 50. BORING THE CYLINDERS

The boring machine is fitted with fixtures that enable the cylinders to be set quickly in place for machining and which, from being so, grip the work so as to prevent distortion of the castings. The boring spindle for the cutter heads also carries the facing arm for the bottom flange of the cylinder and the facing tool is operated simultaneously with the cutters for either boring or counterboring the casting.

The facing tool is seen in operation in Fig. 50, and the manner in which it is operated by star feed is apparent.

The boring heads for this work are generally of Stellite blades inserted in suitable bodies, although in some cases high-speed steels are employed, particularly for the counterboring heads. The results with the Stellite blades are very satisfactory and one of them is illustrated in Fig. 52. While the limits as specified on the blueprint of the cylinder call for an allowance for grinding equal to about 0.020 in., the cutter heads referred to have made possible such close holding to size and such satisfactory surfacing of the interior of the cylinder walls that the actual practice followed with the use of these heads in boring is to hold the work to about 0.010 or 0.012 in., giving a minimum amount for finishing by grinding.

Referring to the Stellite boring head, this inserted blade tool takes out at a single cut all the metal in the cylinder bore preliminary to grinding. It bores out something like ⅛ in. of metal on a side and is fed through the cylinder at the rate of $\frac{1}{16}$ in. per revolution of cutter bar.

It is rotated from 23 to 31 turns per minute, approximating a circumferential speed of 45 ft. per minute. The high-speed-steel counterbore for the cylinder end is operated at the same rate of speed, and from 26 to 28 cylinders are bored, counterbored and faced in a day of 8¾ hours. The counterboring operation is held to a limit of 0.002 in. as this end of the cylinder receives the shoulder under the cylinder head and so locates that member in correct position.

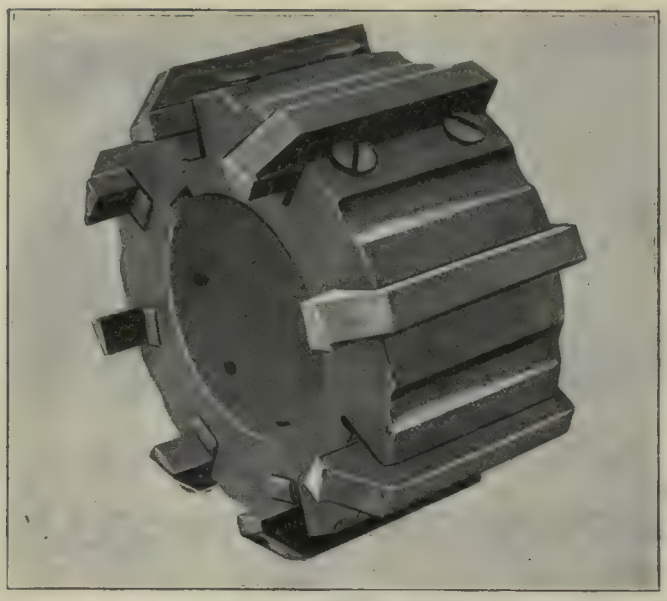


FIG. 52. THE CYLINDER-BORING HEAD

The Stellite boring cutters are used for a long period in steady operation before they show appreciable wear and need of replacement. Two of these cutters have been in service continuously on two boring machines for over a year and still have several months' work ahead of them before they are likely to become worn to a point where they must be discarded. In the time stated they have each bored over 13,500 cylinders of the type shown.

Sharpening Cutters

Ordinarily the cutters are sharpened twice a day of 24 hours. Each sharpening takes off but a few thousandths of an inch from the blade ends, and they are sharpened on the ends only. After 175 or 200 cylinders have been bored the cutter blades usually require setting out radially by careful shimming under their lower edges, but if this operation is performed with judgment the outside diameter does not require grinding to bring the cutting size to standard. About once in two months, however, the outside is ground and the blades cleared again back of the cutting edges to put the cutter head into first-class condition.

Fig. 53 shows what is considered the most desirable method of backing off the teeth at their tops and clearing the cutting ends and incidentally illustrates the manner in which the blades are set into and carried by the cutter head. The blades are ½ in. thick, with a shoulder for the heads of a pair of fillister-head screws for securing the blades in their seats. The method of shimming up under the blades will be understood from Fig. 52.

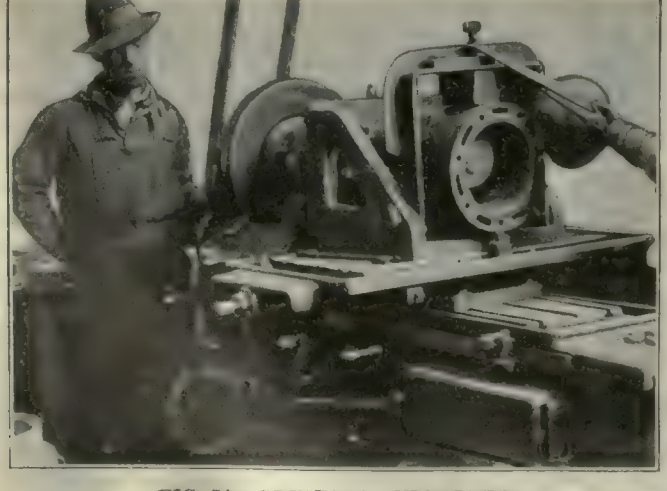


FIG. 54. GRINDING CYLINDERS

Grinding Cutter Blades

The ends of the blades are ground off to an angle of 45 deg., and the outside diameter or outer edge is relieved right up to the cutting edge, leaving no land, but instead a sharp edge which cannot drag or become affected in such a way as to produce unsatisfactory results in the boring of the cylinder.

From Fig. 53 the backing off or relief along the top of the blades will be observed to be from 8 to 10 deg., and the same illustration shows that the cutting ends have a similar amount of clearance. The angles of rake and clearance have been established as the proper ones

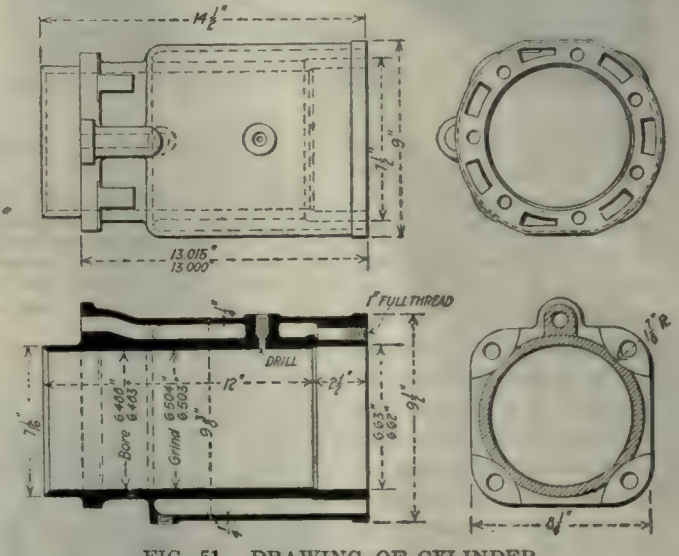


FIG. 51. DRAWING OF CYLINDER

for the work described, and from the foregoing data on the life and stability of the tools it is evident that conditions of cut, clearance, etc., are correct.

The counterboring of the end of the cylinder is accomplished with a cutter head fitted with high-speed-steel blades. The counterbore is roughed out by the passage through of the regular boring head, so that the wear on the counterboring head is correspondingly reduced. The head used for the counterbore operation has been run constantly for over a year and is still serviceable for several months' more work. The diameter of the counterbore is held to within 0.002 in. of standard size.

Grinding Cylinders

The grinding of the cylinders is performed on the cylinder grinding machine shown in Fig. 54, the time required for the operation being 25 minutes.

The method of locating and supporting the cylinder casting in the machine will be obvious from an inspection of the illustration, and requires no description.

The wheel used for the grinding operation is a Crystolon 30J, 5 in. in diameter by ½ in. face. The wheel is run at 5000 r.p.m., equivalent to a peripheral velocity of 6500 r.p.m. The revolving head, which carries the wheel spindle, makes 75 turns per minute, so that

the travel around the bore is at the rate of 110 ft. per minute. The work is traversed past the wheel at the rate of 2 ft. per minute, or one complete forward and backward movement in that time.

Piston Operations

The pistons are carried through a number of operations before they reach the grinding department. Of these only one is illustrated, the machining of the hole for the piston pin, which is accomplished in the heavy turret lathe, Fig. 55.

The piston pin is a hollow member which is fitted into the cross-holes of the piston, which are bored to 1.9375 in. and 1.875 in. diameter, as indicated in Fig. 56. The boring and the machine reaming are attended to on the turret lathe, Fig. 55, where at the same setting the inner ends of the bosses for the pins are machined to the required dimensions.

The piston is held on the faceplate of the turret machine by means of a special fixture in the form of a cradle in which the cylindrical casting is held central in respect to its longitudinal axis and so positioned endwise by suitable stops as to bring the pin hole at the desired distance from the end of the piston.

Two straps, or curved bands, secure the work in the fixture and hold it firmly in place during the boring and

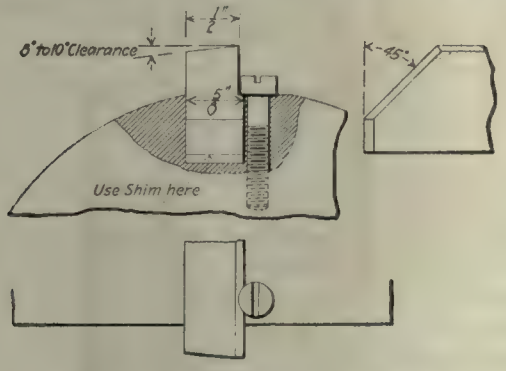


FIG. 53. BORING-HEAD DETAILS

reaming of the holes and the facing of the internal-hub ends.

The machine reaming is followed by a hand-reaming operation in which two or three thousandths of an inch only is scraped out to bring the holes dead to size.

The grinding of the outer diameter is done on a plain cylindrical grinding machine with a 14 x 1¾-in. wheel driven at 6000 ft. surface speed per minute. The wheel is an Alundum 26K, and the work is driven at 100 revolutions per minute.

There is left for removing by grinding from 0.015 to 0.020 in., and this is taken off at one pass of the wheel, the feed being operated by hand after the wheel has been set to depth. The feeding is done slowly, taking say 2½ to 3 min. for the movement clear across the work surface. The rate of production from the grinding machine is 14 per hour.

Crankshaft Construction

A typical crankshaft manufactured at the Holt plant is illustrated in Fig. 57. This is a chrome-nickel steel shaft for a 7½ x 8-in. motor and is machined from a drop-forging.

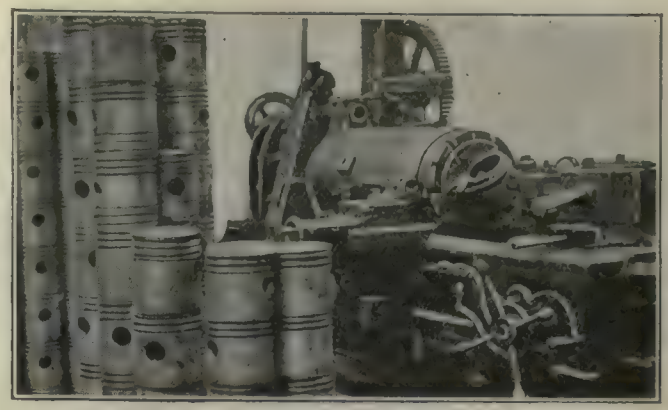


FIG. 55. MACHINING PISTON-PIN HOLES

The drawing is dimensioned for both turning and grinding limits, and it will be noted that the turning is held to 0.004 in. and the grinding to 0.001 in., the amount left by the turning tools for removing by grinding ranging from 0.018 to 0.025 inch.

The drop-forged crankshafts are in the rough about ¼ in. above finished size all the way around. The roughing of the main bearings and the second or finishing cuts are attended to in an engine lathe. No special holding fixtures are required for the work, as it is mounted upon its own centers.

The roughing cut is taken with a depth of chip of about ⅛ in., leaving about 1/16 in. on a side for the next cut. The feed for roughing is 1/16 in. per revolution.

The work is driven at the rate of 60 r.p.m. for the first turning operation and the same speed is used for the next turning cut. Here a coarse feed is employed, say 1/16 in. at least, and about 0.022 in. is left for grinding.

Machining the Crankpins

Crankpin turning operations are represented by Fig. 58, which illustrates a lathe with crank fixtures, arranged as indicated, for carrying the work off center a distance corresponding to the crank throw and enabling the shaft to be set in turning position immediately without preliminary setting in special center blocks. The ends of the shaft are merely slipped into the jaws of the fixture, which is then clamped and the work thus brought into position for the turning of any given pin. For other pins the fixtures are adjusted about their centers to bring each crankpin position into coincidence with the lathe centers.

The amount of metal to be removed from the crankpins is practically the same as for the bearings. The

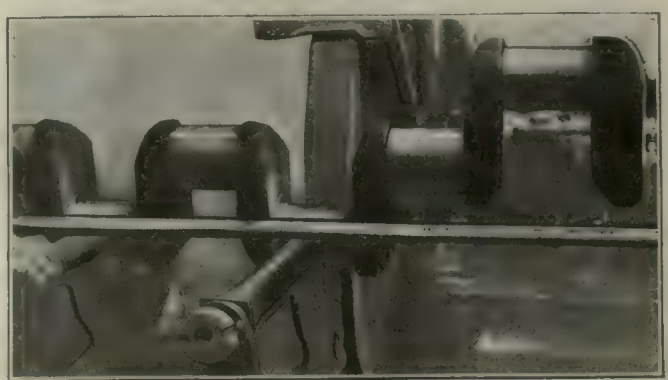


FIG. 60. HOW THE WHEEL IS FED TO THE WORK

pin-roughing operation leaves $\frac{1}{32}$ in. or more on a side for a second turning cut, which leaves the specified amount for finishing by grinding.

The work is rotated at 90 turns per minute and the feed is about $\frac{1}{16}$ in. per turn. The first-roughing lathe on main bearings and the crankpin lathe take care of all of the work on the webs.

Roughing the main bearings is done in $1\frac{1}{2}$ hours. The second turning cut is taken on 10 shafts in a day of 9 hours. The crankpin lathe turns 24 pins, four pins to each of six shafts, in one day's time.

The journals are ground in a 16 x 72-in. machine with an Alundum 36M combination wheel measuring

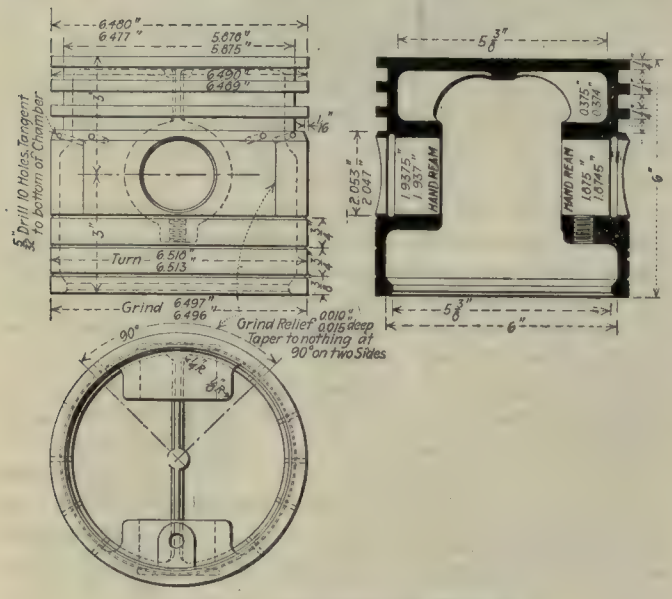


FIG. 56. DRAWING OF PISTON

26 in. in diameter by $3\frac{9}{32}$ in. face. The wheel is driven at 950 r.p.m., or at 6500 ft. surface speed. The shaft is rotated at 60 turns per minute equivalent to 50 ft. surface speed of work. The time required for grinding bearings is 50 min. per shaft.

The pins are ground as in Fig. 59 on a crankshaft grinding machine with an Alundum 36L silicate wheel 42 in. in diameter and $3\frac{9}{32}$ in. wide.

The wheel is operated at 550 r.p.m., this figuring out at 6000 ft. peripheral velocity. The crankshaft is driven at 35 turns, or 30 ft. per minute. The four pins on each shaft require about 30 min. for actual grinding, the total time, including putting in the shaft, setting, etc., and removing when ground, averaging 50 minutes.

The pins are ground before the main bearings. Then, if desired, they are wrapped for protection of the surfaces while the crankshaft is handled for grinding the bearings.

The close-up view in Fig. 60 illustrates the manner of applying the wheel to the grinding of the pins.

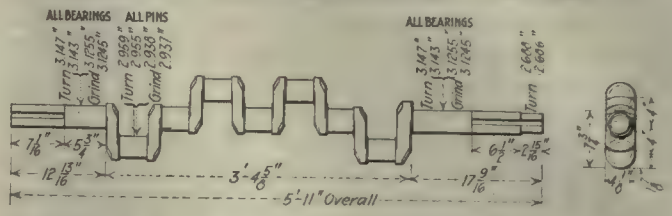


FIG. 57. CRANKSHAFT FOR 75-HP. MOTOR

The length of pin is $3\frac{5}{16}$ in. The wheel is $3\frac{9}{32}$ in. across the face. The pin therefore exceeds the wheel width by only $\frac{1}{32}$ in. The wheel is fed bodily in to a depth to size the pin and to clean up the fillet on one side, then fed into the other side to grind the other fillet. The limit of accuracy here as in the case of the grinding operation on the main bearings is 0.001 in. This limit refers particularly to the shaft illustrated in Fig. 57 and shown in the different stages of manufacture in the various machines ilustrated above. In certain other types of shafts only one-half thousandth inch is allowed for variation in main journals and pins.

Lapping Under Water

By William Hintze

Those who have had occasion to lap hardened pieces of steel of thin section, say from 0.010 to $\frac{3}{32}$ in., know the difficulty experienced from the curling or warping of the work, which is due to several causes, change of temperature and uneven condition of the lap being the principal ones.

I have secured excellent results by placing the lapping block in a pan of water deep enough to cover the work by a couple of inches. Under these conditions there can be no variation of temperature, and as the lap cannot dry out in spots a uniform cutting surface will be maintained.

The main causes of trouble thus removed the lapping may proceed without trouble and the surface may be kept parallel with comparatively little difficulty.

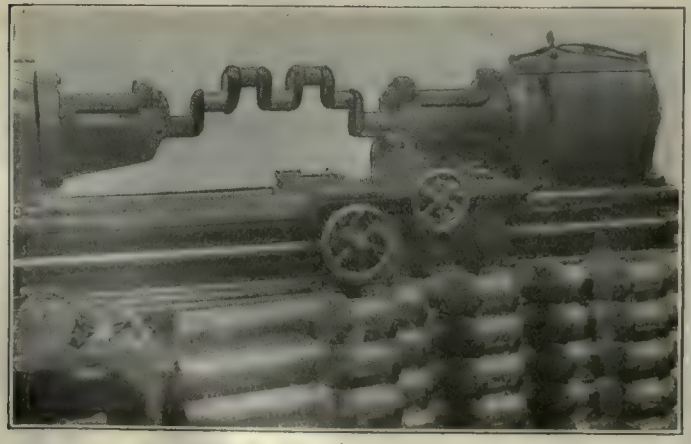


FIG. 58. TURNING CRANKSHAFTS

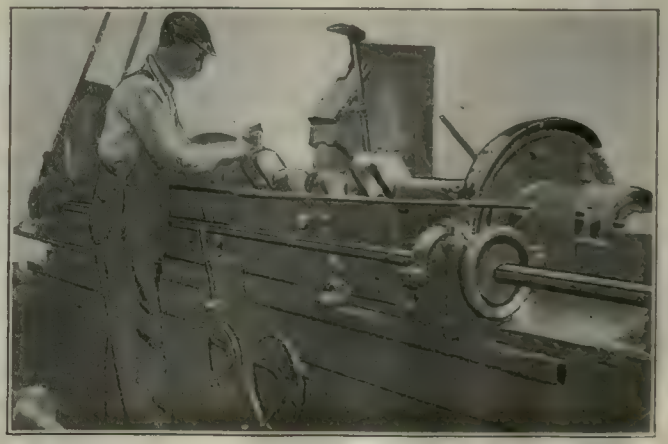
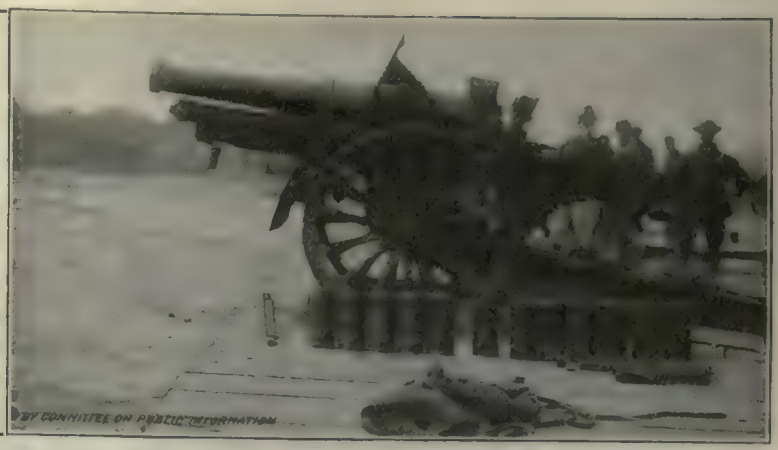


FIG. 59. GRINDING CRANKSHAFTS

How the 155-Mm. Howitzer Is Made—VI

By J. V. HUNTER
Western Editor *American Machinist*



A great many operations are required on the breech-block carrier in order to shape it from the rough drop-forging in which it is furnished into the completed part for service in the howitzer. This article describes the methods used for the production of this piece.

MORE operations are probably required to complete the breech-block carrier than any other single part of the breech mechanism. The general outline of this part is covered by Fig. 97 and the operations are as follows:

Operation 1.—Face back end. Machine—No. 5501. Type—24-in. Gould & Eberhardt shaping machine. Tools—Cutting. Stamp serial number on top of hinge lug with ⅜-in. figures.

Operation 2.—Rough front end and finish-bore. Transformation—Fig. 98. Machine—Nos. 5109 and 5110. Type—24-in. Bullard vertical turret lathe. Tools—Special tool setups, gages. Coolant—Houghton's No. 2 cutting oil. Cut data—Variable.

Operation 3.—Finish back face on arbor. Machine—No. 5220. Type—Reed-Prentice lathe. Transfer serial number with ⅛-in. figures to back face of carrier so that stamping will machine out at operation 21, "Mill slot in lug."

Operation 4.—Finish front face. Transformation—Fig. 99. Machine—Nos. 5252 and 5253. Type—No. 3A Warner & Swasey turret lathes. Tools—Snap gages, etc.

Operation 5.—Thread. Machine—Nos. 5262, 5253 and 5266. Type—Prentice lathes. Transformation—Fig. 100. Tools—Gages, thread-cutting tools.

Operation 6.—Finish joint and locate center line. Machine—No. 5201. Type—25-in. by 10-ft. 6-in. Crawford lathe.

Operation 7.—Mill hinge lug. Machine—No. 5417. Type—No. 3 Kempsmith plain milling machine. Tools—Milling fixture, cutters.

Operation 8.—Mill face and top of lug. Machine—No. 5421. Type—No. 3 Kempsmith plain milling machine.

Operation 9.—Mill surplus stock on face. Machine—No. 5410. Type—No. 4 Becker vertical milling machine.

Operation 10.—Drill and ream hinge hole and counterbore. Transformation—Fig. 101. Machine—No. 5714. Type—36-in. Foote-Burt drilling machine. Tools—Boring bars and cutters, counterboring tools, gages.

Operation 11.—Drill, bore and ream rack hole. Transformation—Fig. 102. Machine—Nos. 5712 and 5713. Type—36-in. Foote-Burt drilling machines. Tools—Drilling jigs and fixtures, thread hole plugs, gages, hand pilot-reamers. Coolant—Solution of cutting compound.

Operation 12.—Mill to profile. Rough cut on Pratt & Whitney vertical shaping machine. Finish cut. Machine—Nos. 5454 and 5455. Type—No. 5C Becker vertical milling machines. Tools—Profile gages, cutters.

Operation 13.—Finish mill rack side. Machine—No. 5417. Type—No. 3 Kempsmith plain milling machine. Tools—Milling fixtures, gages, cutters.

Operation 14.—Mill outside of hinge lug. Machine—No. 5445. Type—No. 3 Kempsmith plain milling machine.

Operation 15.—Mill T-slot and dovetail slot. Machine—No. 5453. Type—No. 5C Becker vertical milling machine.

Operation 16.—Mill small slot and flat. Machine—No. 5490. Type—No. 3 Cincinnati plain milling machine. Tools—Special milling fixtures, gages.

Operation 16A.—Mill plunger clearance. Same machine.

Operation 16B.—Mill plunger angle. Machine—No. 5505. Type—No. 10 Pratt & Whitney vertical shaping machine.

Operation 17.—Slot and broach for rack. Same machine.

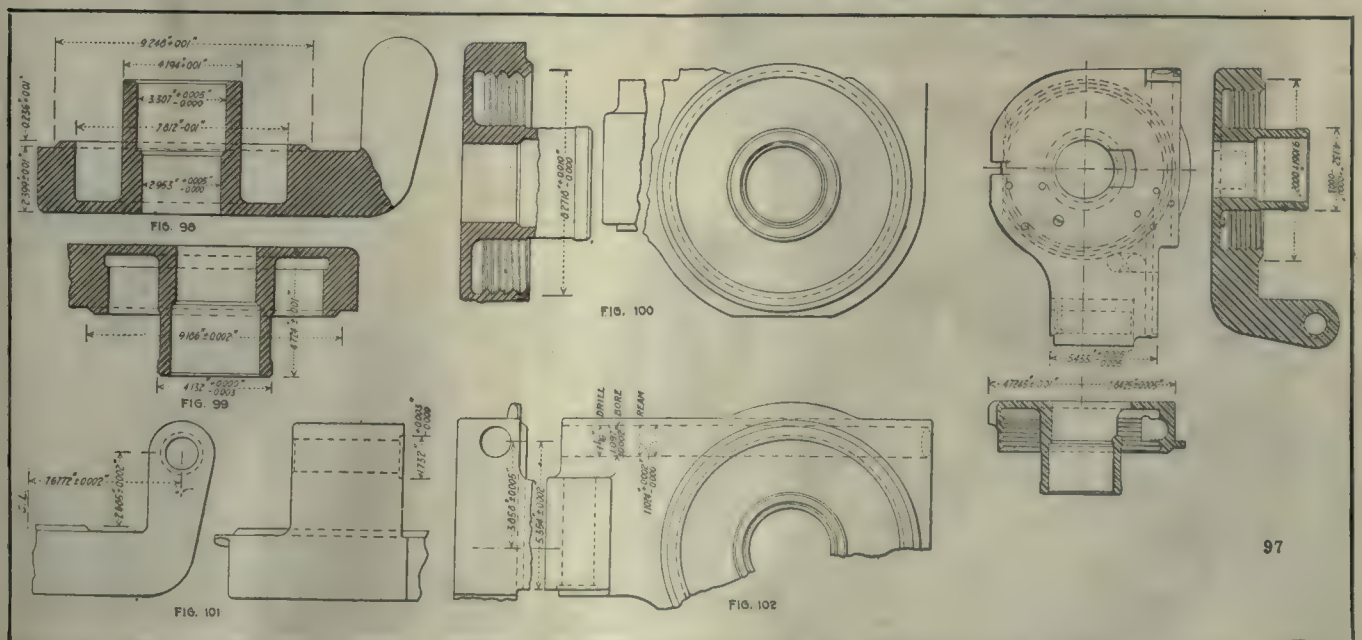
Operation 18.—Drill and tap all holes. Machine—No. 5709. Type—Class L-12 Henry & Wright drilling machine.

Operation 19.—Obsolete.

Operation 20.—Slot angle hole. Machine—No. 5518. Type—No. 10 Pratt & Whitney vertical shaping machine.

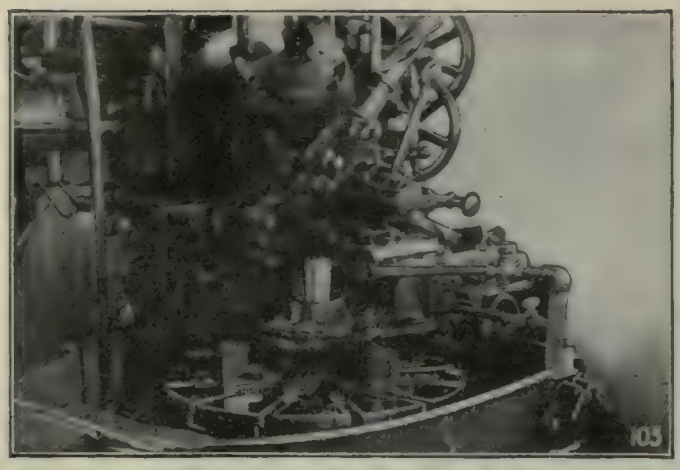
Operation 21.—Mill slot in lug. Machine—No. 5475. Type—Model B Becker vertical milling machine. Tools—Special profile milling fixture.

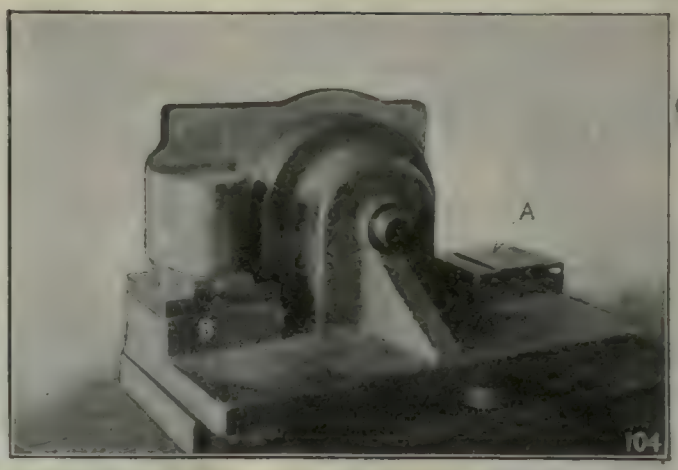
In order to produce a machined surface suitable for chucking this piece for the succeeding cuts a light cut is taken from the back of the forging in a shaping ma-



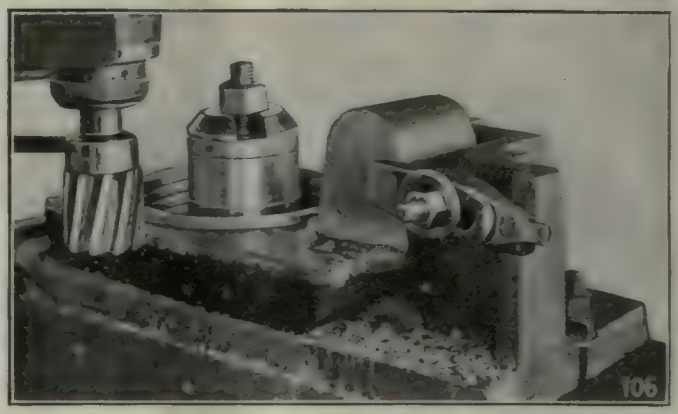
FIGS. 97 TO 102. OPERATIONS TO BE PERFORMED ON BREECH-BLOCK CARRIERS

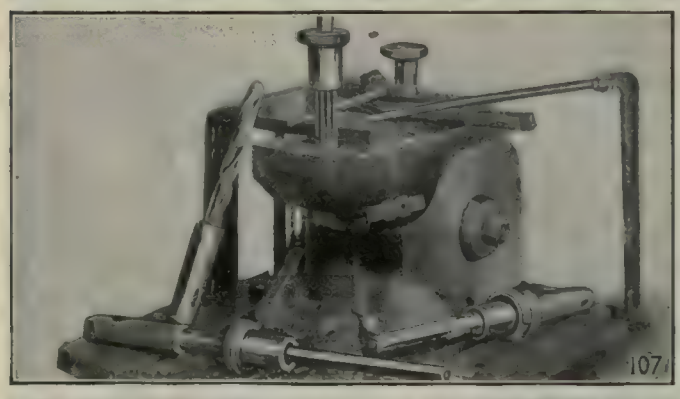
Fig. 97—General outline of breech-block carrier. Fig. 98—Transformation—rough front end and finish bore. Fig. 99—Transformation—finish front face. Fig. 100—Transformation—thread interior of block carrier. Fig. 101—Transformation—drill and ream hinge hole and counterbore. Fig. 102—Transformation—drill, bore and ream rack hole

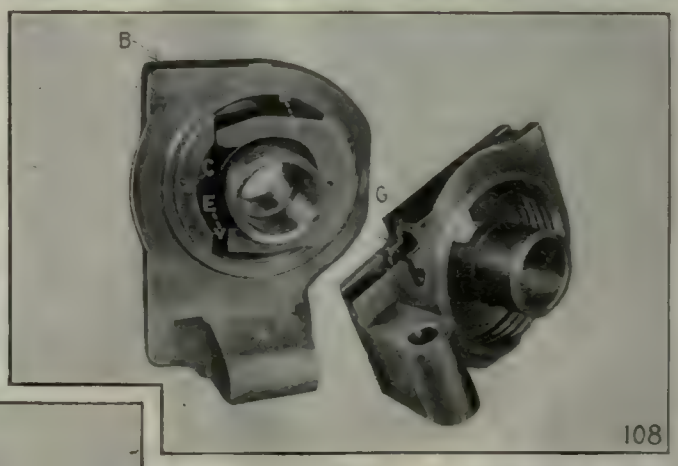


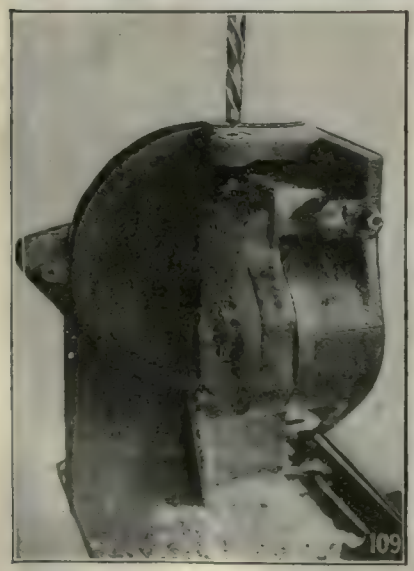


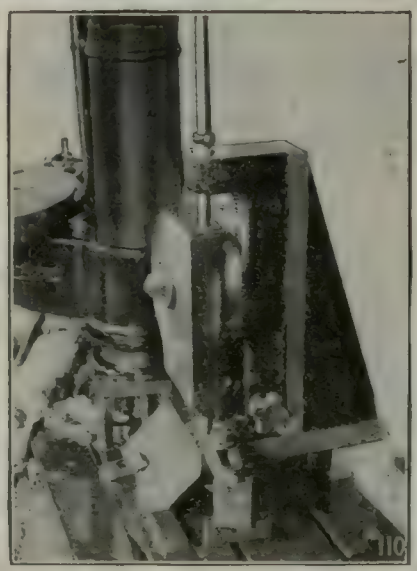












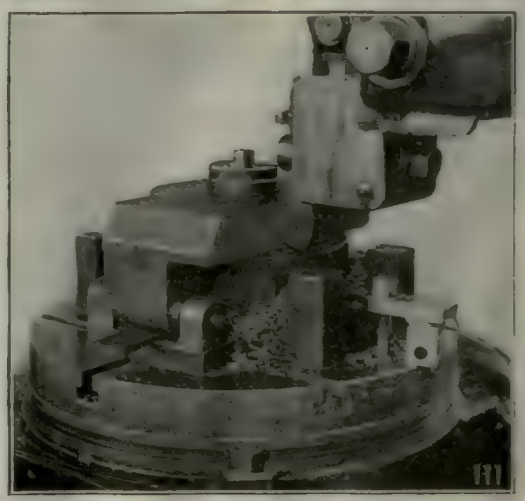


Fig. 103—Heavy preliminary machining operations on Bullard vertical boring machine. Fig. 104—Scraping jig for true surfaces on sides of hinge lug. Fig. 105—Milling radius surface on end of hinge lug. Fig. 106—Milling away surplus stock on surface. Fig. 107—Drilling and reaming of the hinge hole. Fig. 108—Views of partly and nearly completed block carriers. Fig. 109—Drilling operations on the rack hole. Fig. 110—Jig and tools for reboring and reaming rack hole. Fig. 111—Removing excess stock from edges on vertical shaping machine.

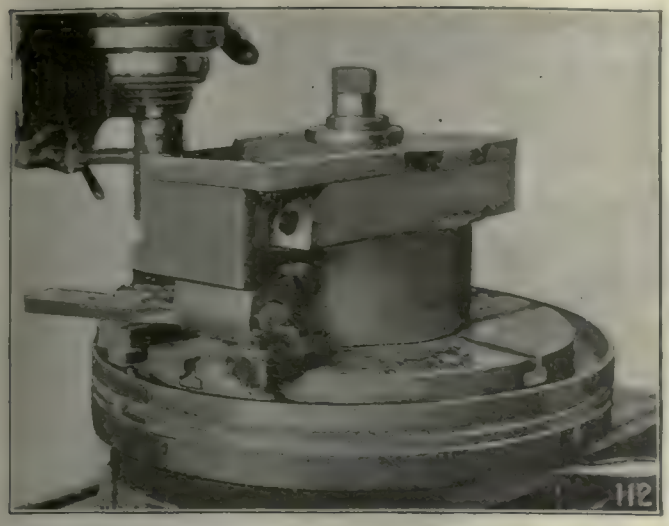


FIG. 112. PROFILING EDGES OF BLOCK CARRIER

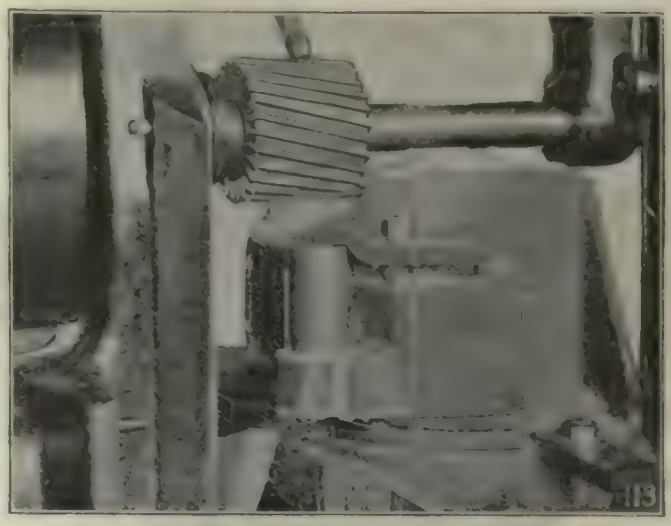


FIG. 113. REMOVAL OF CORNER ADJOINING HINGE LUG

chine. This gives a surface for a firm bearing during the heavy cuts used in operation 2.

The tool setup used in the Bullard vertical turret lathe for the second operation is shown in Fig. 103. During all cuts made in this operation a heavy stream of cutting oil is constantly supplied to the tools.

The roughing cuts on both the lathe and milling-machine operations are followed by lighter cuts until the greater portion of surplus stock has been removed.

After the finish-boring cut in the center and the finish-milling of the hinge lug sides the part is mounted on a special fixture, Fig. 104, and first one side of the hinge lug is scraped to a bearing on the surface plate *A* at the right. Then the piece is rotated about a center bearing, and the opposite side is scraped to a bearing on the surface plate *B*. The thickness of the lug must at the same time be held within the tolerance allowed.

Milling the Radius

Milling the radius on the end of the hinge lug, Fig. 105, is performed with the setup as shown, using a forward milling cutter. The fixture for holding the work has swinging gages for setting the cutters for height similar to those used on the gun body.

Another operation follows in which the faces of the hinge lug are milled. Operation 9 follows this, and consists of milling the surplus stock on the face of the block carrier as shown in Fig. 106.

Drilling and reaming the hinge hole is performed with the use of the drill jigs and drilling and boring bars, which are illustrated in Fig. 107. The position of this hole is within accurately prescribed limits, and the block carrier is centered by a plug which fits the finished inside of the center bore.

Rack-Hole Drilling Operation

A good idea of the appearance of the inside face of this part may be obtained from Fig. 108. The piece *A* at the left is arranged for the rack-hole drilling operation, with the location of the rack hole at the point *B*. As this hole will intersect the threaded recess in the carrier it would be impossible to drill it without supporting the drill at that point. For this purpose the pieces *C* and *D* are inserted. The piece *C* is made up in the form of a circular-threaded ring and suitable sections cut into it with a slitting saw. The U-shaped piece *D* is also threaded where it comes into contact with the surface of the block carrier, and is provided at *E* with a jackscrew to hold both pieces in place.

The type of drill jig used in drilling the rack hole is shown, Fig. 109. With it the work is again centered by the counterbore and the alignment assured by the lug *A*.

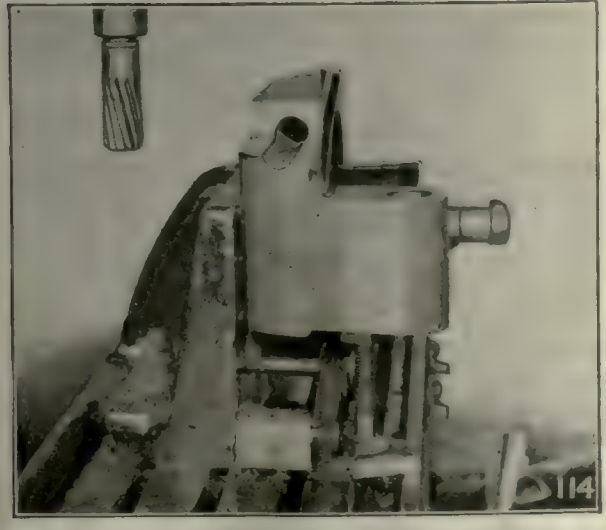


FIG. 114. FINAL MILLING OPERATION BY HINGE LUG

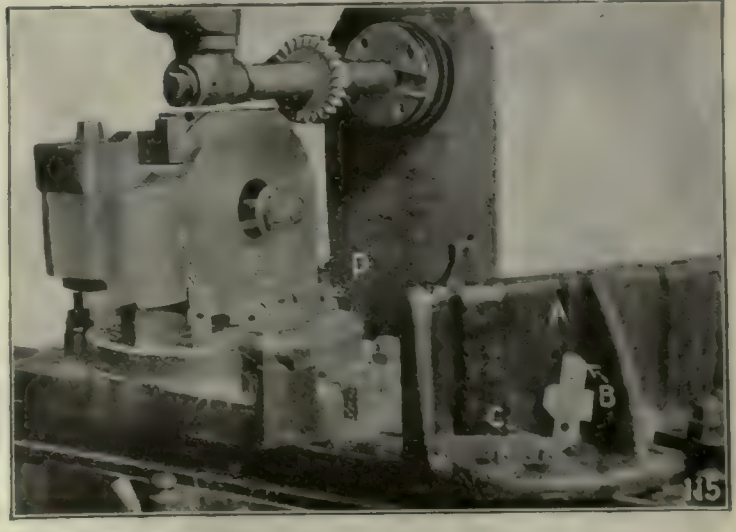


FIG. 115. SETUPS FOR MILLING SLOT AND FLAT

After this hole has been drilled the part is placed in a similar jig, Fig. 110, for reboring and reaming the hole for the different sizes required. A full set of boring bars, reamers and bushings is furnished the operator, who completes the job at this setting, and a large part of the excess stock on the outside of this

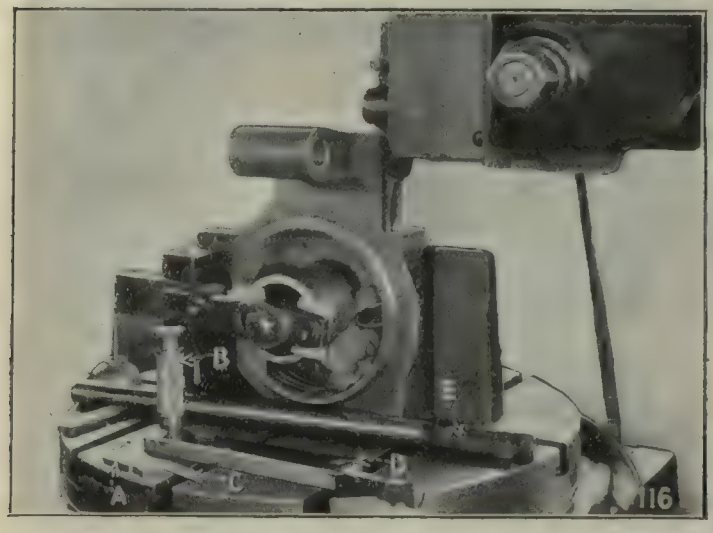


FIG. 116. TOOLS AND FIXTURES CUTTING T-SECTION IN THE RACK HOLE

piece is removed in a vertical shaping machine, as shown in Fig. 111. This is followed by the profile-milling operation illustrated in Fig. 112. A hardened-steel profile gage fits on the back face of the part and a collar above the cutter bears against it when taking the cut. Power feed is used in following the outlines so far as is possible, the remainder of the cut requiring hand feed.

By referring to the right-hand view in Fig. 108 it will be seen that a portion of the corner at *G* has been milled away. The milling operation for the removal of this corner is illustrated in Fig. 113, and it will be noticed from the appearance of the part and fixtures that a very heavy flood of coolant has been used. Another form of milling operation on this same corner is shown in Fig. 114, this latter being the final cut on this section.

Operations 16, 16A and 16B are usually performed

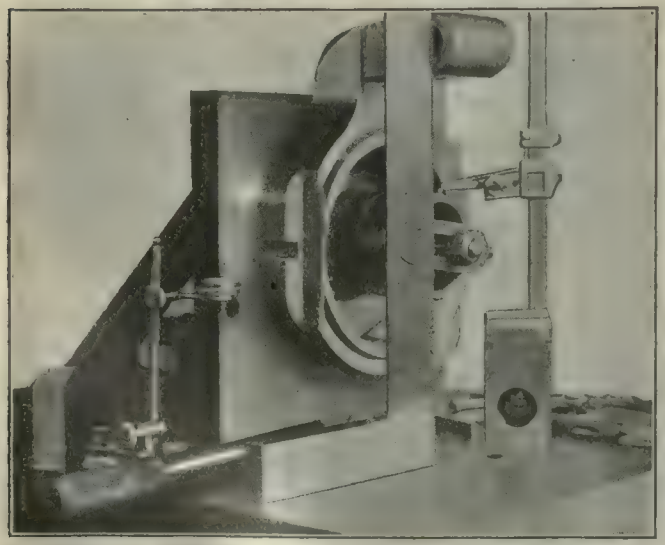


FIG. 118. GENERAL VIEW OF FINAL INSPECTION OPERATIONS AND GAGES

on the same machine. The first of these is shown in process in Fig. 115. This same milling fixture is used for the second cut in the series. For the third cut the work is transferred to the fixture mounted on the right of the milling-machine table at *A*. Some of the small gages used in these cuts are shown at *B*, *C*, *D*, *E* and *F*.

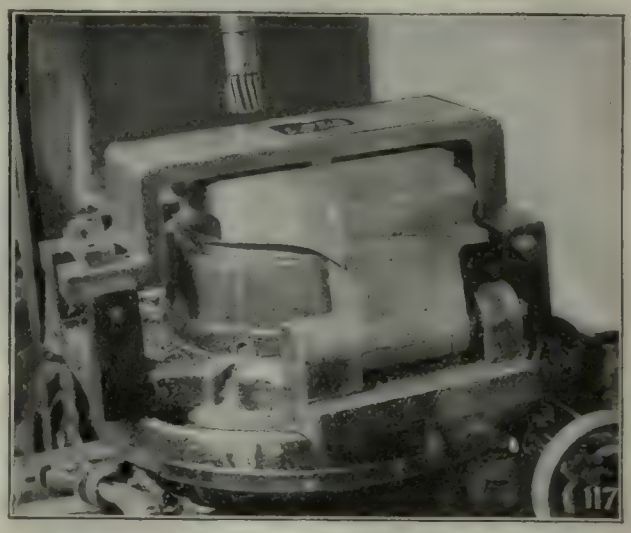


FIG. 117. SPECIAL FIXTURE AND TOOLS FOR MILLING SLOT FOR HOUSING

The cutting of the T-section of the rack hole is illustrated in Fig. 116, which shows the method of setup on a vertical shaping machine. Some of the tools and gages used are shown at *A*, *B*, *C*, *D* and *E*.

Final Milling Operation

The final milling operation on this part will be found illustrated in Fig. 117. The profile guide plate which passes over the back side of the block carrier is hinged at one end, and on the other fits down into a slot in the base casting of the jig when closed down over the work. The methods for aligning the work in this fixture are similar to those employed in the majority of the fixtures previously described.

A thorough inspection concludes the operations on this part, Fig. 118. For this purpose it is mounted on an angle plate, and with suitable gages the inspector checks up between the rack hole, the location of the hinge section and hinge-pin hole, and also of the rack-lock hole.

Paraffine for Rust Prevention

By William Hintze

An excellent substitute for vaseline and those greasy and dirty compounds commonly used on bright pieces to prevent rusting when they are exposed to the weather is paraffine.

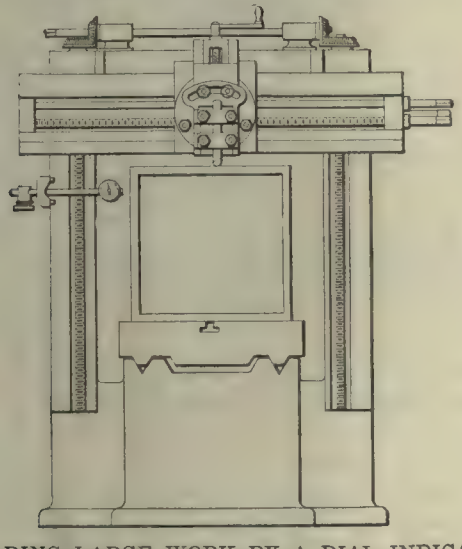
To prepare it for use take a vessel large enough to cover the articles to be coated and fill it with gasoline. Dissolve in this all the paraffine that it will take up without clouding the solution. Dip the articles in the solution, and hang them up to dry out. The gasoline will evaporate, leaving a thin transparent coating of paraffine which is an efficient rust preventive besides being invisible and free from the stickiness that is a disagreeable factor of other compounds.



Dial Indicator Used in Setting Up Work on Planing Machine

By H. W. McCray

In planing a large piece of work on adjacent sides, especially when the work approaches the capacity of the planing machine, there is little or no room on the table on which to set a master square. By the use of the dial indicator as shown work may be set up very accurately without first taking a roughing and finishing



SQUARING LARGE WORK BY A DIAL INDICATOR

cut. Then when the work is planed it can be tested with a master square, the clamps loosened and the work reset to correct this error.

This is very important if the amount of stock to be removed is limited, and it is also the means of saving a considerable amount of time otherwise wasted.

It might be well to add that preliminary to the use of the indicator as described it is necessary to set the cross-rail square (by indicating a master square set on the housing) and take a cut across the table, otherwise the indicator reading would be valueless.

Elimination of Chatter Marks

By F. W. Bach

On page 349, Vol. 49, of the *American Machinist* an article on eliminating chatter marks has constrained me to add a few examples that have come within my own experience.

In dealing with the chattering of internal-threading tools the author of the article referred to above mentions only their tendency to spring down below their normal position and thus dig into the work. There is also a change in the position of the point of the tool with reference to the longitudinal center of the work,

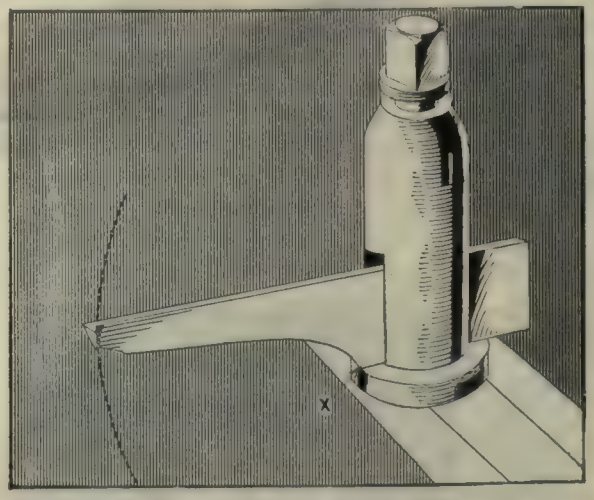


FIG. 1. SPRING OF TOOL IN INTERNAL THREADING

owing to the fact that any movement of the former will take place in the arc of a circle whose center is at *X*, Fig. 1, and thus the tool point will be advanced or retarded as this center is above or below the cutting edge.

The only remedy for this trouble in internal threading seems to be to provide a tool that is rigid enough to withstand the pressure of the cut, but it has been provided against to some extent in external work by the goose-neck form of tool, examples being shown at *A* and *B*, Fig. 2, in which the tool point recedes from

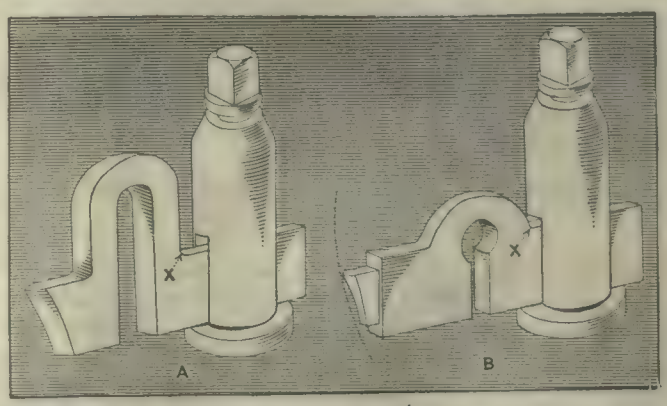


FIG. 2. GOOSE-NECK FORMS OF THREADING TOOL

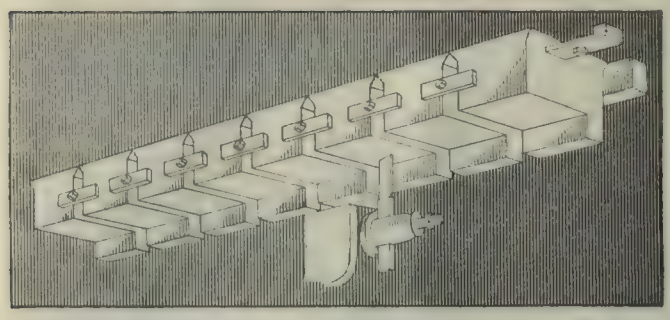


FIG. 3. WORK SPOILED BY SPRINGING TOOL

the work under extra pressure instead of turning about the center X as in the rigid form.

An example of chatter and scoring with the straight form of tool is shown in Fig. 3, where a string of cast-iron blocks is shown upon the table of a planing machine, the work being done with a common parting tool with a blade $\frac{1}{4}$ in. wide.

When about half way across the tool dug in, causing a bad score in three of the blocks. On examination a small piece of metal was found to be "seized" or welded upon the face of the tool and we figured that the spring of the latter had allowed the face, which had only a very slight clearance, to drag, and had generated sufficient heat to weld on the "bug" and spoil the work.

A parting, or cutting-off, tool used in a lathe is a prolific source of chatter, which can be avoided to a con-

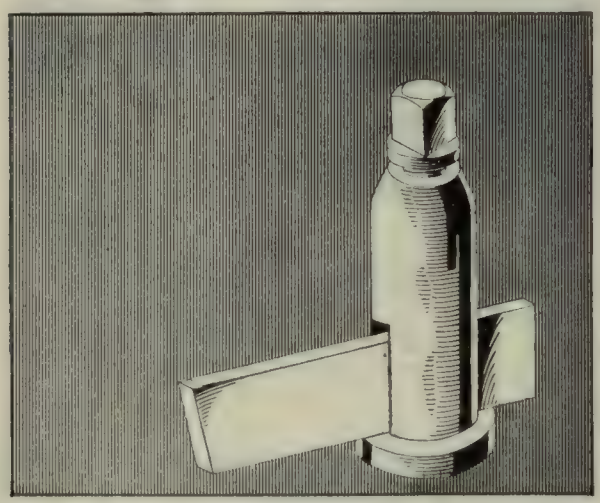


FIG. 4. SQUARE-NOSED PARTING TOOL FOR LATHE

siderable extent by using the goose-neck tool shown in Fig. 2. Such a tool is however not always available, and as a partial remedy or prevention I grind a lip on the ordinary straight-bladed tool and make the end almost square, as shown in Fig. 4. When the tool is set on the center this square nose acts as a brake to prevent the tool from digging in and chattering.

Automatic Ejector for Flat Blanks

By C. W. Hinman

When flat blanks are to be perforated and the old method of making the nest for the blank is followed, the pieces will stick after perforating, or if not pieces will remain under the stripper plate whence it is difficult to get them out.

We have entirely eliminated this trouble in two ways. One way is shown Fig. 1. The punches lift the work up to the stripper plate when the punch ascends, and at the same time forces back the angle-faced spring plunger. When the punches strip out the spring plunger automatically ejects the work in front of the die.

In loading this tool the operator simply pushes back

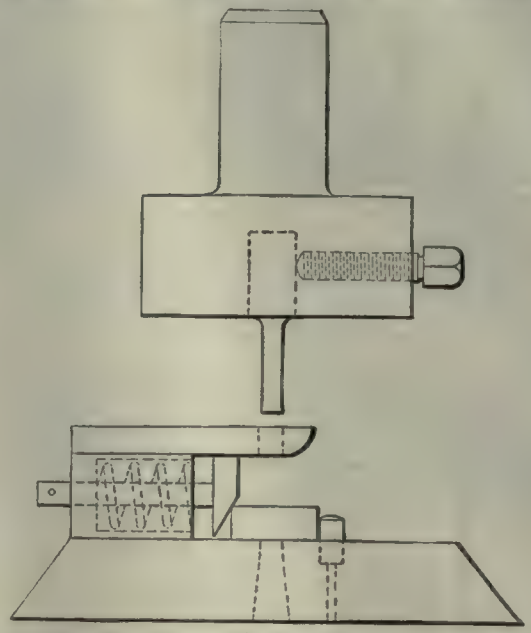


FIG. 1. PIERCING TOOLS WITH AUTOMATIC EJECTOR

the spring plunger with the next blank and snaps the blank between the spring plunger and suitable stop pins.

In the other method shown in Fig. 2, the stripper plate is lifted high, out of the way of the operator's hand, by four coiled springs, so that the blank to be perforated can easily be placed in a nest in the die. When

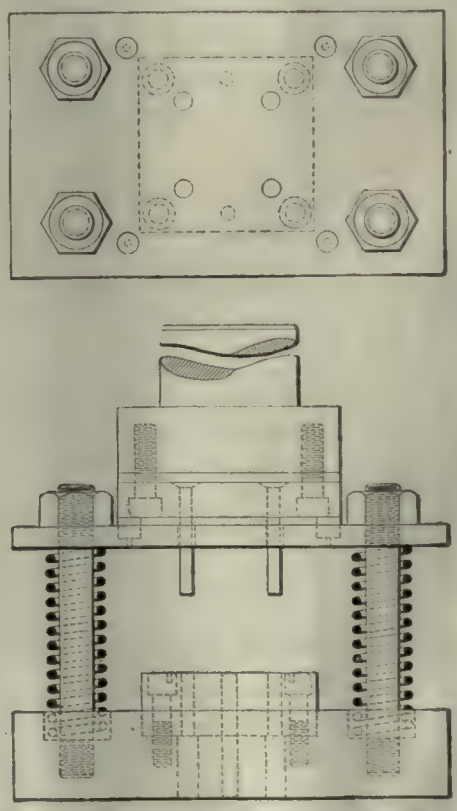


FIG. 2. SPRING-ACTUATED STRIPPER ON PIERCING TOOLS

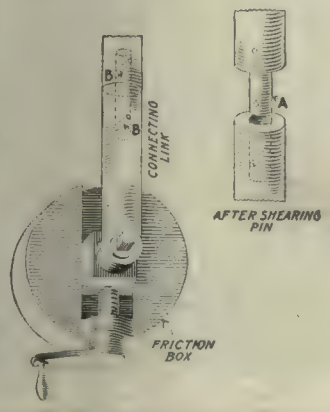
the punch descends the stripper plate is carried down with it and, after perforating, the blank is stripped off when the stripper is high up away from the die.

The perforated blank falls down on the face of the die and can quickly be pushed away when the operator places the next blank.

A Safety Device for Feed Mechanisms On Planing Machines

By J. H. Spoor

The following is a rather interesting example of how a mechanism can be made to break at a predetermined place where repairs can be made quickly. The feed mechanism on the planing machine had been broken several times by careless operators who would feed the vertical slide down to the limit of its travel and then some.



SAFETY DEVICE FOR FEEDS OF PLANING MACHINE

After noting that the regular down feed put the connecting link under tension the repair as illustrated was decided upon. The link, or rod, was cut in two and the pin *A* centrally located in each part, being held in place by the small pins *B*, the size of which was determined by experimenting with pins each slightly larger than the preceding pin, until one was found which would stand all the general operating stresses but would shear before causing some other part to break. About $\frac{3}{32}$ in. was found to be the right size for this purpose.

As this planing machine was doing service in breaking in men who had never operated such tools before, the need for a device of this kind is apparent. Upon the breaking of the pin the operator would at once have a lesson impressed upon him as to the possibilities of trouble inherent in positive mechanism which has a fixed limit to its movement. The link could then be taken to the toolroom, repairs quickly made and the machine put back into operation.

Using Up Stellite Scrap

By T. Pilkington

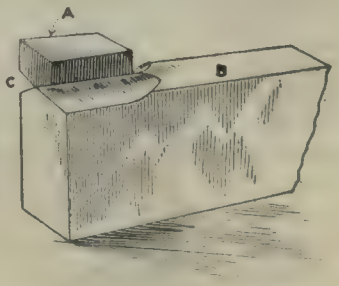
In view of the interest in the use of Stellite shown by recent articles in the *American Machinist* a few words calling attention to methods used for the disposal of its scrap may be useful. The following is the result of experience in England with Stellite used for finish-turning 6-in., 8-in. and 9-in. high-explosive shells of forged steel containing on an average 0.6 per cent. carbon. The shells had been rough-turned so as to leave material for a finishing cut 0.023 in. in depth; the feed was 3.25 in. per minute on the 6-in. shells and the cutitng speed 208 ft. per minute, Stellite of grade No. 2 being used.

The Stellite came to hand in $\frac{1}{2}$-in. square bars, each bar approximately 12 in. long and averaging 1 lb. in weight. The bars were cut by means of a $\frac{3}{32}$-in. thick abrasive wheel into lengths suitable for the toolholders; that is, about 3 in. long. The cut was taken at an angle about equal to the tool-clearance angle in order to save material and grinding labor. The 3-in. lengths were used until too short for the toolholders, that is, until each was about 1 in. in length. They were then collected and returned to the Stellite manufacturers, who allowed 75c. per pound for this scrap. As the price charged for new Stellite at that time was $5 per pound, some method whereby such scrap could be employed to better advantage appeared desirable.

The short tips of Stellite were arc-welded to machine-steel shanks. *A* is the Stellite and B the shank. The clearance at *C* was ground to facilitate arc-welding and was filled up during the welding process by the welding wire.

The resulting tools appeared sound and good in every respect, but upon being put to work the wearing qualities of the Stellite were found to be very inferior, and after a few trials of the welding process it became evident that a radical change should be made as the metal tip was decidedly softer after the welding.

Recasting the scrap into $\frac{1}{2}$-in. square by 12-in. bars was therefore tried and with success. An electric furnace was used for reducing the scrap, and vertical iron molds faced with lampblack and of sufficient bulk to form an effective chill were employed. The molds were warmed before the pouring. To the scrap Stellite was added 2½ per cent. of ferrouranium containing 35 per cent. uranium—some of this latter slags off, however—and the charge was protected from the atmosphere of the room. Uranium in the above proportion appears to refine the grain and consolidate the resulting cast, rendering it free from blowholes. The resulting Stellite gave 650 Brinell hardness, and upon test a $\frac{1}{2}$-in. square sample, held in an Armstrong toolholder, finish-turned 25 to 83 of the 6-in. shells per grinding of the tool as compared with 19 to 33 shells per grinding obtained from a similar tool working under similar conditions of feed, speed and work but made from material supplied direct by the manufacturers as No. 2 grade.



USING UP STELLITE SCRAP

When grinding Stellite tools it is well to remove as little of the surface metal as possible since the hardest and best metal will be found near the surface.

A Convenient Indexing Dial

By J. H. Bodenstedt

We ran up against a job where we had to graduate a dial with 125 divisions and there were no dial plates that would make 125 equal divisions.

We would have had to use a 39 plate and move 13 holes, but that would only give 120. Then it would be up to differential gearing and we could not find gears, so I had the machinist make a new dial with 25 divisions, which by moving eight holes would give me the required 125 divisions.



The discharge of officers in the Ordnance Department continues to be rapid. The present rate is between 200 and 250 a week.

* * *

Capt. A. K. Howell, who is interested in the Bonsack Machinery Co., St. Louis, Mo., has left the service after 16 months' service.

* * *

Capt. Ward A. Miller of Pittsburgh, Penn., who was employed by Joseph T. Ryerson & Son, Chicago, Ill., has left the service.

* * *

First Lieut. Walter R. Mitchell, lately discharged, was formerly with the Crane company, Baltimore, Md., as mechanical engineer.

* * *

Capt. Arthur F. Hebard, discharged Jan. 31, was in the New York office of the Remington Arms Co. before entering the service a year ago.

* * *

Maj. Carroll H. Gardner of Yonkers, N. Y., who has left the service, was formerly with the American International Corporation in New York.

* * *

First Lieut. Martin L. Millspaugh, who was with the Mills & Millspaugh Co., Columbus, Ohio, construction engineer, was discharged on Jan. 31.

* * *

Capt. W. W. Chapin of Montclair, N. J., has been discharged. He was with Thomas Hastings, New York, as structural engineer on heavy construction.

* * *

First Lieut. Paul W. Gaebelein, lately discharged, was previously employed by Benjamin B. Lawrence, 60 Wall St., New York. He is a metallurgical engineer.

* * *

Maj. Rodney D. Day of Pittsburgh, Penn., has left the service. He was with the Mesta Machine Co. of that city before being commissioned in December, 1917.

* * *

Second Lieut. William B. Spooner, Jr., recently discharged, was formerly with the Primos Chemical Co., Primos, Penn., and while in the Ordnance Department was on duty in the Nitrate Division.

* * *

Second Lieut. Frederick C. Birmell, who was recently discharged, entered the service as an enlisted man in September, 1917. He is a chemical engineer and served with the Nitrate Division at Sheffield, Ala.

Lieut.-Col. Merrill G. Baker of New York has been discharged. He entered the department in July, 1917, and was twice promoted. In civil life he was in the steel industry as sales and distribution manager.

* * *

Second Lieut. Paul L. Keachie, who has been at Rock Island Arsenal, was discharged recently. In civil life he is a mechanical engineer and was employed by the Arnold company, Chicago, Ill., on plant construction.

* * *

Two officers whose homes are in Pittsburgh, Penn., were in the list discharged Jan. 31. They are Capt. Harry W. Eisenhart, formerly with the Frick & Lindsay Co. as a steel salesman, and Capt. Ralph R. Lally, former district sales agent of the National Tube Co.

* * *

First Lieuts. William B. Huntley of Syracuse, N. Y., who was formerly connected with the Crucible Steel Co., and Edward F. Keating of the E. F. Keating Co., New York, were discharged on Jan. 30. Both have acted as negotiators in the purchase of steel for the department.

* * *

Three specialists in shop management recently discharged are First Lieut. Edward R. Kent, formerly with the Celluloid Co., Newark, N. J.; First Lieut. William E. Curley with Thompson & Lichtner, Boston, Mass., and Second Lieut. Walter E. Lott, with the Regina Co., Rahway, N. J.

* * *

Among the New York men who have left the service are Capt. Lew E. Wallace, formerly a salesman for the Youngstown Sheet and Tube Co.; Capt. Worthington Campbell, a patent lawyer with W. A. Redding, 38 Park Row, and First Lieut. Cecil McC. Billings, mechanical engineer, formerly with J. M. Lansden, 1790 Broadway.

* * *

Capt. George A. Wills of 1067 Madison Ave., New York, was recently discharged. He has been with the Motor Instruction Schools since entering the service, first as student and later as instructor, devoting his time especially to preparation of technical textbooks. In civil life he was a consulting engineer employed by the Adams Express Co. and others on work in connection with purchase, maintenance and operation of motor equipment. It is understood that he is undecided as to his future connections.

[*Continued on page 316*]



II. Work of the Small Arms Group

This article shows the work done by the Small Arms Group, including rifles and rifle ammunition and artillery ammunition. Few realize how these groups run up into quantity production. The schedule for the service-rifle cartridge, for example, called for nearly two billion during the last six months of 1918, and almost double this amount for the succeeding six months.

THE Small Arms Group has been responsible for the results obtained in the production and inspection of all machine guns of all types, automatic rifles, magazine rifles, pistols, revolvers, tripods, etc., including all accessories, appendages, spare parts and base spare parts for each type of arm. Machine guns of the various models are divided into three different types, i.e., mobile, aircraft and tank. Each type has its individual peculiarities adapting it to the purpose for which intended.

In order to attain the greatest degree of interchange of components between plants the enormous quantity of gages required both by the contractor and the Inspection Division taxed the capacity of all contractors' plants as well as all available outside capacity. It was imperatively essential that the contractors first provide the plants with sufficient gages to start production, the inspection gages being a secondary consideration, consequently no inspection gages were available in the early stages of production. Until the necessary gages were furnished, the inspection was controlled by the presence of a supervising inspector or inspectors being placed at each of the contractor's inspection stations throughout the plant, whose duty it was to observe the gaging of all critical operations and frequently apply the gages personally. It is due to this careful watchfulness that a satisfactory degree of interchangeability of product between plants was obtained, considering the great pressure under which the development and subsequent production was obtained. The difficulty encountered in mass production can only be appreciated when the progress made and the rapidity with which development progressed, coupled with the great lack of skilled workmen wherein inspectors had to be taught, are considered. Female inspectors became a necessity, and through their aptness they have established themselves as permanent inspectors for certain classes of production in the manufacture of small arms. Despite all the obstacles encountered, a percentage varying from 85 to 98.7 per cent. of interchangeability between plants was accomplished from the beginning.

The contractor is responsible for the correctness of the product when it leaves the machines, whence it is then routed to a near-by inspection station where the contractor's inspectors carefully inspect each component either 100 per cent. or less, governed by the accuracy to which the components have been machined and dependent upon the importance of the component relative to the proper safety, functioning and interchangeability required. Such components as pass this inspection are then routed to the finishing departments where they are then filed, burred, cornered and polished, after which they are routed to the Government inspection force. where they are given a similar inspection as above described on a percentage basis. While this will at once be called double inspection the rejections made by the Government vary from 0 to 100 per cent.

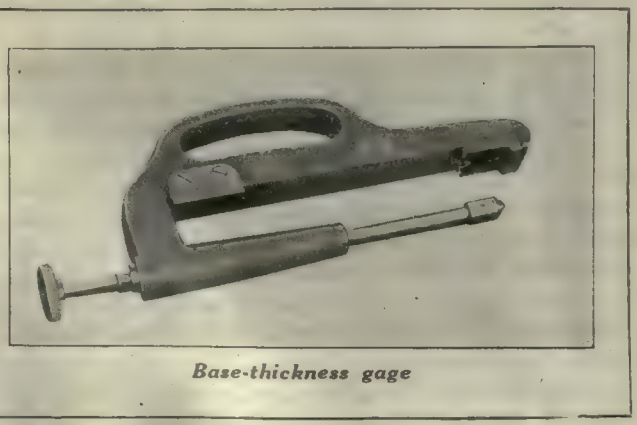
It is due to this careful inspection, however, that a very satisfactory degree of interchangeability was attained, as quoted before and a great quantity of irregular components eliminated from the product, which would otherwise be assembled in arms, that would also affect the assembly output per man. This is organized as a "group inspection" on the larger and more complicated components requiring several gagings which pass through a series of inspectors, the last inspector placing a final inspector's acceptance stamp upon the component, vouching for the correctness of the remainder of the group inspection.

Each inspector's stamp contains a serial number assigned and recorded against the individual inspector. Should the inspector sever his connections with the service the stamp is taken up and not reissued in the same plant, so that any errors existing can be readily traced to the individual inspector responsible. The rejected parts are passed to a Government salvage department where extreme tolerances are applied, and such as are acceptable are stamped by the salvage inspector.

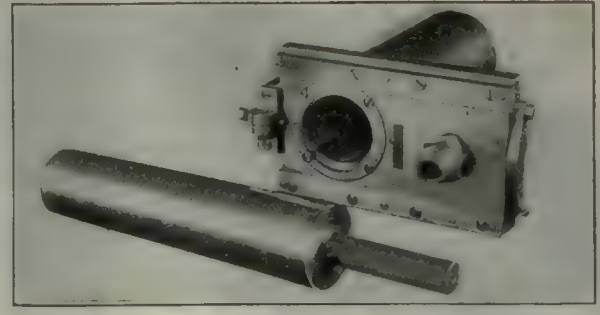
How the Work Is Progressed

The product after passing through the first, or white-stage (untreated), inspection is again routed to the contractor, where it is given the prescribed heat treatment. This includes hardening and tempering or rust-proofing finishes, such as browning, niter-bluing or machine-bluing. When completed, the product is again routed to the Government inspection force for final component inspection (black stage). This inspection is largely visual, inasmuch as the principal gaging points are more or less distorted due to the heat treatment above described. Many of the vital points, however, are subjected to further gaging, as for example the bores and chambers of barrels are examined for straightness and accuracy. The bolt holes in the receivers are tested for size and straightness. The bolts are carefully gaged for size, concentricity, position of locking shoulders, striker-point hole, etc. Such components as are found to be satisfactory are then routed to the finished-stores department, where they are issued to the contractor for the necessary group or final assembly into finished arms, when they are again routed to the Government inspection department for final inspection, proof-firing, targeting, packing and shipping.

The rifle is such a well-known arm that a little data as to its inspection will show something of the enormous task before the inspection division in handling over 10,000 completed rifles a day, with enough spare parts to make up perhaps 2000 more. The largest plant was that of the Midvale Steel and Ordnance Co., with its rifle plant at Eddystone, Penn., as this plant made something over 50 per cent. of the total output of the country, or between 5000 and 6000 completed rifles a day, with spare parts in addition. And realizing that this was a new plant and that very few of the organization were familiar with rifle manufacture, it deserves great credit.



Base-thickness gage



Chamber gage for 75-mm. gun

The company made the 1917 model, which has something over 100 component parts and weighs about 9¾ lb., complete, so that over 50,000 lb., or 25 tons, of finished product was handled every 24 hours.

There are 1660 operations on the rifle, of which 927 are inspected operations, and these require 1897 different kinds of gages. There were 15,826 gages in use daily by the inspectors of the company, while the Army inspectors used 527 different kinds of gages, 50 of which were not used by the company at all. The Army inspectors numbered about 1300 in this plant, while the company employed 1500, or 10 per cent. of the force.

Allowing for rejects and for recuts, or pieces which had to be returned for correction, there were something over 15,000,000 operations a day which had to be inspected, or about 1000 per employee.

With nearly every piece the inspection was 100 per cent., but they hold the record for rapid assembling of rifles—194 complete rifles in 5 hours by one man.

The following records of some of the principal items will give some impression of the volume of finished arms inspected and accepted since the war began to and including Dec. 7, 1918:

MACHINE GUNS, RIFLES, PISTOLS, ETC., INSPECTED

Weekly Production of Finished Arms	Inspectors	Operations Inspected	Number of Gages Used
57,584	3,000	10,708	13,405

SUMMARY OF ARMS INSPECTED TO DEC. 7, 1918

Type	Inspected and Accepted
U. S. rifles, caliber 0.30, model 1917	2,341,732
U. S. rifles, caliber 0.30, model 1903	343,949
Ross rifles	20,000
Russian rifles	280,049
Pistols, caliber 0.45, model 1911 (Colt and Remington, Bridgeport)	417,275
Revolvers, caliber 0.45, model 1917 (Colt and Smith & Wesson)	289,211
Browning machine guns, model 1917	50,661
Browning automatic rifles, model 1918	61,712
Vickers' machine guns, model 1915	15,239
Colt's machine guns	2,500
Marlin aircraft machine guns, model 1917	38,545
Marlin tank guns	490
Browning aviation	133
Lewis machine guns, model 1917	52,342
Tripods, all types, (11/21/18)	25,085
Bayonets, model 1917 (11/21/18)	638,107
Bolos, models 1910 and 1917 (11/21/18)	129,771
Sabers, model 1913	28,767
Gunstock blanks, models 1903 and 1917 (11/21/18)	5,476,378
Hand guards, models 1903 and 1917 (11/21/18)	1,487,349



Diaphragm

From the above record it will be noted that the total rifles of all types inspected is 3,048,442 and does not include the United States rifles, caliber 0.30, model 1903, manufactured prior to the declaration of war. The next larger item is the total machine guns inspected, 219,093. While the former figures are believed to be unequaled the latter is considered fully as great an achievement, due to the adoption of the several new types and the consequent later development and organization for their mass production.

Small-Arms Ammunition

Prior to 1917 the regular 0.30-caliber service and 0.45-caliber pistol cartridges developed at our ammunition factories were acknowledged to have no superiors among the military ammunition of the warring nations. On the declaration of hostilities with Germany and her allies the experts from our regular army establishment and reserve officers from the technical field were organized into the Small Arms Division under Col. John T. Thompson (now Brigadier General) to develop and produce small arms and small-arms ammunition in hitherto unheard of quantities.

THE SCHEDULE OF PRODUCTION

	Last Six Months of 1918	First Six Months of 1919
Service 0.30 caliber	1,775,000,000	3,300,000,000
Tracer	90,000,000	107,000,000
Incendiary	70,000,000	80,000,000
Armor piercing	120,000,000	145,000,000
0.45 pistol ball cartridge	700,000,000	1,000,000,000

With some changes in order that the standard ammunition would be adaptable to the many types of machine guns in use in our army in this quantity production, a quality even superior to that of peace times has been reached. A great deal of attention was devoted to our sources of raw material and existing stocks of metals and chemicals. During peace times it was customary to send broadcast over the world for materials of the highest quality. For instance, two rare chemicals which are used by most manufacturers of ammunition and which were obtained from foreign sources are antimony sulphide and potassium chlorate. In the case of the former it was feared we faced a serious shortage. In the case of the latter the purity of that from available sources was questioned. It became necessary to develop substitutes which would function as well or to refine the available raw material. Such problems as these and the supplies of copper, zinc, lead, antimony, nickel and tin, with the many metallurgical problems arising from their use, require the attention of a large corps of engineers and metallurgists.

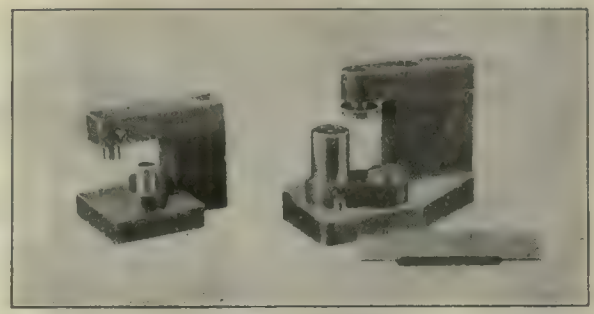
During the refinement and development of the 0.30-caliber service cartridge and getting into a war-time stride of production of this type, special types which have been developed abroad for aircraft and antiaircraft use were pressing for the attention of the engineering experts. Officers were sent overseas to familiarize themselves with their manufacture and design. Here was a new field, for the small 0.30-caliber bullet was called upon to hold within itself until discharged from the gun incendiary materials and diamond-hard armor-piercing cores. As the weight and form of the bullet have a great bearing on the distance and velocity of its flight careful adjustments were necessary on the complicated special types in order that the same setting of the sights on the rifles and machine guns can be used interchangeably for all types.

Machine Gun Feed Mechanism

The feed mechanism of the modern machine gun is carefully devised to operate with a cartridge and bullet of an exact form. If this form is not carefully controlled the feed mechanism will fail to operate. Few people realize that the modern type of machine gun will discharge bullets at the rate of 700 to 800 a minute. This high rate of fire requires ammunition of exact form and size as well as highest quality of material and mechanical workmanship. The Government arsenals and private plants have been brought up to high production of these special airplane types of small-arms ammunition.

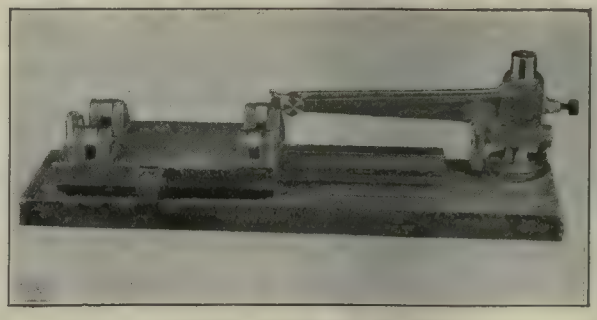
Cartridge Inspection Delicate

The inspection of the finished cartridge presented one of the greatest difficulties. In the increased production it is very necessary to have experts whose sole duty is to determine the quality of the finished product. In spite of the coöperation of manufacturers and skilled mechanics at the plants slight variations from the tolerances will occur and will, if overlooked, cause malfunctions of the rifles or machine guns. A malfunction is particularly serious, as it has a direct effect upon the morale of the men in the field. During the inspection of the small-arms ammunition every cartridge is gaged to determine whether it will enter the rifle chamber. Quantities of cartridges from each manufactured lot are fired to determine the accuracy and to verify the quality and weight of powder charge and infallibility of the primer cap. In the case of special airplane ammunition the bullets are made the object of special functioning tests to determine their action on armor plate and inflammable parts of airplanes.



Fuse-socket holder

Perhaps one of the latest developments in testing small-arms ammunition is the machine called the hang-fire tester. A hang-fire is usually the result of improper mixing of the chemicals, the use of impure chemicals or some mechanical defect of the primer cap, causing slow burning and slow propagation of heat to the powder charge. The primer cap is in truth the very heart of the cartridge. Minute quantities of intimately mixed chemicals go to make up this small but important component. As the machine gun is mounted on the airplane immediately behind and synchronized with the propeller in a manner to allow each shot to be fired between the revolving blades a delay in the explosion of the powder charge might shatter the blades of the propeller and result in the death of the aviator. The hang-fire testing machine is so devised that a revolving disk geared to the machine gun will measure the deviation by angle or time of any shot lagging behind the group of the test lot.

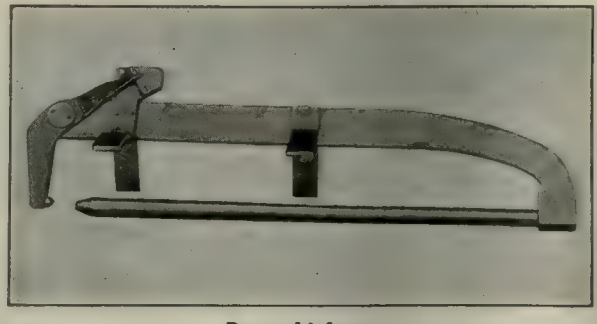


Eccentricity of shells

Artillery Ammunition

Next to small-arms ammunition artillery ammunition runs up into the largest quantities, and so far as tonnage is concerned it far exceeds anything else. Some idea of the amount of this may be had from the fact that the program of 75-mm. shells called for 7,000,000 a month and of the 155-mm. shells about 1,000,000 a month. One of the fears was that the French shells would all have to be hydraulically tested and we did not have either a sufficient number of hydraulic testing machines or the capacity for building them at a sufficiently rapid rate.

The physical properties of the French shells necessitated heat treatment, and the French practice was to water-quench all shells by a spraying system wherein a spray is used both inside and outside the shell. This is a very drastic treatment, and it was feared by some that it would cause cracks, which in turn might be responsible for premature explosion in the gun with its consequent damage, and in too many cases the death of the gun crew. It is stated that during the late summer and fall of 1914 the French lost over 500 guns on account of premature explosion. It is also stated that in small-sized ammunition the French have one "premature" in every 35,000 shots, while the British have but one premature out of every 300,000 shots. This difference is attributed to two causes, one the difference in the type of fuse, and the other to the fact that the shells are not heat-treated. The heat treatment, however, gives superior fragmentation, which makes the shells more effective, and all of our shells are heat-treated but are quenched in oil instead of water. Just to give some idea of the work involved in shell inspection, we show a page of gages used together with other tests which have to be made. The list at the bottom explains each operation and also gives the sequence. When we realize that this inspection must be carried out on over 120,000 shells a day, the size of the task confronting inspectors becomes more apparent.



Base thickness

Among the interesting data which have been collected as a result of the munition contracts are those relating to the life of gages used in the different work. These, as would be expected, vary greatly, both on account of the kind of gage and the use to which it is submitted, together with the effect of the way in which it is used. A nose plug gage for the 155-mm. shell averages 35,000 shells before wearing to the point of being rejected. The gage for the bourrelet and driving bands lasted for 155,000 shells.

Shell rejections for all causes, including the shells wasted in setting up the tools in the machine, average about eight-tenths of 1 per cent., although in some instances it goes as high as 2 to 3 per cent.

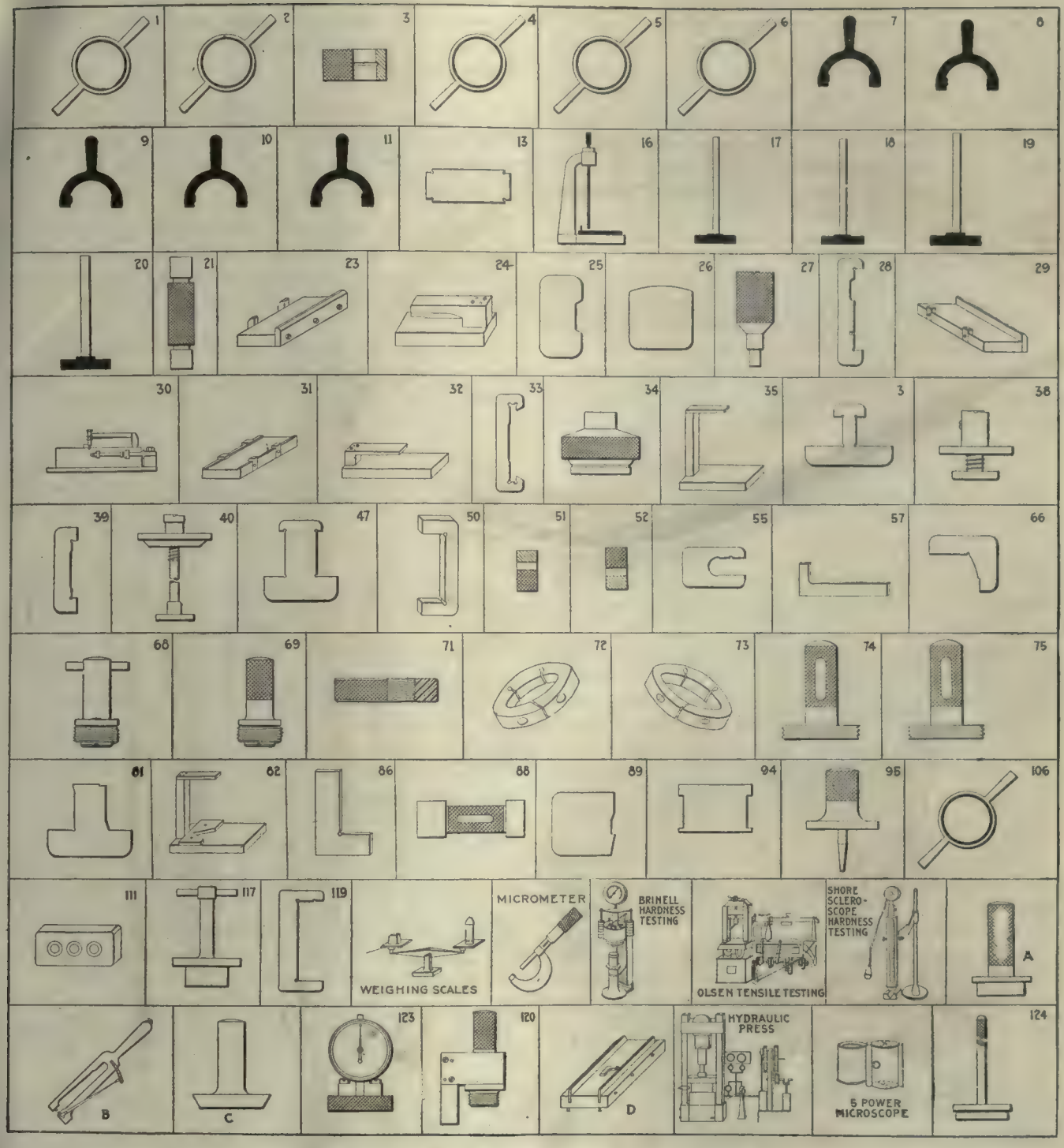
The daily production as of Nov. 1, 1918, is here shown:

SHELL PRODUCTION AS OF NOV. 1, 1918

Type of Shell	Daily Production	Weight in Lb. of Forgings Used
75-mm. high-explosive shell	122,000	2,562,000
75-mm. shrapnel	35,000	560,000
4.7-in. high-explosive shell	9,200	641,200
5-in. high-explosive shell	1,500	126,000
6-in. high-explosive shell	2,500	380,000
155-mm. high-explosive shell	25,828	4,313,276
8-in. high-explosive shell	3,200	1,020,800
9.2-in. high-explosive shell	2,800	1,087,800
240-mm. high-explosive shell	800	520,000
10-in. high-explosive shell	800	552,000
12-in. high-explosive shell	73	97,236
155-mm. shrapnel	2,500	229,750
		12,090,062

The importance of careful and accurate inspection is outlined herewith:

Any piping in the base of the shell may allow hot gases from the gun chamber to ignite the explosive in the shell, often resulting in the destruction of the gun and killing of the gun crew. Base covers are applied to the shell to minimize this danger, but should they be insecurely attached the hot gases may penetrate the base of the shell. Should base covers become detached from the shell during flight there will be serious danger to any troops in the vicinity, as these covers have a sharp edge and travel at a tremendous speed. This danger would be particularly grave in



Gages Used by U. S. Inspectors—75-Mm. Shrapnel

Gage Number	Description
1	Ring Gage, Diameter of Bourrelet, Go
2	Ring Gage, Diameter of Bourrelet, No Go
3	Ring Gage, Concentricity, Band, Go; with rear of Band, No. Go
4	Ring Gage, Diameter of Driving Band, No Go
5	Ring Gage, Diameter of Rear of Band, Go
6	Ring Gage, Diameter of Rear of Band, No Go
7	Snap Gage for Diameter of Body, Go and No Go
8	Snap Gage for Diameter of Bourrelet, Go and No Go
9	Snap Gage for Diameter of Driving Band, Go and No Go
10	Snap Gage for Diameter of Rear of Band, Go and No Go
11	Snap Gage for Diameter of Band Seat, Go and No Go
13	Width of Band Seat, Go and No Go
16	Gage for Thickness of Base
17	Plug Gage for Diameter of Powder Chamber, No Go
18	Plug Gage for Diameter of Powder Chamber, Go
19	Plug Gage for Diameter of Diaphragm Seat, No Go
20	Plug Gage for Diameter of Diaphragm Seat, Go
21	Double end pluggage for counterbored hole in Diaphragm
23	Slide Gage for Diameter of Diaphragm, Go and No Go
24	Snap Gage for Height of Diaphragm, Go and No Go
25	Profile of Tube Support Diaphragm
26	Profile Bottom Radius of Diaphragm
27	Plunger Gage, Bottom of Ct'Bored Hole to Base of Diaphragm
28	Length of Case, Snap Gage, Go and No Go
29	Slide Gage, Large Diameter of Head
30	Eccentricity of Finished Shell Gage
31	Slide Gage, Length of Shoulder on Head, Go and No Go
32	Stand Snap Gage, Length of Head, Go and No Go
33	Stand Snap Gage, Location of Waterproof Cover Groove
34	Plunger Gage, Diameter and Depth of Countersink
35	Stand Snap Gage, Assembled Height of Tube and Diaphragm
37	Snap Gage for Depth of Washer Seat
38	Plunger Gage, Top of Socket to Top of Washer
39	Length of Outside Thread on Head
40	Depth of Diaphragm Seat, Plunger Gage
47	Snap Gage, Distance from Base to Band Groove
50	Snap Gage for Length of Center Tube
51	Ring Gage for Maximum Diameter of Center Tube
52	Ring Gage for Minimum Diameter of Center Tube
55	Snap Gage for Thickness of Diaphragm
57	Snap Gage for Radius of Diaphragm
66	Profile of Fuse End
68	Plug Thread Gage, Inside Thread of Head, Go
69	Plug Thread Gage, Inside Thread of Head, No Go
71	Ring Thread Gage, Outside Thread of Head, No Go
72	Ring Thread Gage, Outside Thread of Head, Go, Adjustable
73	Ring Thread Gage, Outside Thread of Head, No Go Adjustable
74	Plug Thread Gage, Thread in Shell Nose, No Go
75	Plug Thread Gage, Thread in Shell Nose, Go
81	Position and Profile of Band and Bevels
82	Concentricity of Assembled Tube and Diaphragm
86	Right Angle to Base Gage
88	Plug, Root Diameter of Thread in Fuse Socket
89	Profile of Finished Band
94	Snap Gage, Diameter and Depth of Washer Seat
95	Concentricity of Center Tube and Top of Shell
106	Ring Gage, Maximum Diameter of Driving Band
111	Ring Gages Diameter of Center Tube
117	Plug, Top Diameter of Head
119	Assembled Length, 75-Mm. Shrapnel
123	Gage for Checking Deflection in Diaphragm Forgings
120	Concentricity Gage for Bourrelet with Thread in Head
A	Plug, Inside Diameter of Thread in Head, Special
B	Gage for Wall Thickness, Finished Case, Special
C	Plug, Top Diameter Taper Bore Finished Case, Special
D	Gravity Plane Gage
124	Plug Gage for Concentricity of Powder Pocket and Diaphragm Seat.

the case of troops following close under a barrage fire. Shell having thin bases also increase the danger of premature explosion, owing to the very high chamber pressure used in field artillery, some types of gun being as high as 38,000 lb. per square inch. Shell having walls which are below the minimum thickness allowed are liable to upset in the gun, which always results in some damage to the gun and often destroys it.

Rotating bands which are loose, or which are too small in diameter, seriously impair the range and accuracy of the shell. This also is true of shell which are eccentric or of too small a diameter at the bourrelet. A very small variation in length or in weight will also produce a marked variation in range and accuracy.

It is also important that the physical properties of the steel shall be carefully watched, as the shell must be hard enough to fragment properly upon detonation and yet soft enough to machine, and of the proper tensile strength to resist "setback" at the time of firing from the gun.

A band which is too soft will shear in the rifling of the gun, with a consequent loss of range and accuracy.

The fuse threads must be of proper diameter and have a sufficient number of perfect threads to insure the satisfactory fitting of the fuse, otherwise a deterioration of the explosive in the shell is probable, sometimes resulting in premature explosion and sometimes in failure to explode at all.

Certain types of explosive and ordinary varnish react to form highly unstable compounds, and it is therefore essential that shell to be loaded with this type of explosive must have an interior coating free from any chemicals which would react with the explosive.

A further responsibility of the inspector is to make sure that the finished projectiles are properly protected in transit to prevent any damage to the rotating band or the fuse thread and from rust.

Among the methods of reclamation which have been used to advantage is that of plating the inside of light-weight shells with lead to bring them up to weight. About 75,000 shells were so treated.

A very important effect of this process was the great reduction in the number of light-weight shell produced. The reason for this was that previous to the use of lead plating, light-weight shell were accepted on a salvage basis. Since the introduction of lead plating, on the other hand, no such salvage acceptance is allowed, and all light-weight shell must be lead plated at the expense of the contractor. This has led to the contractors making strenuous efforts to avoid the production of light-weight shells, with the most excellent results.

[*Concluded from page 310*]

Second Lieut. John B. Pagin was formerly a mechanical engineer with the Sherman-Klove Co., Chicago, Ill.

* * *

First Lieut. H. M. Beebe was discharged after 15 months' service. In civil life he is a mechanical engineer and was employed by the Link-Belt Co., Chicago.

* * *

First Lieut. Robert G. Meyler, who has been an instructor in industrial engineering at Cornell University, has left the service. He was commissioned in June, 1917.

Maj. Charles E. Sholes, who was with the Granville Chemical Co. before entering the service, has been discharged. He was connected with the office in New York, where he lives.

* * *

First Lieut. I. W. Pettengill of Haverhill, Mass., was discharged after 16 months' service. He is a mechanical engineer, and was employed by the Wagner Electric Co., St. Louis, Mo.

* * *

Capt. Henry A. Brown of Kenmore, N. Y., was released on Jan. 31. He had been in the service over 20 months, and left the Brown & Sharpe Manufacturing Co., of Providence, R. I., to enter.

* * *

First Lieut. Xanthers R. Smith of Jenkintown, Penn., has been discharged after 15 months' service. He is a mechanical engineer and was employed previously by the Atlantic Refining Company.

* * *

First Lieut. Gerald H. Deacon of Germantown, Penn., has left the service. Before receiving his commission in January, 1918, he was with the Robert Gair Co., Brooklyn, N. Y. manufacturer of paper containers.

General Jamieson Renews Consulting Practice

Brig.-Gen. Charles C. Jamieson, who was discharged from the service at his own request on Jan. 3, 1919, has renewed his connections with George W. Goethals & Co., Inc., 40 Wall St., New York, as vice president and partner. General Jamieson graduated from the Military Academy in 1892 and retired as a major in 1910. He then spent five and a half years in the manufacture of agricultural implements and harvesting machinery, three of which were with the Walter A. Wood Mowing and Reaping Machine Co., and two and a half as manager of factories for Deere & Co. He resigned from Deere & Co. in 1916, opened offices as consulting engineer in New York, and organized the firm of George W. Goethals & Co., which is engaged in consulting and organization work in connection with industrials.

Lieut.-Col. William H. Eaton Resumes Civilian Activities

Lieut.-Col. William H. Eaton has resumed his position as treasurer and general manager of the Eaton, Crane & Pike Co., Pittsfield, Mass. Colonel Eaton was commissioned a captain on Aug. 1, 1917, and became assistant to Brig.-Gen. (then Colonel) C. B. Wheeler, Chief of the Supply Division, Ordnance Department. When General Wheeler was promoted to be Acting Chief of Ordnance Colonel Eaton was his assistant until General Wheeler was appointed Chief Ordnance Officer of the American Expeditionary Forces, at which time Colonel Eaton sailed for France to continue in the capacity of assistant to General Wheeler. Colonel Eaton, who is a graduate of the Peekskill Military Academy, became secretary of the Eaton, Crane & Pike Co. in 1907 and treasurer and manager in 1912. He is president of the Union Coöperative Bank of Pittsfield, director of the Pittsfield National Bank and trustee of Trinity College of Hartford.

Attention!!

If you believe in industrial education—

If you believe in giving American boys a chance—

If you believe in training mechanics who think about their work in addition to merely doing it—

If you believe in developing to the utmost America's resources and increasing to the utmost America's wealth—

If you believe in these things, sit down this minute and write your Congressmen and Senators to get back of the movement to let the American people make use of the tools they have bought and paid for.

Mention Representative C. P. Caldwell's bill, H. R. 15625, introduced February 4, 1919.

65th Congress
3d Session

H. R. 15625

In the House of Representatives, February 4, 1919.

Mr. CALDWELL introduced the following bill, which was referred to the Committee on Military Affairs and ordered to be printed:

A BILL

To provide further educational facilities by requiring the War Department to loan certain machine tools not in use for Government purposes to trade and technical schools and universities, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War shall lend to trade and technical schools and universities and other recognized educational institutions which in the discretion of the Secretary of War should have such equipment the machine tools suitable for their use which are owned by the United States of America, which are under the control of the War Department, and which are not being used for Government purposes: *Provided, however,* That each institution so equipped shall be responsible to the United States of America, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

EDITORIALS

Re-education of Returned Soldiers

SOME of the agencies which are engaged in the re-education of returned soldiers are attacking the problem in a somewhat different manner than has been understood in some quarters. Instead of trying to find means whereby appliances can be made to enable a machinist to return to his trade considerable success is being attained by finding the man's capability and inclination along allied lines or even in distinctly different lines of work. In the case of a man who has lost a hand or an arm, for example, the attempt is made to find some occupation which he can follow with the use of one hand instead of fixing him up with appliances to return him to his old trade.

While it is not of course possible to do this in all cases, and while all crippled men are not capable of other vocations, the idea of reëducation is being extended so as to cover new education along different lines. If, for example, the man has been an expert machinist, thoroughly understanding the operations of the various machines in the shop, he may be trained to read blueprints and to become a planner of work for others, thus utilizing his shop experience and at the same time enabling him to make himself more useful than before without the aid of mechanical appliances.

When additional education will fit a man for a better job, and the man has the capacity for this education, it is certainly much better to reward his sacrifice by promotions of this kind than to send him back into the shop under a handicap, which is not only physical but, what is equally undesirable, also a constant source of mental depression.

Profiting by Our Mistakes

WE LEARN by doing, and in doing we make many mistakes. But we do not learn unless we acknowledge that we have made mistakes and try to correct them or prevent their recurrence. The best teachers do not gloss over the mistakes of their pupils. They point out the errors so that they and others may not make the same mistakes again.

We made many mistakes in our war preparation and activities, as was to be expected. But in too many cases we are trying to deceive ourselves into believing that everything went just as it should when we knew that this was not the case. We are losing a great opportunity of profiting by our mistakes by attempting to hide them under camouflage of various kinds.

There are good and sufficient reasons for failure in many cases, and nothing is to be gained by indiscriminate censure of individuals. The greatest reason for failure can probably be found in the selection of men unfitted for their particular job and in the handicapping of good men by impractical conditions. But we shall lose all opportunity for profiting by our mistakes if we continue the application of whitewash instead of looking the facts squarely in the face and endeavoring to profit by them. And unless we do this we are liable to make the same mistakes again.

It is quite natural that the individuals involved should seek to shield themselves and to try and gather what glory they may. But the individual must give way to the best interests of the nation. His reputation must stand or fall on accomplishment or failure.

It is said that to err is human and to forgive divine. But while we may be ready to forgive the errors made we can hardly be expected to forgive deliberate misrepresentation, copious applications of whitewash and claims to inventions and improvements which clearly belong to someone else. Before we forgive the prodigal and take him back into the family he must acknowledge the error of his ways and not pose as either a hero or a martyr.

Rewarding Fair Treatment

THE time is coming when we shall have practical demonstrations as to how long we remember the kind of treatment we received during the stress of the past four years; to show perhaps whether it pays to take advantage of every opportunity or to play fair in all things.

The machine-tool builder of this country showed with few exceptions a desire to handle matters fairly and to give considerate treatment to all. The prices of machine tools advanced less than many other metal products, and no increase has taken place since June, 1917.

There has been, however, a difference in the treatment accorded customers, as was to be expected. Traits of individual character will show themselves under stress or when opportunity offers. The time is now coming when those who were well treated can show their appreciation, and those who were gouged and taken advantage of can also show that they do not forget unfair treatment and will take their trade where they were well cared for.

While the majority of machine-tool builders were reasonable in their price advances there were a few cases where an urgent demand for a machine was very apt to boost the price; where an inferior machine could be obtained more readily, but at a higher price, than the best. On the other hand there are a few cases where builders of machines of the highest grade advanced prices barely enough to cover the increases in materials and labor and refused to accept any bonus for early deliveries.

Unless men of this kind are rewarded by continued orders from those they served so well there is little incentive in playing the game squarely. Is it not the duty of every buyer to take an inventory of his treatment during the past few years and to reward those who have treated him with fairness and consideration? This will give a direct incentive in addition to the self-satisfaction of having done the fair thing.

The "Coverage" of the Compensation Acts—II

By CHESLA C. SHERLOCK

The first of the series on "The Coverage of the Compensation Acts" appearing in this paper defined the status of employers. This, the second contribution, establishes who are employees and when they are entitled to compensation, with an incursion into the question of dependents and when they come under the protection of the compensation laws.

UNDER the early compensation laws there was a great deal of uncertainty as to the intent and purpose of this legislation, and men who had been schooled in the theories of the common law could not catch the spirit of the newer protective acts. Consequently we find that while the courts have been concerned with the question of who are employers under the compensation laws there has been probably more litigation over determining who are employees.

In considering who are employees it will be necessary to enlarge the word to include all persons who are entitled to compensation, and we will consider not only their rights, but also the question of dependency and the rights of dependents to compensation. To ascertain the status of employees and stop there is plainly leaving only half said in determining the "coverage" of the acts.

Most of the acts attempt to define the term employee just as they attempt to define the term employer, and the same objections to accepting the statutory definition of employees apply with equal force as they did in the case of defining employers. In fact, the courts have taken more liberties with the legislative definition of employees than of employers.

When an Employee May Recover Damages

Once an employer has become bound by the terms of the compensation acts there are two vital considerations that determine the right of a workman to recover compensation, namely, Was he an employee? and Did his injury arise by accident out of and in the course of his employment?

These tests apply to all of the acts, which agree that no person is entitled to compensation unless he or she was an employee; and no employee is entitled to compensation unless the injury was received by accident arising out of and in the course of the employment.

If a workman walks into an establishment and goes to work he is not an employee because there is no contractual relation between employer and employee. The word employee carries with it an implication of continuity of service. It does not signify merely temporary or transitory employment. It means regular, steady, continuous service. Casual employees are not employees within the technical meaning of the acts. The acts specifically exclude them, for industry should not be charged with losses where the workman is a "floater," a "drifter," or mere casual worker.

Workmen who stand in the position of independent contractors are not employees within the meaning of the acts and are not entitled to compensation. Let me illustrate. A man operating a shop had a number of trees on his premises which interfered with the light on cloudy days. He called one of his employees, who was about to take a vacation, and asked him if he would like to spend his vacation cutting down the trees. The workman consented, the agreement being that the workman would receive $40 and the wood the trees yielded. He was to use any method he might choose and the employer was concerned in the work in no way. This man was an independent contractor, and when he was injured by a falling limb he was not entitled to compensation. If the employer had called him in and told him to cut down the trees in a certain manner and had paid him his regular wages he would still not be entitled to compensation in some states because the work he was doing was casual and not in the employer's usual line of business.

In the technical sense employees are deemed to be workmen following a certain employment continuously and at a regular wage. The mere fact that the employment recurs with more or less frequency is not sufficient. A physician is not an employee, nor are professional nurses, pastors or public lecturers.

Clerks Not Always Employees

Not every person employed in an industrial establishment would be regarded as an employee even though his employment was regular and for hire. Clerks, stenographers, assistants, executives and the like are not employees within the meaning of the compensation acts. There are instances when clerks may be entitled to compensation, but this depends on the character of the work done and not upon the title. If a clerk is subjected to all of the hazards of the business he will be entitled to compensation in most of the states, although he is called a clerk, and clerks are expressly excluded from participation in the benefits of the acts.

It has been said that the test to apply in such cases is to determine whether a man earns his daily bread with his hands or by his intellect. There can be no doubt but that those who labor with their minds are not employees within the sense of the compensation acts, but even this test is manifestly unfair.

A lawyer, doctor, lecturer, engineer, executive or any other person depending for his income on the fruits of intellectual labor is not an employee in the sense of the compensation acts, but he may become an employee under certain conditions as in a case that involved a school-teacher. It was urged that no compensation could be paid because teachers depend for their income upon intellectual labor, but it was shown that this teacher performed her service in a country school where she was not only teacher but janitor as well. She was injured while building a fire in the schoolhouse before school commenced, and she received compensation.

The decisions of today tend to follow this broader rule. Clerks who are required to do things that subject them to hazards not ordinarily incurred by clerks who merely keep books or get out reports are entitled to compensation.

Industrial workers are commonly employed on some sort of a commission basis, either sharing in the profits or being paid a bonus. But since independent contractors are excluded from the operation of the act when they are themselves injured it naturally follows that the courts would be called upon to determine whether a workman employed on a commission or a bonus basis was an employee.

While a person is not ordinarily deemed an independent contractor unless he works for a lump sum the courts quite universally hold that the mere fact that a workman is employed on a commission basis will not take him out of the operation of the compensation acts. The test to apply in such cases is as to the control of the employer over the method of work, his right to discharge or to put the employee on other work or anything that tends to establish a relationship of employment rather than of independent employment.

Compensation for Officer of Corporation

Simply because an employee is an officer in the corporation employing him will not deprive him of compensation in case of injury, but in this connection some wages are necessary in the character of employee. A bank director in Connecticut was held not to be entitled to compensation as an employee of the bank when had he been the director of a tool-manufacturing establishment and also a machinist in its employ he would be entitled to compensation if injured in the latter employment.

Certain individuals who have no legal standing, such as convicts or others who are not paid for the work they do, cannot enjoy the status of employees under the compensation acts.

In New York the statute defines an employee as "a person who is engaged in a hazardous employment in the service of an employer, carrying on or conducting the same upon the premises or at the plant, or in the course of the employment away from the plant of his employer." It will be observed that this definition limits recovery in New York to persons engaged in "hazardous employment." A list has since been compiled by the legislature setting out the employments deemed hazardous.

In Iowa an employee is defined as "one who works under a contract of service, express or implied, or apprenticeship for another," but the definition states that clerks subjected to the hazards of the business shall be entitled to compensation, so it might be inferred from that expression.

The act is limited to employees in "hazardous occupations" in Alaska, Arizona, Illinois, Kansas, Louisiana, Maryland, Montana, New Hampshire, New Mexico, New York, Oklahoma, Oregon, Washington and Wyoming.

Every state having compensation legislation, either expressly or by implication, exempts farm labor and domestic servants from the benefits of the system.

The recommendation of the American Association of Labor Legislation as to what employees should receive compensation is as follows: "It is believed that sufficient progress has now been made in public education on the problem and in the development of efficient and economical machinery for insuring the employer against his compensation liability to justify the inclusion in the system of all employments. The only exception which should be made is of casual employees in the service of employers who have only such employees and who therefore cannot fairly be required to carry compensation insurance policies. Such policies, on payment of a small additional premium, are now drawn so as to embrace casual as well as regular employees. No serious burden is therefore entailed on employers, even of domestic servants, in making them liable to pay compensation to casual employees."

It is interesting to note that Alaska, Kansas, Louisiana, Nevada, New York, Oklahoma and the new federal act have followed the recommendation of the association and have allowed casual employees to participate in the benefits of the compensation system.

We have found that an employee is one engaged in the service of an employer, which service is continuous, regular and for hire. The elements are: (1) A contract of service, either express or implied, oral or written, wherein the employee enters into the service of the employer. There must be a contract of hiring, for the compensation acts are by implication of law written into every contract of service where such acts are in force. (2) The employees excluded are farm laborers, domestic servants, clerks, casual employees (in some states they are compensated), independent contractors and the officers of a corporation or the representatives of the employer.

The Status of Dependents

There is a great deal of misunderstanding in some quarters regarding the term dependents and just what it covers. It should not be thought that it is interchangeable with the terms heir or beneficiary. A dependent may be an heir and a beneficiary, but a mere heir or beneficiary could not obtain compensation as a dependent under the compensation acts.

The acts seek to define who are dependents, just as they define employers and employees, but there are many cases where further light is needed to determine the matter justly. In defining the word liberally a dependent is any person who is actually dependent upon the earning capacity of the workman for support. It may even include those who are not his blood relatives.

It is not sufficient to determine whether the so-called dependent was capable of supporting himself or herself. All the courts want to know is, was this person actually dependent upon the injured or deceased workman for support, and did such workman actually support the person. If so, he or she is entitled to compensation. Many of the acts provide that a wife is not deemed a dependent unless she is living with her husband at the time of the injury, the intention of the legislature being to deprive wives who had separated from their husbands from obtaining compensation, but so far as aliens were concerned the courts have held that for the purpose of the acts a wife was living with her husband when he contributed money toward her support even though thousands of miles might separate them.

The question of what to do with nonresident alien dependents is a matter which is only now coming to our attention. From the first most of the states have provided compensation for them, some, however, decreasing the amount they might recover.

There is no doubt but that we have been liberal with our liberty and the advantages of citizenship in the past. We have allowed aliens who were undesirable to come to this country, and our industries have given them employment. When a situation of great menace to our commonwealth arose many of these aliens did not hesitate to burn down factories, blow up shops and munition plants, wreck bridges and otherwise destroy our industrial effectiveness. Most of these aliens came to this country for no purpose other than to make money. A majority of them left their dependents in other countries, intending to return as soon as they had accumulated money enough to elevate them in the eyes of their countrymen, and many did not even sympathize with our form of government or our ideals.

Yet the police power of the state is used and probably will continue to be used to compel American employers to divide their property with nonresident alien dependents, people who have never been to this country and who have contributed nothing to our society or to our ideals. But American employers do not take kindly to it and perhaps the solution of the matter lies in refusing employment to those who have not taken out their first citizenship papers or who have not brought their families to this country.

This evil was most apparent when we declared war on the imperial German government, after which the commissions were bombarded with claims from dependents residing in the countries of the Central Powers.

There are several kinds of dependency as defined under the acts. Persons may be either totally dependent or partly so. When totally dependent they are entitled to the full benefit of the compensation act, but when partly dependent, the employer is liable only for his share, as determined by the statute, of the loss which they have suffered by reason of the withdrawal of the contribution ordinarily made by the deceased workman.

Persons such as husband or wife, parent or child, are presumed to be totally dependent, and the question of actual dependency cannot be raised by the employer.

No hard and fast rule can be formed as to what constitutes dependency. Ordinarily it means the condition arising where one looks to another for support, for the necessaries of life, or for the wherewithal to maintain himself in the same station of life maintained by the deceased workman. No employer can be compelled to pay compensation to maintain a dependent in any other station of life than that in which the deceased maintained such dependent, but where total dependency is presumed by law this may in fact occur.

Two tests that any employer can use to satisfy himself if there is dependency or ground for the claim are: (1) There must be actual dependency in fact as well as in appearance or claim; unless it is presumed the mere fact that one might ordinarily be deemed a dependent is not sufficient evidence of it. (2) There must have been actual contributions made by the injured workman to the person claiming dependency and such contributions would have been of an amount which can be ascertained or established and must have occurred with reasonable frequency.

The mere casual sending of money to one is not evidence of dependency, but might properly be more of an evidence of the liberality of the injured workman.

The Annual Meeting of the Society of Automotive Engineers

This year's annual S. A. E. meeting, as usual, was held in New York in conjunction with the Automobile Show and there was presented a three-day program of professional and social sessions at which there was a good attendance. The social features included two luncheons, a ladies' night at the Astor and a victory dinner, followed by a roof-garden whirl to wind up the proceedings.

The business meeting on Wednesday morning disposed of the various reports, after which came the reading of professional papers on "Tanks," by Lieut.-Col. Alden; "Principles of the Wheeled Farm Tractor," by E. R. Hewitt; "Automotive Applications of Marine Engines in the War," by G. F. Crouch, and "Automotive Ordnance Apparatus," by Lieut.-Col. Wall.

The afternoon session began with a "Symposium on the Probable Effect of Aeronautic Experience on Automobile Practice" by three of the leading authorities on these subjects, Henry H. Crane, Howard Marmon and O. E. Hunt. This was followed by papers on "High-Speed, High-Efficiency Engines," by D. McCall White, and "The Story of the United States Standard Truck," by J. G. Utz.

On Thursday morning the fuel session occupied the center of the stage with papers on the fuel problem by experts from the U. S. Geological Survey, the Bureau of Mines, the Bureau of Standards and the Bureau of Oil Conservation. The general trend of these papers pointed to the improvement of engines rather than to the increase of production of gasoline or better refining methods as the solution of the problem. The suggestion was made that engines be divided into two classes, one to embrace truck and tractor motors which could be built to burn a low-grade fuel because of their practically constant speed and the needlessness of flexibility and accelerative ability, and the other to consist of the passenger-car and airplane engines in which flexibility, acceleration and light weight demand a better quality of gasoline.

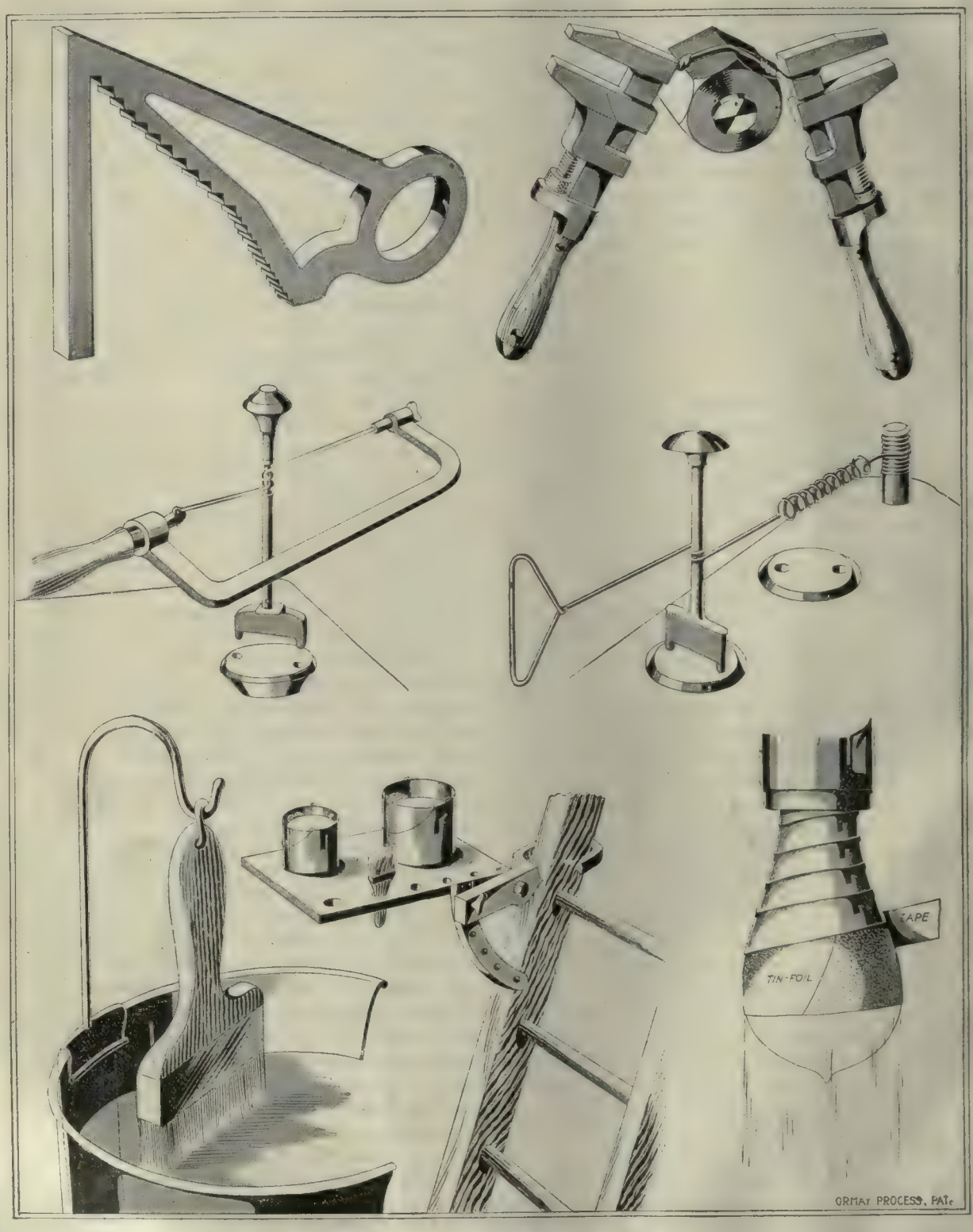
The Aeronautic Session on Thursday afternoon brought out an attendance which attested to the widespread interest in this field. Papers by Alexander Klemin and J. G. Vincent recounted the experiences of the Army with the problems of airplane and engine design and testing. The Navy's point of view on the aspects of the situation was explained in papers by Commanders Coburn, Richardson and Towers.

A paper on "Making the Airplane a Utility," by Grover C. Loening, emphasized the need of extreme speed in commercial airplanes to enable them to compete with express trains and to reduce the danger incident to the long distances between the existing landing fields. Attention was called to some of the disadvantages of the modern airplane; the uncomfortable muffling up of the occupants, the unpleasant factors of noise, oil and smoke from the exhaust and the drain of nervous energy incident to long trips. Much of this could be obviated by proper protection of the fuselage of the machine.

The meeting closed with a paper on "Forest Products for Aircraft Use," by Clyde H. Teesdale of the Forest Products Laboratory.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



TIME-SAVING AND EFFICIENCY DEVICES

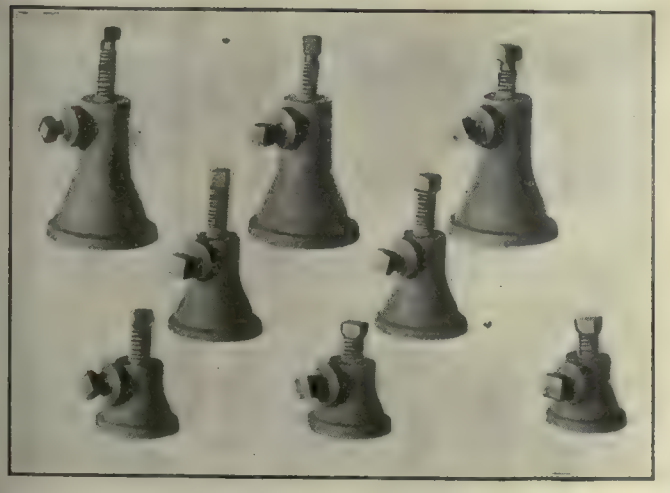


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Kent Planing-Machine Jacks

The Kent Machine Co., Kent, Ohio, is now marketing a line of planing-machine jacks as here shown. These jacks are made in three sizes, covering a range of from 2 to 6 in. The bases of the jacks are made of cast iron, the adjustment being secured by means of a screw placed in the top of the casting. This is prevented from turning while in use by means of a setscrew at the

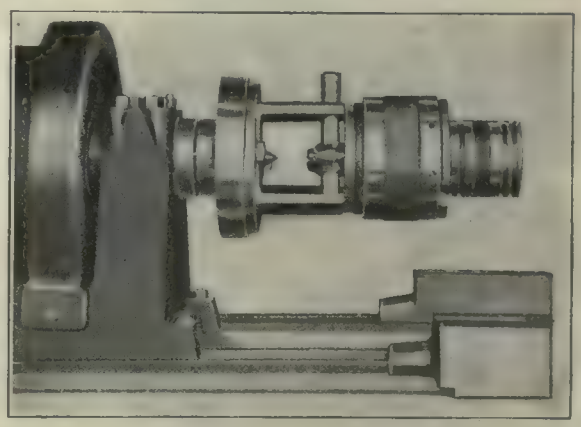


KENT PLANING-MACHINE JACKS

side bearing on a brass plug, which in turn bears on the raising screw and prevents mutilation of the thread. The screws for all sizes for both adjustment and for clamping have the same sized head, thereby entailing the use of but one wrench.

Hartog Piston Chuck

The piston chuck shown in the illustration has recently been placed on the market by the S. D. Hartog Manufacturing Co., St. Louis, Mo., and is intended for the use of garages, service stations or other places where it is desired to re-turn the piston-ring grooves in automobile or gas-engine pistons. A particularly desirable feature of this chuck is that the pistons may be re-turned without the necessity of removing the connecting-rod. It is also claimed that the method of holding the piston avoids the liability of cracking it, as is often done when it is held in chuck jaws. The



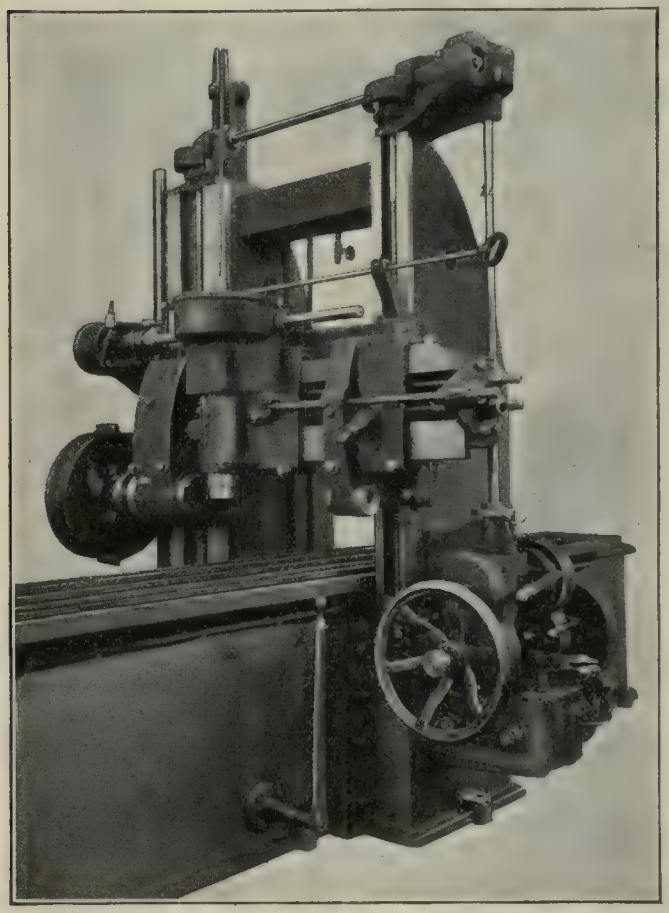
HARTOG PISTON CHUCK

chuck is clamped to a faceplate, after which the piston is put in place and a pin is put through the sides of the chuck and through the crankpin bearing of the rod. An outer sleeve on the chuck body is then screwed forward, carrying the faceplate up against the base of the piston, and thus holding it securely in place. The sleeve is knurled and also provided with holes so that a spanner wrench or pin can be used.

Newton Heavy-Duty Horizontal Keyseat Milling Machine

The heavy-duty horizontal keyseat milling machine shown in the illustration has just been placed on the market by the Newton Machine Tool Works, Inc., 23d and Vine Sts., Philadelphia, Penn. It is stated that the machine is very flexible in control and that it is particularly desirable for long shafts because the table is supported its full length and does not overhang. The base and table can be made to mill any desired length. Another advantage of this type of machine is that a

cutter can be mounted on the horizontal spindle to allow milling keyseats in shafts in multiple. The machine can be equipped with centers with quartering devices for accurately milling on the quarter the keyseats of locomotive axles, and when these special quartering fixtures are used the keyseats in both ends may be finished with the original setting if this is desired. The vertical spindle is used to end keyseats when necessary, such as those in eccentric strap bearings. The vertical spindle saddle is mounted on the flat cross-rail and has a hand cross-adjustment employing a rack-and-pinion mechanism. The independent hand vertical adjustment of the vertical spindle sleeve is controlled by a worm and



NEWTON HEAVY-DUTY HORIZONTAL KEYSEAT MILLING MACHINE

Diameter of horizontal spindle in bearing, 4⅜ in.; diameter of horizontal spindle through driving gear, 4 in.; side adjustment of horizontal spindle by hand, 4 in.; distance from center of horizontal spindle to under side of cross-rail, 2½ in.; maximum cutter swing on horizontal spindle, where vertical spindle saddle does not interfere, 10 in.; maximum cutter swing under vertical spindle saddle, 6 in.; width of work table over working surface, 20 in.; length of table to mill, 10 ft.; width between uprights, 26 in.; maximum height from center of horizontal spindle to top of work table, 33 in.; maximum height from end of vertical spindle to top of work table, 35 in.; diameter of vertical spindle, 2 in.; independent hand vertical elevation of vertical spindle sleeve, 6 in.; vertical spindle adjustable to maximum height of 2 in. above the center of the horizontal spindle; weight complete, 22,000 pounds.

wormwheel connected to the spindle rack pinion, the control being actuated by a spline shaft carried to the right-hand end of the cross-rail. The horizontal spindle head is also adjustable by hand across the rail by a screw controlled from the right-hand side of the cross-rail. Nine changes of gear feeds are provided for the table from a box in which are mounted adjustable sleeves giving the changes without the removal of gears. The table is also equipped with reversing fast power traverse. The cross-rail is counterweighted and is equipped with both hand adjustment and reversing vertical fast power traverse. A micrometer adjustment is provided on the shaft transmitting motion for the vertical adjustment of the cross-rail for adjusting the cutter on the horizontal spindle to the depth that is required.

This horizontal spindle is driven by a bronze wormwheel and a hardened-steel worm which is fitted with roller thrust bearings. The vertical spindle is driven by a wormwheel and spiral gear of bronze; both of these drives are incased to permit of continuous lubrication. The horizontal spindle is fitted with a Morse taper, a holder, a face keyway, and through retaining bolt, the vertical spindle being equipped in the same manner. The outer support on the cross-rail is adjusted by means of a rack-and-pinion mechanism, the elevating screws having top and bottom bearings to insure their operation in tension. The work table has three finished T-slots, drilled stop-pin holes, and is surrounded by a pan for draining off the lubricant to a tank in the base. The drive to the table is through a spiral pinion and angular rack. Practically all bearings are bushed, all gears in the driving train are steel or bronze, and those in the feed train except the large spur gear are also of steel or bronze. A feature of the machine is that all the controls are brought together convenient for the operator. The vertical lever at the center engages the primary clutch which controls all movements in the direction of rotation for the movement. The upper horizontal lever at the right engages the clutch controlling the power vertical movement of the cross-rail. The lower horizontal lever at the right controls the clutch for engaging the table feed and fast power traverse. Two latch levers at the right control the feed-gear combination. The handwheel controls two hand adjustments, namely, that of the table and the vertical adjustment of the cross-rail.

Products That Sweden Needs From the United States

The following products are among those which Sweden particularly needs from the United States: Food of all kinds; machines and machine tools; lubricants; lubricating oils; copper; nickel, tin and like metals; sulphur; harvesting machinery; cotton; wool; leather; rubber; coal; copper wire. Sweden would buy toys; cotton, wool and silk cloths; cotton, wool and silk underwear; cotton, wool and silk stockings; shoes; all kinds of clothing for men, women and children; motor cars; thread; typewriters and adding machines, and so forth.

Sweden does not need wood and wood pulp; iron and steel, except cheap foundry iron, which the high price of coal makes exceedingly costly to manufacture; turbines; oil engines; electrical machinery.

It is realized that raw material will be rationed, and that orders for many other things cannot be completely filled, but it seems as if the present possibilities could advantageously be made known to interested manufacturers and exporters of the United States.—*Commerce Reports.*



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



The Miller Rubber Co., Akron, Ohio, manufacturer of Miller Geared-to-the-Road tires, has begun the manufacture of heavy-duty pneumatic tires for trucks.

To manufacture its standard air-brake equipment for motor trucks and trailers the Parker Appliance Co., Cleveland, Ohio, is planning new quarters with 20,000 sq.ft. of floor space in Cleveland.

The sale of the 60,000 shares of the American Bosch Magneto Corporation, which was taken over by the Alien Property Custodian, has been completed. The entire amount of stock was sold at $65 a share.

The War Department has appointed a special official for disposing of the big quantities of surplus motor trucks and equipment and for selling the 50,000 American motor trucks to the French and Belgian governments.

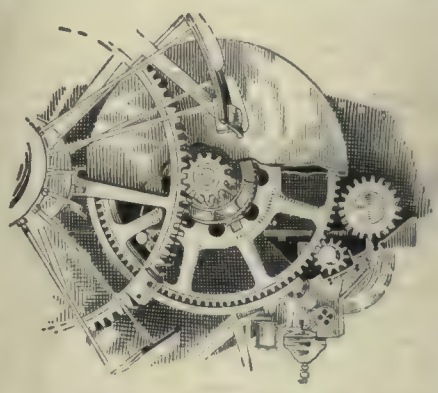
On returning to a peace-time basis the General Motors Truck Co. announced its intention of price reduction for every G. M. C. truck model. The many G. M. C. trucks used in the war won a record for excellent abilities.

The 1919 production schedule of the Fordson tractors manufactured by the Henry Ford & Son Co. calls for 100,000 tractors. This means a daily production of about 325 tractors instead of 225 as at present. In 1918 the company turned out and sold 30,000 tractors.

The Knox Motors Association of Springfield, Mass., manufacturing the Knox tractor, has fixed the price of the model 35 tractor at $5500 f.o.b. factory and that of the model 36 tractor at $6000 f.o.b. factory, with an additional charge of $100 for cleated steel driving wheels.

During the Packard war-product exhibit at Detroit a demonstration was given to show the tremendous power of the Liberty motor. This famous aviation engine was mounted on a Packard 3-ton truck weighing 7000 lb., from which the motor, radiator, hood and transmission had been removed. The air propeller drove the truck not only at the speed of a swift passenger car, but also slowly and smoothly in abrupt turns, figure eights and serpentine curves.

The illustration shows an interesting tractor transmission design manufactured by the Minneapolis Steel and Machinery Co. A single-spur pinion on the crankshaft engages the differential and at each end of the differential shaft are the bull pinions which drive the bull gear. This design does away with



the commonly used intermediate gear, which is a well-known source of tractor transmission troubles. The transmissions using an intermediate gear must have two gears running on it, and consequently they get twice as much wear as any other gear, because the teeth of this gear cannot be made any stronger since they must correspond with those in the main pinion and differential.

There are 6,361,502 farms varying in size from less than 20 acres to more than 1000 acres in the United States. During 1916, 1917 and the first part of 1918 150,955 tractors were manufactured in the United States. A comparison of the number of farms with the number of tractors manufactured up to June 30, 1918, shows that a tractor was manufactured for only one farm in 42.

Piston clearance in kerosene engines is larger than in the gasoline motors because the kerosene-engine piston is subjected to higher and more sustained temperature than that of the gasoline motor. Experiments with various types and sizes of kerosene-engine pistons show that the body clearance should range from one to one-half thousandths per inch of diameter, and the rest of the piston should be tapered toward the head with a clearance of four to five thousandths per inch of diameter at the extreme top in order to take care of the additional expansion and avoid the piston seizing and scoring the cylinders or at least a heavy preignition.

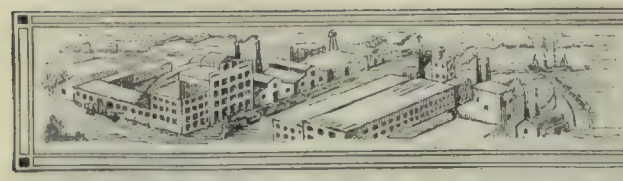
The newly incorporated United Aircraft Engineering Corporation, New York, has increased its capital from $200,000 to $500,000. The company was organized by E. G. Diffin, Roy U. Conger and M. B. Stout and has offices at 52 Vanderbilt Ave., New York.

That the rural motor express is a healthy business possibility is shown by a Canadian company which has been capitalized at $300,000. The company is operating a line out of Toronto to London westward and to Hamilton and Buffalo southward, taking in all the way stations. The length of the route is approximately 200 miles.

The new Metz passenger car will be a six-cylinder, 45-hp. model with 117 in. wheelbase and 32 x 4-in. tires. A feature of this new model is the replacing of the Metz friction drive with a three-speed selective-gear transmission. The car will be equipped with an electric starting and lighting system and will sell for $1495.

An allied aviation conference of representatives from France, Great Britain, Italy, Belgium and the United States will be held in Paris to incorporate an aeronautical clause in the peace settlement. One of the questions to be settled by the conference will be that of adopting regulations to prevent airplanes engaged in international mercantile traffic from flying over frontiers and delivering their cargoes withot stopping at the custom house to pay duty.

Notes on Airships for Commercial Purposes," a report issued by the British Air Ministry, contains interesting suggestions for the future of aerial transportation. To eliminate the commercial competition between the two types of aircraft, the use of airplanes is suggested for distances under 1000 miles, leaving nonstop flights of more than 1000 miles to dirigibles. Large airship stations 2000 to 3000 miles apart should be established mainly for transoceanic traffic and airplanes used to bring merchandise and passengers to this airship center from neighboring countries. By operating aircraft in this way airplanes would compete with railroads, and airships with ocean steamers, the advantage over the present transportation system being in the saving of at least 50 per cent. of the average time of transit.



Sparks from the

National Merchant Marine Association

Created for the Purpose of Carrying On Propaganda Advocating a Large American Merchant Marine

As a result of the American Merchant Marine conference held at the Smithsonian Institution, Washington, Jan. 22 and 23, Senator Joseph E. Ransdell of Louisiana, presiding, and to which invitations were extended to all industrial elements of the country, a new organization was created to be known as the National Merchant Marine Association, the purpose of which will be to carry on a nation-wide propaganda in advocacy of a large American merchant marine. R. Goodwyn Rhett, former president of the Chamber of Commerce of the United States, was elected chairman and Winthrop L. Marvin of Boston secretary.

The governing body of the organization will consist of the officers and a council of not less than 30 members, the nucleus of which will be members of the resolutions committee which recommended the creation of the new organization.

Strong opposition was made to the report of the resolutions committee by Rear Admiral Francis Bowles, in charge of the Emergency Fleet Corporation at Hog Island, who contended that the interests of the various parties engaged in shipping were in the United States well represented by the American Steamship Association. He said that he was of the opinion that it was inappropriate to attempt the organization of any body representing private interests when the nation's interests were at stake.

Assurance that the United States Navy would lend every aid to the new organization was made by Commander Charles Belknap, U.S.N., who stated that the Navy should train the men and officers of the merchant marine and that they should then be made members of the Naval Reserve. "The Navy will back any legislation which promises to promote the interests of the merchant marine," he said.

J. J. Powell, vice-president of the Bethlehem Shipbuilding Corporation; Homer L. Ferguson, president of the Newport News Shipbuilding and Dry Dock Co., and Holden A. Evans, president of the Baltimore Dry Dock and Shipbuilding Co., spoke for the builders and were united in their opinion that the cost of building American ships was a barrier against any attempt to establish a merchant marine unless the nation assumed the undertaking.

Mr. Powell stated that the difference between the cost of a ship in Great Britain and one in this country was approximately an increase from about $25 or $35 a ton before the war to $100 today. A great part of this cost, he said, was due to the increase of the cost of labor.

Mr. Ferguson said that he favored laws and treaties being made which would confine trade between the United States and other countries to ships of either those countries or the United States. This, he said, would assure each country having a merchant marine commensurate with its commerce.

Mr. Evans indorsed the presentation of Mr. Ferguson and declared that he favored the immediate leasing of Government ships to private operating companies, which should be given options of five years in which to purchase them, giving $75 a ton as a value on which leases should be fixed.

Matthew Woll, representing Samuel Gompers, president of the American Federation of Labor, said that the federation would join the organization if it could be assured that seamen were not to be reduced to serfdom.

Efforts will be made, it was stated, to have legislation enacted under which the American merchant marine may develop favorably.

Among members of the resolutions committee named by Chairman Ransdell were H. A. Wheeler, president of the United States Chamber of Commerce; P. A. S. Franklin, president of the International Mercantile Marine; J. H. Pruitt, president of the Masters, Mates and Pilots' Association; F. L. Sanford of the Southern Pine Association, and C. E. Gunsky of San Francisco.

J. Parker Kirlin of New York headed the committee on organization.

* * *

Bureau for Engineers

The Cornell Society of Civil Engineers has established a Registration Bureau for Engineers at 30 East 42d St. Approximately 1000 Cornell engineers who have been in the military or naval service have been registered. The bureau supplies trained men without charge to employers. Alumni of the Cornell engineering colleges and employers are invited to make use of the service.

* * *

Iron That Can Be Whittled

It is well known that rapid cooling of hot metals hardens them. That the opposite is true has recently been demonstrated in striking fashion by the General Electric Co. One of its scientists annealed American ingot iron surrounded by hydrogen gas for three hours at a temperature above 1600 deg. F. The product was very little harder than the softest copper and can be whittled with a knife.—*Brass World.*

Monoplane Ascends 19,500 Ft. Carrying Three Passengers

A new record for monoplane altitude was made by Maj. R. W. Schroeder, Air Service (Aeronautics), the holder of the American altitude record, on Jan. 18 at Dayton, Ohio.

According to reports received from the chief of the Technical Section, Division of Military Aeronautics, McCook Feld, Dayton, Ohio, the Loening monoplane climbed to a height of 19,500 ft., carrying three passengers weighing 470 lb. The pilot was Maj. R. W. Schroeder, the observer Lieut. George V. Elsy, and the mechanician K. A. Craig. The previous altitude record for a monoplane with three passengers is understood to be about 16,000 ft. A report from Mr. Loening gives the time of climb as 31 min., which will average 500 ft. per minute.

The plane piloted by Major Schroeder was the two-seated Loening monoplane built by Grover C. Loening of Long Island, N. Y. The power plant is an eight-cylinder Hispano-Suiza engine, which has driven the monoplane as fast as 145 miles per hour.

* * *

Tractor Schools

Schools for teaching the operation and mechanism of farm tractors are being held in different parts of Iowa this winter. The duration of the tuition varies from two to several days, and is free to anyone who wants to take it. The attendance is usually made up of farmers or their sons instead of the farm owner, prospective buyers or salesmen. In a few cases the schools are under the auspices of the county agricultural bureau, an association or a tractor firm. The latest school was held at Waterloo on Jan. 17 and 18 and was conducted by the International Harvester Co., which prepared a textbook for the use of those taking the instruction and also furnished a tractor and other equipment for the school.

Part of the instruction was the answering of all questions that may have come to operators of tractors. In connection with this school there was shown at a local theater a film entitled "America's Golden Harvest," which showed a tractor in operation.

* * *

Industrial Hygiene Library

A library of industrial hygiene is being prepared by the Department of Labor. It is planned to collect all the information available which bears on questions of health in industry, industrial safety and employment management, and to have this information readily accessible at all times.

World's Industrial Forge

By E.C.Porter
News Editor

Melting Points of Chemical Elements

The table of melting points of chemical elements here given was issued by the Bureau of Standards, Department of Commerce, in answer to numerous requests for this information.

The values of the melting points used by the Bureau of Standards as standard temperatures for the calibration of thermometers and pyrometers are indicated in capitals. The values have been assigned after a careful survey of all the available data.

Element.	C.	F.	Element.	C.	F.
Helium	<−271	<−456	Neodymium	840?	1544
Hydrogen	−259	−434	Arsenic	850	1562
Neon	−253?	−423	Barium	850	1562
Fluorine	−223	−369	Praseodymium	940	1724
Oxygen	−218	−360	Germanium	958	1756
Nitrogen	−210	−346	SILVER	960.5	1760.9
Argon	−188	−306	GOLD	1063.0	1945.5
Krypton	−169	−272	COPPER	1083.0	1981.4
Xenon	−140	−220	Manganese	1230	2243
Chlorine	−101.5	−150.7	Beryllium (Glucinum)	1280	2336
MERCURY	− 38.87	− 37.97	Samarium	1300–1400	2370–2550
Bromine	− 7.3	+ 18.9	Scandium	?	
Caesium	+ 26	79	Silicon	1420	2588
Gallium	30	86	NICKEL	1452	2646
Rubidium	38	100	Cobalt	1480	2696
Phosphorus	44	111	Yttrium	1490	2714
Potassium	62.3	144.1	IRON	1530	2783
Sodium	97.5	207.5	PALLADIUM	1549	2820
Iodine	113.5	236.3	Chromium	1615	2939
Sulphur	S_{II}112.8 / S_{III}119.2 / S_{III}106.8	235.0 / 246.6 / 224.2	Zirconium	1700?	3090
Indium	155	311	Columbium (Niobium)	1700?	3020
Lithium	186	367	Thorium	>1700 <Mo.	>3090 <Mo.
Selenium	217-220	423-428	Vanadium	1720	3128
TIN	231.9	449.4	PLATINUM	1755	3191
Bismuth	271	520	Ytterbium	?	
Thallium	302	576	Titanium	1800	3272
CADMIUM	320.9	609.6	Uranium	<1850	>3360
LEAD	327.4	621.3	Rhodium	1950	3542
ZINC	419.4	786.9	Boron	2200–2500?	4000–4500
Tellurium	452	846	Iridium	2350?	4260
ANTIMONY	630.0	1166.0	Ruthenium	2450?	4440
Cerium	640	1184	Molybdenum	2550	4620
Magnesium	651	1204	Osmium	2700?	4890
ALUMINUM	658.7	1217.7	Tantalum	2900	5250
Radium	700	1292	TUNGSTEN	3400	6152
Calcium	810	1490	Carbon	>3600	>6500
Lanthanum	810?	1490			
Strontium	>Ca<Ba?				

MELTING POINTS OF THE CHEMICAL ELEMENTS

As nearly as may be, all values, in particular the standard points, have been reduced to a common scale, the thermodynamic scale. For high temperatures and for use only with optical pyrometers this scale is satisfied very exactly by taking $c_2 = 14{,}350$ in the formula for Wien's law (see Bureau of Standards Circular No. 7 or Scientific Paper No. 11) connecting I_λ, monochromatic luminous intensity of wave length λ, and T. absolute temperature: $I_\lambda = c_1\lambda^{-5}e^{\frac{c_2}{\lambda T}}$. For all purposes, except the most accurate investigations, the thermodynamic scale is identical with any of the gas scales.

At high temperatures some of the values are quite uncertain; thus while the melting point of platinum may be considered accurately known to 10 deg. C., that of tungsten is possibly uncertain by 50 deg. C. or more. Temperatures centigrade are rounded off, and the exact Fahrenheit equivalents are usually given.

* * *

Philadelphia Foundrymen Elect Officers

The Philadelphia Foundrymen's Association at its monthly meeting Jan. 8 reëlected the following officers for 1919: President, Thomas Devlin, Thomas Devlin Manufacturing Co.; vice president, George C. Davies, Pilling & Crane; treasurer, Josiah Thompson, J. Thompson & Co.; secretary, Howard Evans, J. W. Paxson Co.; executive committee, Walter Wood, R. D. Wood & Co.; Thomas M. Eynon, Eynon-Evans Manufacturing Co.; H. L. Haldeman, Pulaski Iron Co.; Walter T. MacDonald, Fletcher Works, Inc.; W. T. Dunning, Chester Steel Castings Co., Chester, Penn.

* * *

Copper Estimate

Official and semiofficial figures indicate that the world's supply of refined copper is about 300,000,000 lb. It is estimated that the allied countries of Europe will require the coming year between 950,000,000 and 1,000,000,000 lb. of American copper. If industrial readjustment in this country is accomplished within two or three months the domestic demand should absorb more than 1,000,000,000 lb. next year.

Railroad Administration Has Big Project in View

Will Spend as Soon as It Is Able the Huge Sum of Money at Its Disposal

Improvements authorized on the railroads under federal control to Dec. 31, 1918, required for their completion $573,150,159. Of this the Administration used $242,260,135. The latter figure provides for the payment for improvements to Nov. 30.

For equipment the Administration was authorized to spend $658,893,761, and by Nov. 30 had bought equipment valued at $254,060,941. For construction, extensions, etc., an expenditure of $46,771,078 was authorized, but of this sum only $20,194,318 was used.

The entire program provided for capital expenditures of $1,278,814,998, of which until Nov. 30 $516,515,394 had been disbursed. These figures are given in a report by former Director General McAdoo, just made public.

Under Direction of Lovett

The work of financing improvements, equipment and construction is under the direction of the Division of Capital Expenditures, administered until the end of last year by Judge Robert S. Lovett, former chairman of the board of directors of the Union Pacific.

For locomotives the Administration expended $91,451,107, and for freight train cars $130,000,000, while for passenger cars only $1,829,085 was disbursed. Nearly three hundred million dollars had been authorized for freight cars, and the Administration was prepared to spend approximately two hundred million dollars for locomotives.

After the armistice was signed the program was cut somewhat, but it is understood that the Administration intends to go forward with ambitious building projects as soon as it feels free to do so.

* * *

German Workshops Use Paper Belts for Machinery

A driving-belt substitute made of paper is now being introduced into German workshops for driving machinery, according to reports. The paper is cut into narrow bands which are then spun. The belts are made by weaving or braiding. Woven-paper belts are of two kinds—paper-fabric belts and paper-thread belts, the former type being the most frequently used. The fabric is first cut into bands 40 m. long, which are subsequently made up according to the desired width and thickness. A core of strengthening material is interposed, either cot-

ton or sheet metal, though more recently these cores have consisted of paper thread and metal wires interwoven. The core is surrounded with the paper strips and the whole sewed with strong thread. Belts so prepared are said to be very flexible and to wear satisfactorily. Woven-paper belts have a tensile strength of from 100 to 125 kilos per centimeter of width.

* * *

Kelly Reamer Company Sends Telegram to the Senate

The following is a telegram sent to the Senate by the Kelly Reamer Co., Cleveland, Ohio, asking for advice, also requesting information on the $1,500,000,000 being withheld from manufacturers and which is causing much inconvenience to the machine-tool industry:

Jan. 30th, 1919.

The United States Senate,
Washington, D. C.
(To the attention of the President of the Senate.)

Honorable Gentlemen: We think some employee has stolen a dollar. Our superintendent suggests holding up our entire payroll until his committee locates the culprit. I as general manager advise paying all hands, then find the guilty one, prosecute and recover the dollar. Will you kindly ask your honorable body to grant us a decision on this problem? We wish to be prudent, but if possible to avoid further stoppage of our industry. We await with interest your valued advice and more light.

Respectfully yours,
WILLIAM E. KELLY,
President The Kelly Reamer Company.

P. S.—As an ultimate beneficiary to some thousands out of the one and a half billion payroll now held in abeyance we feel a deep concern that enough receivers cannot be procured to supply all of the manufacturers who have exhausted their working capital in delivering the goods at any cost. We, as one of the many manufacturers, seriously and urgently implore your honorable body to establish a precedent, lay aside all red-tape customs and pay off all hands, starting the wheels of industry now dormant and give employment to two million returned soldiers. The Government is big enough to find, prosecute and convict, if fraud is discovered. This is a calamity, an emergency calling for quick action. We want your prompt and best efforts in this crisis.—Kelly.

* * *

Sawmill Machinery in Russia

An American band-saw manufacturer urges the possibility of selling band-sawing machinery in Russia to the displacement of the frame saws now generally used in that country.

There is no doubt of the advantage of the American band-saw mill in output, but the frame saw, which can be operated by comparatively unskilled labor, is already a standard type in Russian sawmills. Band saws can be sold there only where foreign superintendents can be had to train the workmen. Undoubtedly sawmills will be installed by foreign capital and managed by Americans who are capable of getting results out of band-saw mill machinery, but the bulk of the business will likely be supplied by frame saws of the Swedish type should American manufacturers undertake to compete for the Russian market by supplying frame saws of the type generally used in Russia. In this way a share of the present business probably could be secured.

Personals

WILLIAM J. PURDY, formerly with the Hoe Printing Press Co., has been made assistant manager of the Wood Printing Machine Co., Plainfield, N. J.

THOMAS W. PANGBORN, president of the Pangborn Corporation, Hagerstown, Md., has been elected a director of the Maryland Surety and Trust Co. of the same city.

ALONZO WHITCOMB, who for four years has had charge of the engineering department of the Heald Machine Co., Worcester, Mass., is now shop superintendent.

J. ARTHUR DEAKIN, formerly American representative of H. W. Ward & Co., Ltd., Birmingham, England, has become New York manager of E. Isbecque & Co., 15 Park Row, New York.

E. R. ABBOTT has been discharged as captain from the Chemical Warfare Service of the United States Army and is now sales manager of the Kar Engineering Co., Inc., 79 East 140th St., New York.

S. R. WARNER, formerly in charge of gage production in the Plant Section of the New York District Ordnance office, is now connected with the sales department of Russell, Holbrook & Henderson, Inc., New York.

LEWIS RUSSELL, who has been manager of the plant section of the New York District Ordnance office, has returned to his duties as president of Russell, Holbrook & Henderson, Inc., 30 Church St., New York.

E. ERICKSEN, formerly manager of the Allied Machinery Co. in Russia, has become associated with the Youroveta Home and Foreign Trade Co., Inc., of which A. Peskine is manager of the machine-tool department.

MAJ. MASON P. RUMNEY will be out of the service about Feb. 15 and will return to the Detroit Steel Products Co. as assistant general manager. He has been located in Washington with the Ordnance Department.

L. P. PROSSEN, who was mechanical superintendent of the Black and White Taxicab Co., New York, has been made vice president of the Nilson-Miller Co., Hoboken, N. J. He will be in charge of the gear-cutting, piston and piston-ring departments.

L. M. BAKER has been made special sales engineer of the Hyatt Roller Bearing Co., Detroit. At one time he was sales manager of the United Motors Service, Inc., and previous to that was Western sales manager of the Standard Steel Spring Co., Detroit.

K. K. HOAGG has been appointed engineer in the sales department of the Hyatt Roller Bearing Co., Detroit. Mr. Hoagg, who has been connected with the company since 1912, left his position as assistant chief engineer to go into Government service.

WILLIAM B. PATTERSON, president of the Patterson Tool and Supply Co., Dayton, Ohio, has been appointed special representative in Italy and Switzerland of the Monarch Machine Tool Co., Sidney, Ohio. He will, however, retain his position and interests in the corporation of which he is president.

ROBERT S. ALTER, vice president and foreign manager of the American Tool Works, Cincinnati, and president of the Foreign Trade Association of the Chamber of Commerce, has been elected to the board of directors of the Mississippi Valley Foreign Trade Association, an organization which was launched recently at New Orleans, and which brought together practically all the live wires of the export trade in the Middle West.

L. S. DEVOS has recently been appointed general manager of the machinery department of the American Machinery Syndicate, 35 West 39th St., New York. From October, 1917, to the latter part of December, 1918, Mr. Devos was the Chief of the Inspection Department of the United States Air Service, with offices in Paris. Previous to his entry into the United States Army, he was the New York representative of the Selson Engineering Co., Ltd., London.

Obituary

THOMAS F. HART, widely known as a manufacturer of shoemaking machinery, died on Jan. 22, 1919, at his home, in Lynn, Mass.

ELMER L. EWING, secretary and acting treasurer of the Sharples Separator Co., died of pneumonia at his home in West Chester, Penn., on Jan. 29, 1919.

WILLIAM J. SELLERS BANCROFT, a noted inventor, and founder of the firm of Bancroft & Sellers, died Jan. 29, 1919, at his home, in Philadelphia, Penn. He was 76 years old.

Trade Catalogs

Steelcrete Machine Guards. Expanded Metal Engineering Co., 8 West 40th St., New York. Booklet. Pp. 40; 3½ x 6¼ in. This booklet describes Steelcrete mesh, giving sizes and various uses, also Steelcrete machine guards and partitions with their specifications.

Ladew Leather Belting. Edward R. Ladew Co., Inc., Glen Cove, N. Y. Catalog. Pp. 104; 6 x 9 in. The first part of this book gives a discussion of belt engineering and belting economics. Following this are several fully illustrated pages describing just how Ladew belts are made. Price lists and specification tables are also given.

The Design and Test of Standards of Mass. Bureau of Standards, Washington, D. C. Circular No. 3. Pp. 90; 7 x 10 in. This circular treats of the types of weights used as standards of mass and of their design, test and adjustment. Information is given relating to the manner of using weights, and complete routine for their verification, test and intercomparison is developed. Those interested may obtain a copy by addressing a request to the Bureau of Standards, Department of Commerce, Washington, D. C.

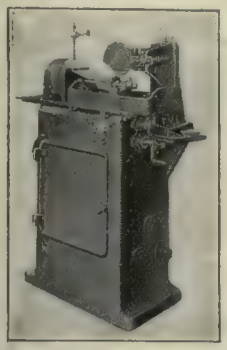
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Automatic Universal, for Hobs and Form Cutters, No. 4

Harris Engineering Co., 1047 Broad St., Bridgeport, Conn.

"American Machinist," Jan. 28, 1919

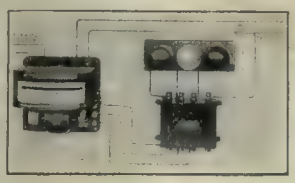


It is claimed that hob-grinding work may be done on this machine with lower-priced labor than is ordinarily used for this purpose and the points of advantage of the machine cited are as follows: Hobs and form cutters can be accurately and evenly ground. The amount of material ground away at each stroke of the machine is a minimum and therefore crowding and its attendant heating and burning are avoided. Flood lubrication is used, avoiding overheating. The speed at which the hob or form cutter is fed to the grinding wheel is constant and an experienced operator is not required, and the machine being automatic in action the operator can run it in connection with other work. Setting up is simple, avoiding the use of hobs or form cutters until dull. It may be used to salvage milling cutters by regashing the teeth and to grind form cutters or hobs within range.

Pyrometers, Automatic Signaling

Brown Instrument Co., Philadelphia, Penn.

"American Machinist," Jan. 23, 1919

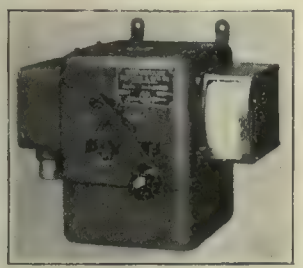


This device is for the automatic operation of the three signal lights generally used at furnaces to indicate to the operator whether the temperature is too high, too low or correct. The contacts in the instrument are made once a minute and an automatic three-position relay keeps the proper light burning until the next contact is made. In case it is desired to read the temperature of other thermocouples besides the one being automatically signaled a hand-operated switch may be installed. By introducing an automatic motor- or clock-driven switch the temperature of practically any number of thermocouples can be automatically signaled by one instrument. An automatic advancing mechanism for the contacts is also provided by means of which the signal lights may be controlled to indicate a temperature advancing at a predetermined rate.

Switch, Quick-Make Motor-Starting

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," Jan. 23, 1919

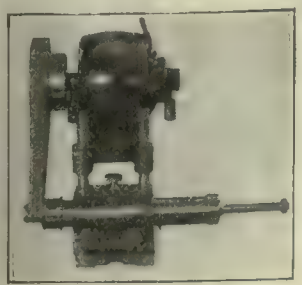


The characteristics of this quick-make motor-starting switch are 10 to 100 amp., 25-hp. maximum, three-phase, 220, 440 and 550 volts. The device may also be used to control feeder circuits and is supplied in any of the following combinations, each having the quick-make and quick-break feature for either hand or shipper-rod operations: Nonautomatic switch, switch with low-voltage protection, switch with inverse time element overload protection, and full automatic switch with low-voltage and inverse time element overload protection. It is said that the switch is particularly suitable for shipper-rod operation on account of its positive action, it being impossible for the operator to retard the motion of the contacts after they have started to close.

Grinding Attachment

Saphil Manufacturing Corporation, 149 West Austin Ave., Chicago, Ill.

"American Machinist," Jan. 30, 1919

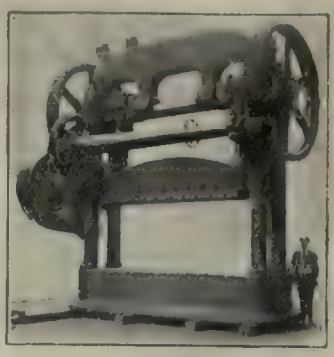


Designed to be placed over the toolpost of a lathe, being held in place by the toolpost screw which is tightened down upon a bar slipped through the hole. An adjustment is provided for raising or lowering the grinding spindle to the necessary position and the motor is supported on two vertical bars, making it possible to raise or lower it to adjust the belt tension. A stand is also furnished as an extra for holding the attachment for grinding milling cutters. Furnished with either a $\frac{1}{10}$ hp., 110-volt, direct-current, compound-wound, 3500-r.p.m. motor, or a 110-volt, alternating-current, single-phase, 60-cycle motor operating at 3400 r.p.m. It can also be equipped with a $\frac{1}{4}$ hp., 110- or 220-volt motor if this is desired. Weight complete, 26 pounds.

Press, 500-Ton Type S-507

Ferracute Machine Co., Bridgeton, N. J.

"American Machinist," Jan. 30, 1919

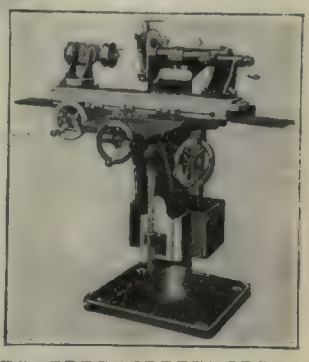


Designed for pressures up to 500 tons. Tensile stresses are taken by four 5½-in. steel rods shrunk in cast-iron columns. Vertical motion of ram, 18 in.; strokes of ram, about 5 or 6 per minute; distance between columns from right to left, 148 in.; distance from bed to ram at top of stroke and adjustment, 60 in. Power is applied through a combined friction clutch and brake, giving one operator complete control of the action. Attention is called to the tapered back shaft, which is used to equalize the torsion, so that both the large gears will be driven with equal tangential pressure on the teeth. The weight of the press is approximately 137,000 pounds.

Grinding Machine, Universal, "Connecticut"

Middlesex Machine Co., Middletown, Conn.

"American Machinist," Jan. 30, 1919



The illustration shows the machine as a universal grinding machine, but the head can be swung around at right angles to the travel of the table for surface grinding. Diameter of spindle, 1½ in.; length of front bearing, 4½ in.; length of rear bearing, 3½ in.; longitudinal movement of table, 19 in.; vertical movement of table, 13 in.; transverse movement of table, 8½ in.; capacity for work on centers, 12 in. in diameter, 24 in. long; working surface of table, 5⅞ x 34 in.; maximum distance from spindle to table, 9 in.; diameter of column, 7 in.; diameter of chuck, 4 in.; taper in headstock, No. 10 B. & S.; taper of dead center, No. 6 Jarno; weight, 1700 pounds.

Truck, "Jacklift," Type G, Elevating

Louis Sheppard Co., 48 Binford St., Boston, Mass.

"American Machinist," Jan. 30, 1919



The particular feature of the truck is that the load may be elevated 6 in., and it is claimed that it is the only elevating truck in the market that lifts the load over 3½ in. It is also claimed that the 6-in. lift is handy where the load must be trucked over steep inclines and that it may be used to great advantage in taking battery cradles, with the battery intact, from an electric truck. Contains the usual features of the "Jacklift" line, which are easy lift, vertical lift and free lifting handle. This truck is made in 10 models and five different lengths. Each may be equipped with either 8- or 10-in. wheels as desired.

Gear-Hobbing Machine, No. 48

Jones Superior Machine Co., Chicago, Ill.

"American Machinist," Feb. 6, 1919



Rated size; to cut gears 48 in. diameter by 20 in. face; actual capacity, 72 in. maximum and 10 in. minimum diameter; weight, 14,200 lb.; floor space 121 in. long by 64 in. wide; base, 14 ft. 2 in. long by 36 in. wide; total height, 80 in.; table diameter, 45 in.; standard work arbor, 2⅜ in. diameter and 18 in. long; standard hob arbors, 1¼ in. and 1½ in. diameter; countershaft speed, 350 r.p.m.; countershaft pulley, diameter 16 in., 4½ in. face; cone-pulley diameters 16, 14⅜, 13½ and 12¼ in. by 4½ in. face; spindle speeds using back gears, 38 to 115 r.p.m.; table feeds, 0.005 to 0.060 in. per table revolution; head feeds, 0.010 to 0.120 in. per table revolution.

Patented Aug. 20, 1918

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$35.85	$37.60
Northern Basic	31.80	34.80
Southern Ohio No. 2	32.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	39.55
Southern No. 2 (silican 2.25 to 2.75)	39.95	.....
BIRMINGHAM		
No. 2 Foundry	31.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	39.15*
Virginia No. 2	38.10†	40.50†
Basic	33.90*	36.90*
Grey Forge	33.90*	36.90*
Bessemer	.....	39.10*
CHICAGO		
No. 2 Foundry Local	31.00	34.50
No. 2 Foundry Southern	37.20	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	35.40
Basic	30.00	34.40
Bessemer	32.20	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For $\frac{3}{16}$-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.22	6.445	5.75	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.12	6.405	5.65	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.07	6.295	5.60	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.02	6.245	5.50	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.37	5.645	4.96	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.27	5.545	4.85	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.17	5.445	4.75	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.57	7.695	7.15	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.27	7.395	6.85	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.12	7.245	6.70	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
$\frac{3}{8}$, $\frac{11}{32}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{7}{32}$, $\frac{9}{16}$ No. 8, $\frac{5}{32}$ and No. 10	25.50 to 33.00	$\frac{3}{8}$ by 12 in. long	14.00
		$\frac{1}{4}$ by 19 in. long	12.00
$\frac{1}{8}$ No. 12		$\frac{5}{32}$ by 19 in. long	10.00
$\frac{3}{32}$, No. 14 and $\frac{1}{16}$ No. 18		$\frac{1}{8}$ by 21 in. long	10.00
No. 20		Special Welding Wire, Coated	
		$\frac{1}{4}$	33.00
		$\frac{5}{32}$	30.00
		$\frac{3}{16}$	38.00

Domestic 20c. for $\frac{1}{16}$, 15c. for $\frac{1}{4}$ to $\frac{5}{16}$.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
$\frac{1}{8}$, $\frac{1}{4}$, and $\frac{3}{8}$	47%	20½%	¾ to 1½	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

$\frac{1}{8}$, $\frac{1}{4}$ and $\frac{3}{8}$	43%	25½%	¾ to 1½	36%	21%
½	48%	35½%			
¾ to 1½	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	29%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	18.50	21.00	23.50
Tin in 5-ton lots	72.50	72.00	85.00
Lead	5.00	5.75	7.00
Spelter	6.60	7.85	7 87½
ST. LOUIS			
Lead	4.65	5.45	6.85
Spelter	6.25	7.50	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

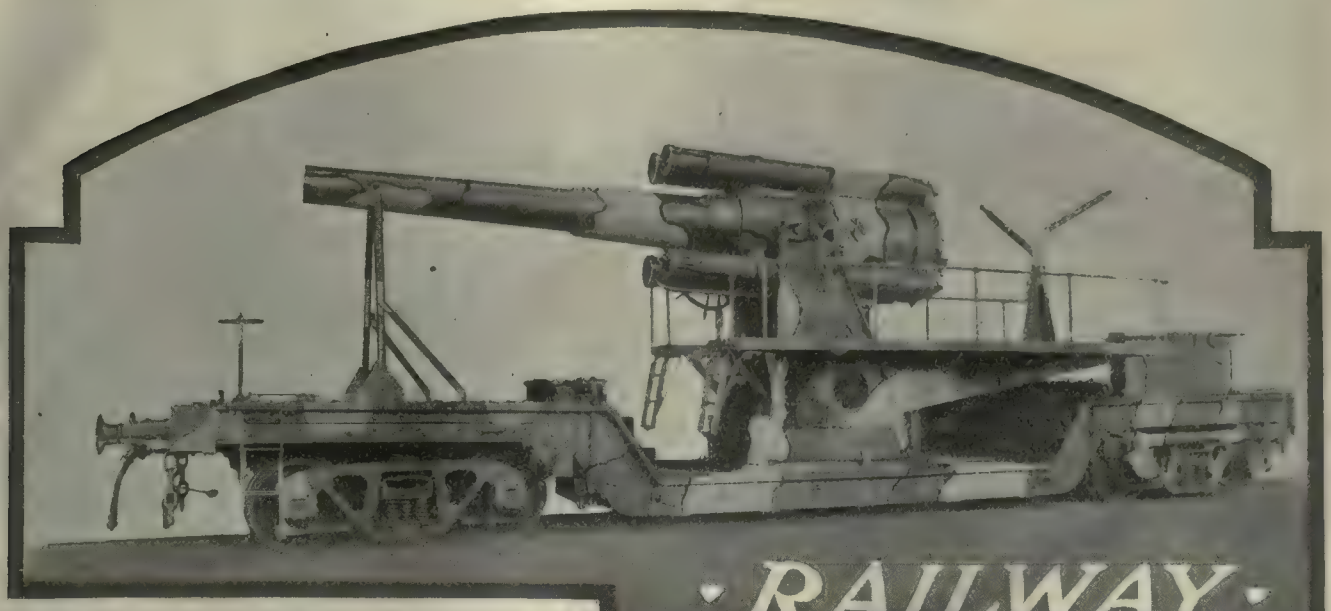
	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	29.00	35.00	31–33.50	30.00	32.50	32.00	36.00
Copper wire (carload lots)	28.00	32.00	32.00	32.00	28.50	28.50	34.50
Brass sheets	29.00	36.75	32.00	32.00	29.00	29.00	35.50
Brass pipe	37.00	40.00	36.50	38.00	36.50	37.00	41.50
Solder (half and half) (case lots)	41.00	55.00	43.00	44.00	47.00	39.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$22.76	$25.25
New York	26.28	27.25
Cleveland	30.00	34.00
Chicago	28.50	37.00

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RAILWAY GUN MOUNTS

By LIEUT. COL. C. M. BARNES
ORDNANCE DEPARTMENT, U. S. A.

Only the sudden ending of the war prevented the railway-mounted gun from playing a tremendous part in crushing the resistance of the enemy, as preparation had been made for the construction of a larger number of huge guns than had ever been dreamed of before. The railway-gun mount provides the solution of mobile offense or defense and it can be used equally well along our coast.

WHILE the use of railway-gun mounts dates back to the Civil War they have been developed to an astonishing degree during the past four years and would have played a very important part in the closing chapters of the European War had it continued another six months. The first gun mounts of which we have record were used in 1863 both by the Union and the Confederate armies. They ranged from a 32-pounder, which was about a 4-in. gun, to a 13-in. mortar weighing about 17,000 lb. Twenty years later Gen. Joseph L. Brent, formerly of the Confederate army, who had operated railway guns in the Civil War, interested the French in this idea, which was promoted by General Peigni. General Brent published a book on railway artillery in 1885, in which he foresaw the use of railway artillery for coast defense, its use in special emplacements, the use of special spur tracks and also the armored automobile and the tank, which was lately so successfully utilized. Some idea of the development which has taken place in this connection may be had from the illustrations, which show some of the more striking developments during the past four years and which require little description.



FIG. 1. 8-IN. GUN, RAILWAY MOUNT, AND AMMUNITION CAR

Going back to the 13-in. mortar of 1863, which had a range of 3600 yd. and weighed 35,000 lb., and then coming to the German Krupp mortar, which was used on the forts of Namur and Liège, we see an enormous contrast. This was a 420-mm., or about 16½-in., mortar, with a range of nearly 9 miles, a muzzle energy of over 24,000-ft.-tons and a weight of 250,000 lb. Shells from this gun, it is reported, have penetrated 30 ft. of concrete and have blown up forts killing some 1700 people. Since that time muzzle energies have increased to from 30,000 to 60,000 ft.-tons, the weights to from 300,000 to 600,000 lb. and the range from 12 to 30 miles. The Ordnance Department of the United States



FIG. 2. 8-IN. GUN, RAILWAY MOUNT, WITH STRUTS AND BRACES OUT

Army had been working on the problem of mounting big guns on railway trucks before war was declared, and had at that time two types under construction. It had also prepared designs for a third type, which was put into production soon after war was declared. This article is a brief description of the more important types of railway mounts that have been produced by the Ordnance Department.

To Be Manned in France

All of this artillery was to be manned in France by the United States Coast Artillery. It has been common knowledge for some years that the United States Coast Artillery defenses are the best in the world, and the officers and men attached thereto are unequaled as heavy artillerists. Since war was declared these coast artillery officers have had the additional advantage of French training, and taking the best from both the French and our own systems splendid results have been achieved by them. The problems in the design of railway artillery may be divided under two heads—transportation and firing. Under the first come weight and clearance, and under the second the transmission of the shock of discharge to the earth and the steadiness of the gun platform while firing. In the matter of transportation weight is very important, as, on account of the track, the load on the axle is limited by the rail and roadbed, and when the loads even now run up to 300 tons a large number of axles is necessary, which must be obtained by using several trucks equalized with span bolsters so as to distribute the load to all parts of the vehicle and the track which supports it. Clearances, particularly on long guns, must also be determined, for they are an essential matter, large mounts having great distances between truck centers. Some designs necessitate the digging of a large hole into which the gun may recoil, which of course adds to the time necessary to get the gun into operation. The main difficulty comes with very long guns swung at the center of gravity. There are three methods of transmitting the forces to the earth—by friction, as with the sliding type; by allowing the carriage to roll on the rails, as with the English Armstrong and the United States Army ordnance large howitzer of the 1918 pattern, and by the platform mount with struts, all of which are shown in the illustrations.

Mortars, Howitzers and Rifles

The types of guns used on railway artillery are mortars, howitzers and rifles. Each type has certain tactical uses and the different types cannot be used interchangeably. Mortars are usually from 9 to 12 calibers long and are used for a plunging fire, the projectile going high in the air and dropping on its objective. They have comparatively short range.

Howitzers vary from 15 to 20 calibers in length and have a small range as compared with the longer rifled guns. They throw large charges and have a long life, which are advantages. They are used for destroying fortifications and deep underground chambers.

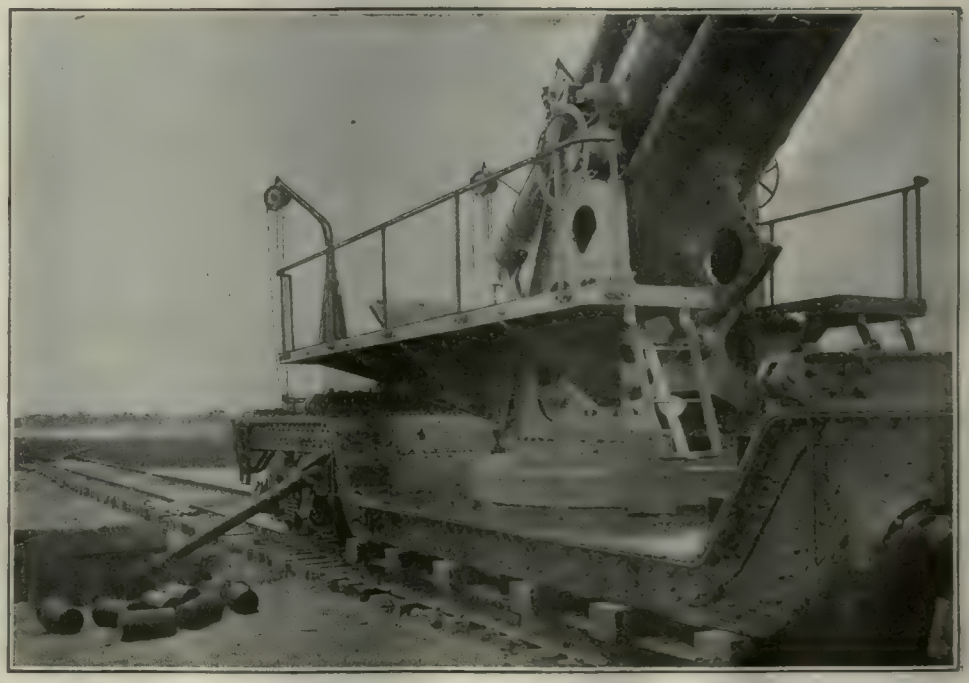


FIG. 3. 8-IN. RAILWAY GUN, TRACK ARRANGEMENT

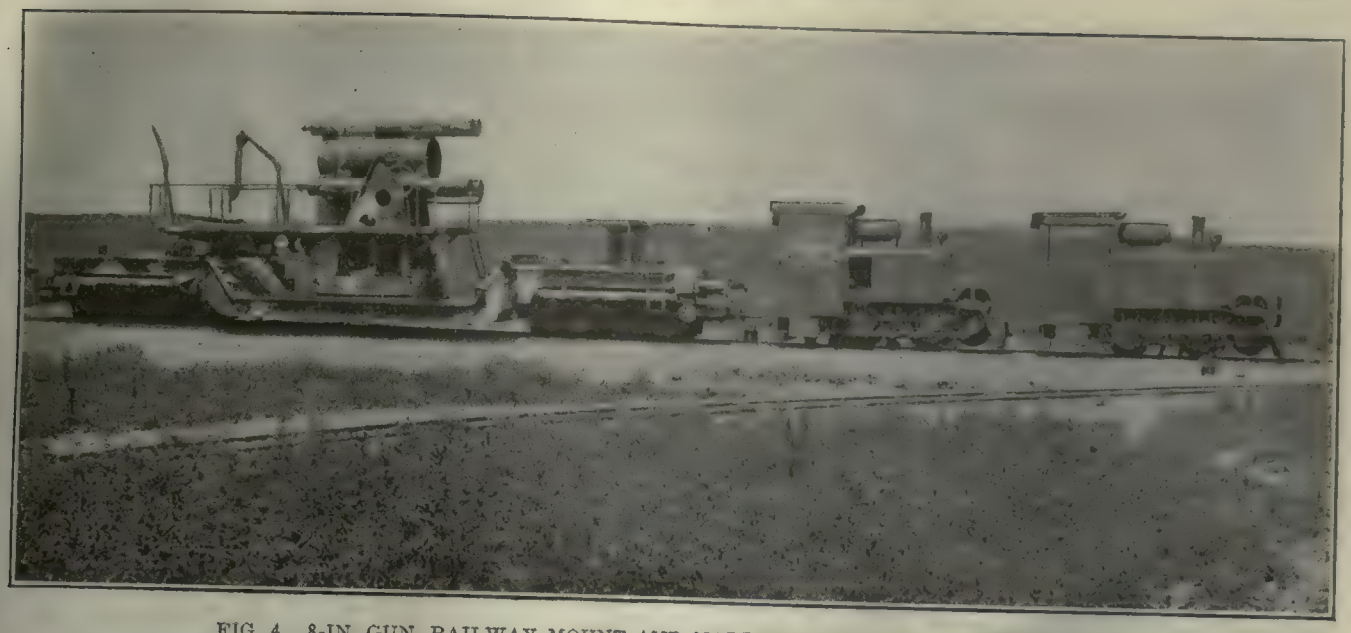


FIG. 4. 8-IN. GUN, RAILWAY MOUNT AND NARROW-GAGE AND 12-WHEEL TRUCKS

Rifles which have a long range vary from 30 to 50 calibers in length as a rule, although very long-range guns have a much longer barrel. These are sometimes figured up to 160 calibers in length for extreme ranges. These guns are used for direct and indirect fire and have a considerably shorter life than the howitzers or mortars.

Can Be Moved by Train

Take as an example the case of the 8-in. gun as being typical and also because it has been developed to quite a remarkable degree in that it can be put in position anywhere along a railway track in 15 min. and can be fired through an arc of 360 deg. traverse. The mount can be removed from its position in the same time. It can be moved in a train at 40 miles an hour, and can be operated over any standard-gage railway line in the United States, France, Germany or England.

This mounting, Fig. 1, was developed by the Ordnance Department, United States Army, and is the only mount of this type in existence. The car serves as a firing platform for the gun and also as a transport vehicle for the gun, gun carriage, outrigger float and foot plate, cross-ties and H-beams of the ground platform, the loading box and chest.

Jacks and Outriggers

This car consists of a drop-frame type of car body built up of structural-steel plates and shapes and mounted on standard four-wheel railway trucks. It is equipped with four screw jacks and six outriggers with wooden floats, the location of these being shown in Fig. 2. When not in use these wooden floats are held in place on the front end of the car as seen at *A*. By carefully noting the change in track construction under the gun itself, Fig. 3, the use of the cross-ties and the H-beams will be clearly seen. The cross-ties are inserted between the top of the H-rail and the bottom of the



FIG. 5. 8-IN. GUN, NARROW-GAGE, WITH GUN-TRANSPORTATION CAR

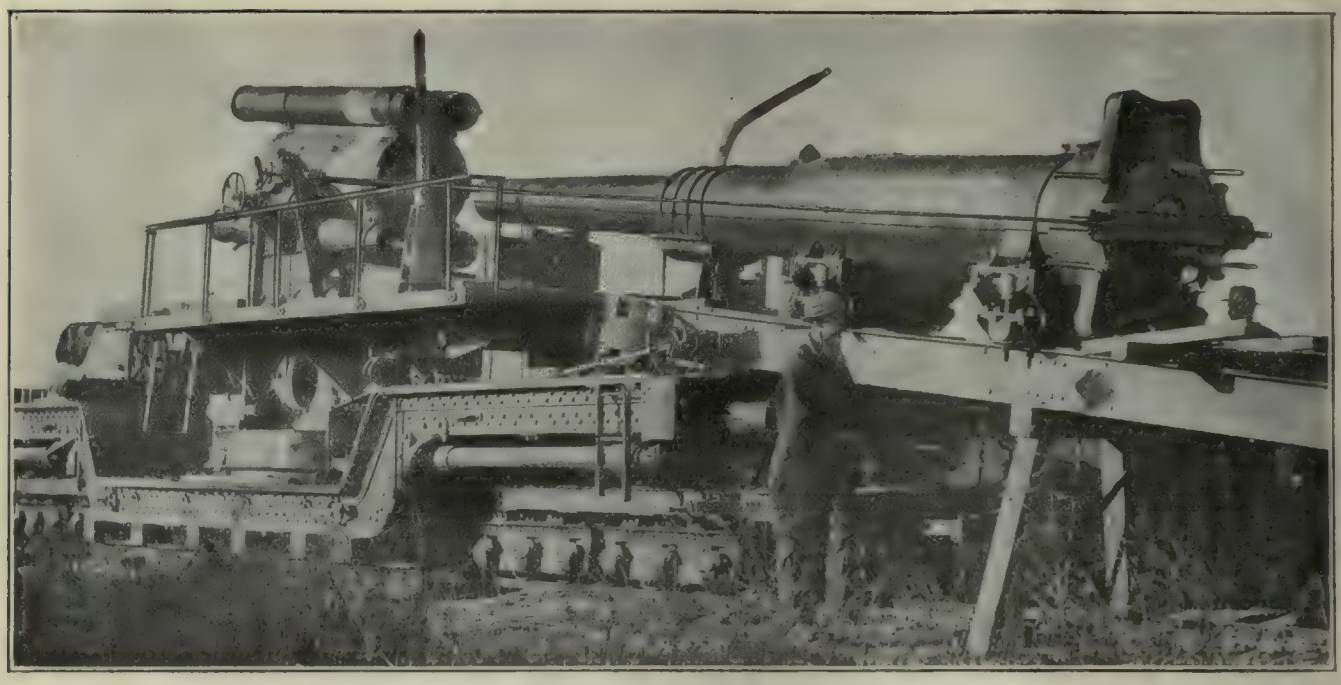


FIG. 6. 8-IN. NARROW GAGE WITH INCLINED BRACES

central portion of the car body, screw jacks being used to make it easy to slip these ties into place so that they can relieve the truck of a portion of the load due to the recoil and shock of firing.

Much of the track near the front is 60-cm. gage (about 24 in.), so that it becomes necessary to remove the standard trucks and substitute 12-wheel trucks at each end, as shown in Fig. 4. This also necessitates removing the gun from its mount during transportation on account of its being top heavy on a narrow-gage car. Several experienced railway engineers declared that it would be impossible to transport such a heavy load on poorly laid narrow-gage track of the type used abroad. Trial has shown that it is not only possible, but that the same can be moved over any piece of track over which a locomotive can be run. Speeds up to 15 miles an hour are feasible. Fig. 5 shows the method of dismounting the gun by means of an inclined railway of H-rails. This shows how the gun is slid down the inclined railway onto the narrow gage car which is placed behind the regular car. The upper portion of this view shows the standard-gage battery train with the gun mounted in its regular position. Fig. 6 shows in detail how the gun is removed from its mount.

Remounting the Guns

Before using the gun it must be remounted on its regular car, which has previously been properly supported by means of the H-rails on the side. These H-rails must be firmly supported at the side of the narrow-gage track and the gun is then remounted in its proper position in the carriage.

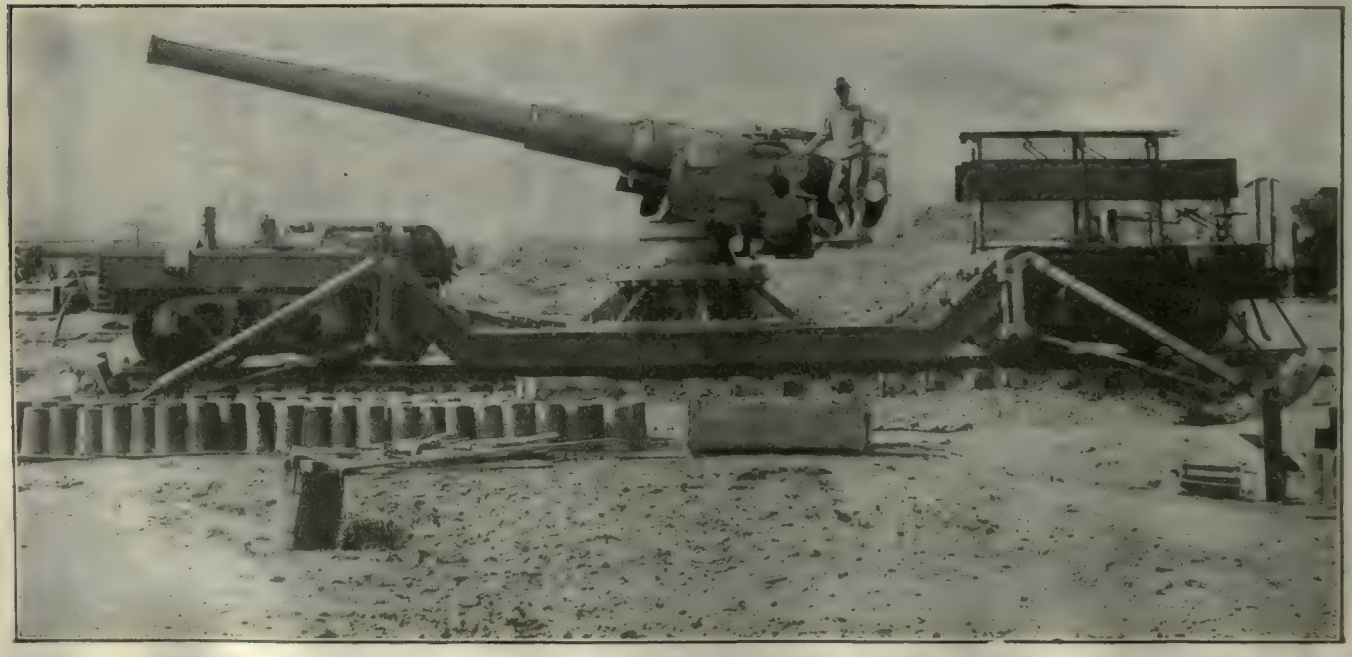


FIG. 7. 7-IN. NAVY GUN, RAILWAY MOUNT

An overhead runway in the ammunition cars is equipped with a trolley carrying a 2-ton Yale triplex chain hoist and shell tongs, and retainers are provided to prevent the shells rolling around in the car while being transported. The difference between the standard and narrow gage ammunition cars is that the latter necessitate an entirely different arrangement for locating the ammunition. The powder for guns of this size is carried in bags or containers and these stacked in a somewhat similar manner to the shells in the cars of the two types.

Fig. 7 shows a 7-in. navy gun mounted on a carriage similar to the 8-in. gun shown in Fig. 1.



FIG. 8. 12-IN. SLIDING MOUNT

The Sliding Railway-Gun Mount

The designing and manufacturing of railway-gun mounts have not however been confined to the 8-in. gun, but include 12 and 16 in. guns. Fig. 8 shows a powerful long-range weapon mounted on a railway mount known as the sliding type. The entire mount is about 125 ft. long and carried on 32 wheels. This includes the crane for handling the ammunition and it is so designed as to meet railroad clearances and to go round a curve of less than 90 meters radius. The total weight of this mount, including the trucks and the gun, is approximately 575,000 lb., the total weight being distributed over a wheelbase of 92 ft. 2 in. This mount supports the gun both for transportation and firing on standard-gage railway tracks.

Interesting and Unlike Other Types

This mount is especially interesting in that unlike all other types of mounts it has no recoil mechanism. The fact is that the whole mount acts as the recoil brake, the energy of recoil being absorbed in friction produced by the sliding of the mount along the special track which supports it. The mount recoils about 15 ft. It is returned after each shot to its original position by the use of a gasoline-power winch and a special hand device which permits the mount to be moved slowly along the track. The principal parts of the mount are the car body, the span bolsters, the trucks, translating mechanism, the bearing stringers and sleepers, the lifting wedges, the elevating mechanism and the panoramic sight with its telescope and elevation quadrant. The car body consists of two heavy box girders which support the gun on its trunnions at approximately the center of the girders. These trunnions are carried in special castings placed on the upper plates of the girders and the gun swings between them to secure its elevation.

The gun is mounted rigidly in the car body, and as stated above has no recoil mechanism of any kind, the recoil energy being absorbed through sleepers under the car body which bear on special stringers. These sleepers consist of wooden beams which extend lengthwise under the car body, the bearing stringers being steel beams laid on ties parallel to the rails. The lifting wedges control the contact between the sleepers and the bearing stringers. The general appearance of this mount is shown in Fig. 8.

Bearing Stringers and Sleepers

The tremendous amount of energy which must be absorbed in the recoil of the gun makes the construction of the bearing stringers and sleepers of particular interest. These stringers are made up of eight lines of 12-in. steel beams weighing 55 lb. to the foot. These beams are bolted together in pairs with bolts and separators and are 6½ in. apart center to center. All sec-

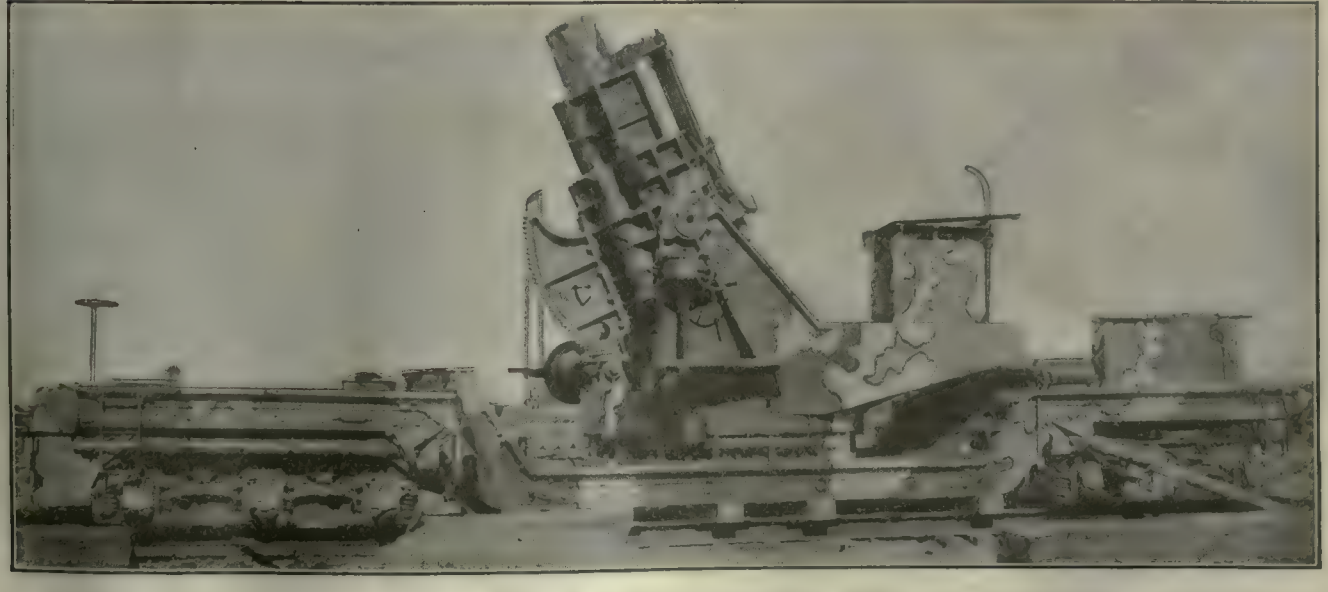


FIG. 9. 12-IN. MORTAR, RAILWAY MOUNT

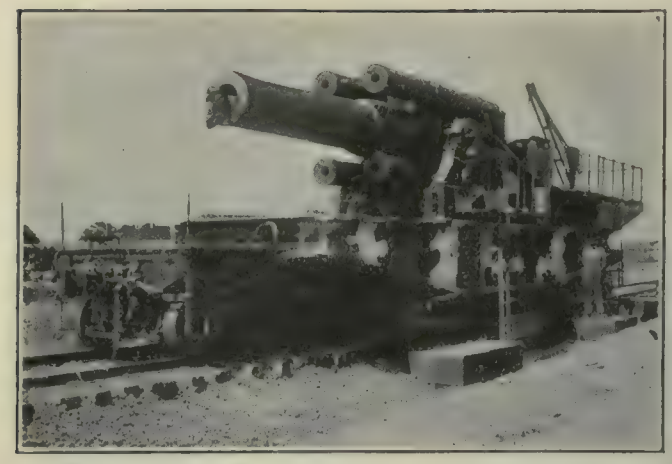


FIG. 10. 16-IN. HOWITZER RAILWAY MOUNT



FIG. 11. 16-IN. HOWITZER, SHOWING LOADING PLATFORM

tions are made alike and are laid end to end, being bolted together.

There is a shuttle, or handling, car between the ammunition car and the end of the railway mount proper. The ammunition is run out from the ammunition car by means of a beam trolley placed on the shuttle car and handled from here to the runway by which it is conducted to the breech of the gun itself.

Mortar Railway Mount

A huge mortar mounted on a railway truck is shown in Fig. 9. This weapon is without doubt more important from the standpoint of winning a battle than the large gun mounts. Such a mortar will throw a huge shell more than 10 miles. It can be transported on narrow-gage tracks (24-in. gage) and thus brought close to the front. It is used where high plunging fire is necessary to dig the enemy out of his concrete dugouts and fortifications.

The Recoil Mechanism

The recoil mechanism of this mortar carriage is interesting in that compressed air is used. When the gun recoils the air in the cylinders is compressed, and this compressed air in turn lifts the gun back into the firing or original position. Part of the energy of the recoil is thus made to do useful work. The maximum air-pressure obtained is about 3000 lb. per square inch. The gun can be traversed through 360 deg. on its carriage, the weights being carried on conical rollers. One man exerting a force of 20 lb. can easily turn the mount. The gun can be fired at all angles with the track, the car being held in position by means of the outriggers and floats as shown.

In Fig. 10 is the huge 16-in. howitzer developed by the United States Army Ordnance Department. This is the most powerful howitzer known. It illustrates an important type in that it is possible to fire it direct from a standard-gage track. The energy of recoil is absorbed in the recoil mechanism and also in moving the gun backward along the track. This howitzer can be fired up to angles of 65 deg. It recoils about 30 ft. along the track each shot. It is returned to its original position by means of a gasoline winch located at the front end. A special rail clamp is attached to the rail. The gun can be traversed 10 deg. in azimuth by the sliding of the top carriage over the car. Additional changes in azimuth are obtained by use of a curved track.

A platform shown in Fig. 11 is also provided for this mount, so that if time permits the howitzer can be emplaced so that it is rigidly held during firing. The platform takes the vertical and horizontal loads. The vertical load is transmitted to the platform through

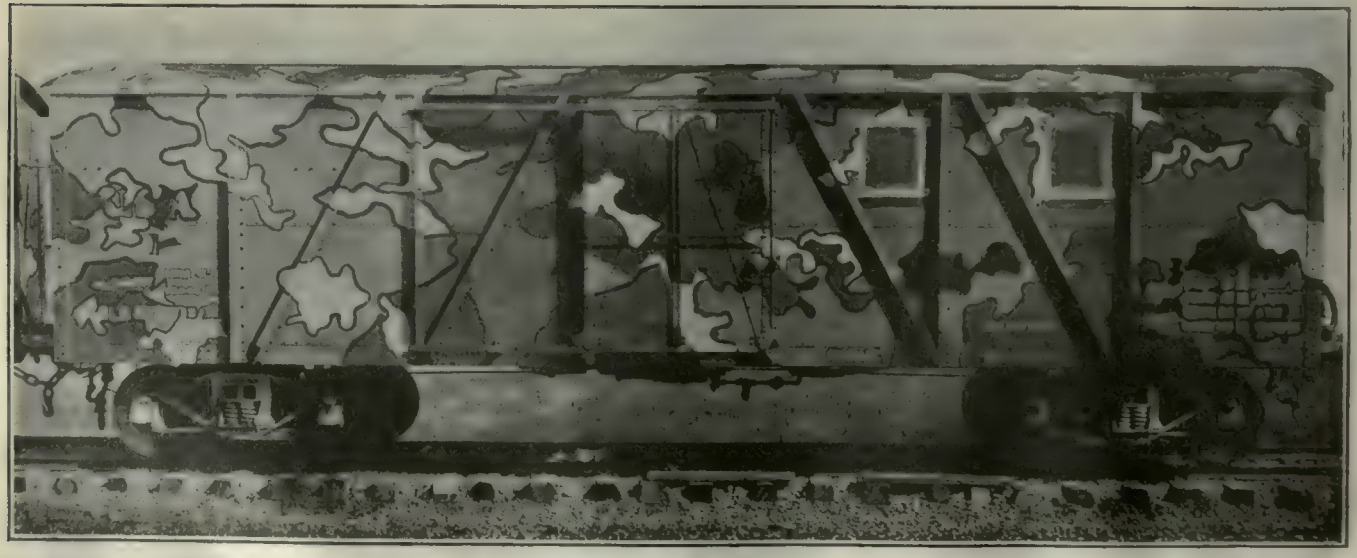


FIG. 12. AMMUNITION CAR, STANDARD GAGE

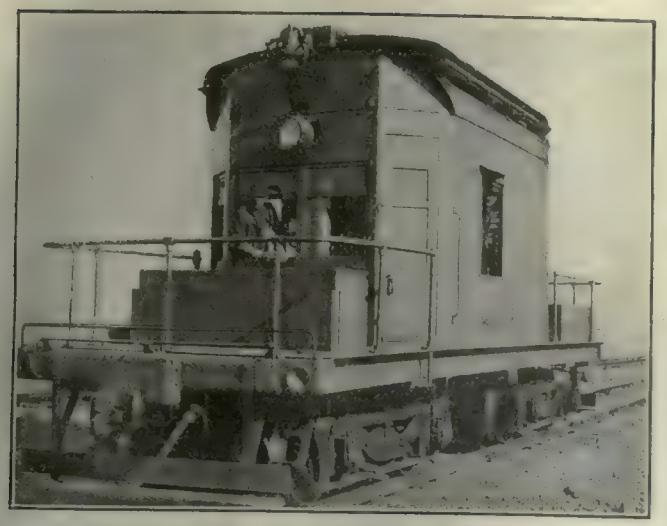


FIG. 13. 400-HP. LOCOMOTIVE

four screw jacks which relieve the trucks of a portion of the dead load. The horizontal force is transmitted to the platform by means of two struts as shown. The howitzer, which weighs nearly 300,000 lb., can be elevated by one man to 65 deg. in 40 seconds.

The Ammunition for Large Guns

This gun uses separate loading ammunition, the projectile being a high-explosive common steel shell with a base fuse. This is issued completely filled and with the fuse in place. The components of each round are the primer, the propelling charge and the filled and fused projectile. The primer is what is known as the friction primer, model 1914, consisting of a Tobin-bronze body resembling a small-arms cartridge case. The cartridge, or propelling charge, consists for the maximum charge of two sections or bags of nitro-cellulose smokeless powder, a base section and one smaller increment section corresponding to the different muzzle velocities and marked accordingly.

The entire charge is 14 in. in diameter and 74 in. long, the base being 52 in. long, and the increment 22 in. long. The bags are made of the usual cartridge cloth tied together for easy handling. The igniting charge consists of 100 oz. of black powder distributed in three portions of 10 oz., 63 oz. and 27 oz. respectively. The exact weight of powder charge varies slightly with each lot, which gives the standard muzzle velocity for that particular powder. This car is shown in Fig. 12. The windows are camouflage, as an ammunition car has no windows.

The projectiles are thin walled and carry large bursting charges in order that the shell may do the maximum damage possible.

Figs. 13 and 14 show two types of locomotives used in connection with railway-gun mounts. Fig. 13 is 400 hp. and Fig. 14 150 horsepower.



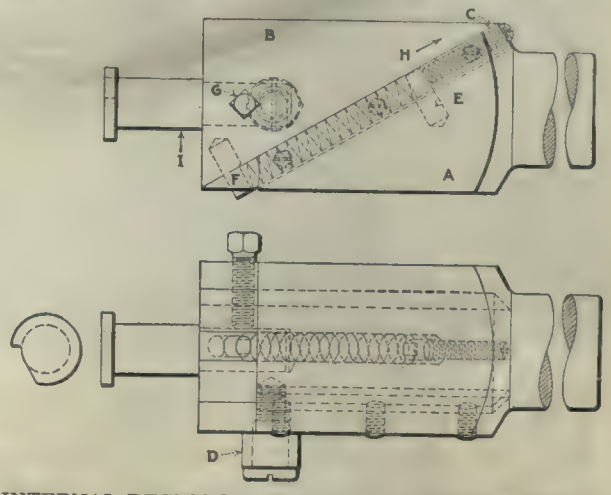
FIG. 14. 150-HP. LOCOMOTIVE

Special Internal Recessing Tool

By William King

An internal recessing tool is shown in the sketch. It is for use on turret lathes and automatic and semi-automatic screw machines and can be used without any change on the regular cams that accompany the last two types of machine.

Body *A* is made of mild steel with shank to suit the machine or holder to which the tool is attached. The face is cut at 30 deg. and dovetailed. *B* is made of mild steel and slides in dovetail in *A*.



INTERNAL RECESSING TOOL FOR TURRET LATHE OR SCREW MACHINE

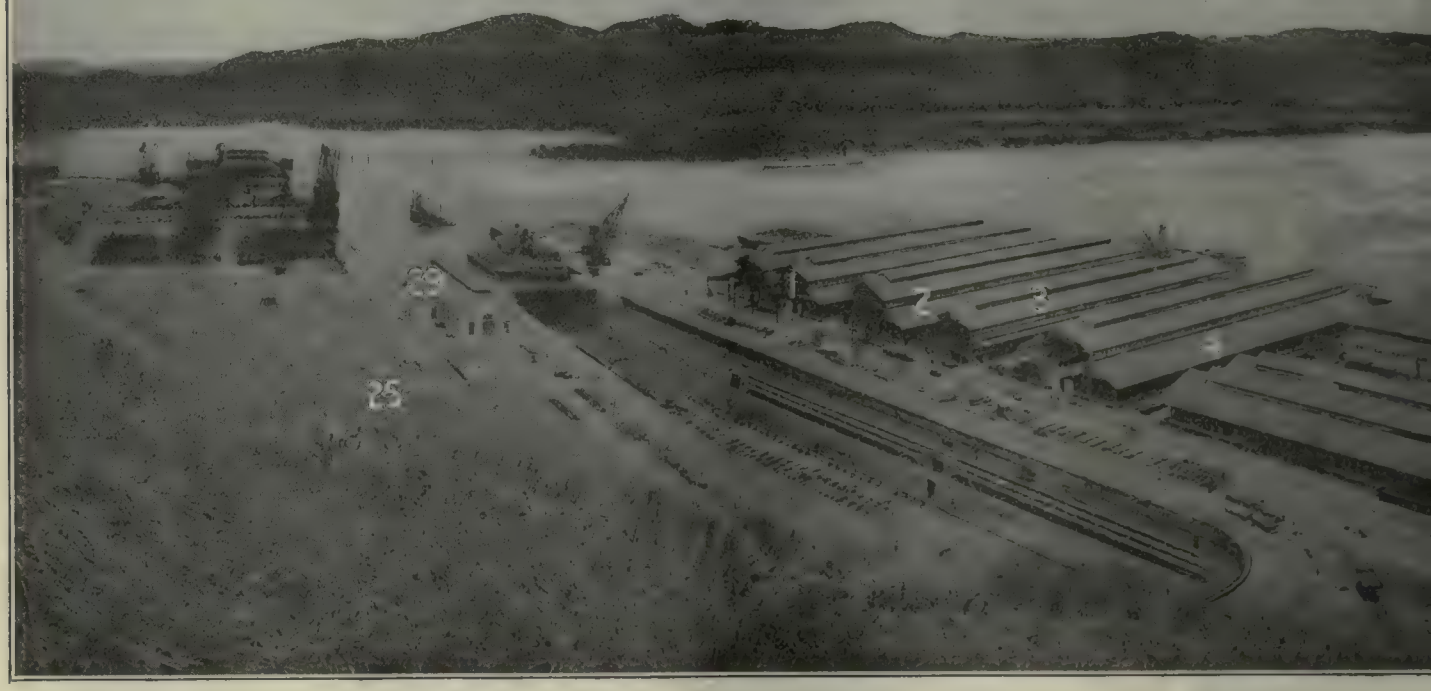
In the dovetailed face of *B* is end milled a $\frac{1}{2}$-in. slot $\frac{1}{2}$ in. deep from the front face to within $1\frac{1}{4}$ in. of the rear end. At point *C* a $\frac{5}{16}$-in. hole is tapped into the slot for an adjusting screw. In this slot is a stiff spring compressed between the pins *E* and *F*, which are flattened where they touch the spring. When the turret comes up roller *D* comes against a block which is attached to the top of the cross-slide forcing *B* along *A* in the direction of arrow *H* until the cutter has moved in the direction of arrow *I* to the proper depth. When the turret starts to return, the spring compressed between the two pins *E* and *F* expands and forces *B* back along *A* until stopped by the adjusting screw *C*.

The function of *C* is to prevent *B* being forced back to bring the recessing tool against the back of the hole, which may occur on small work.

The hole *G* is reamed to suit the tool and is set below center to allow the use of a formed tool of the circular type. The slide is kept tight with a gib. This has been used on Potter & Johnson lathes and has proved highly successful. It was made to cut on the back but works equally well cutting on the front with but slight changes. It can readily be adapted to other jobs.

OUR CANAL-ZONE DRY

By R. D. Gatewood
MECHANICAL SUPERINTENDENT



Our $375,000,000 investment in Panama has some and the necessary locks for getting vessels through vessel repairs and in spite of the high rate paid some past year in this connection both as to time and cost plant at Balboa? Is there any reason wh

THE principal repair shops of the Panama Canal are located at Balboa, the Pacific terminal, adjacent to a dredged inner harbor which has an area sufficient to permit access to docks, either completed or in process of construction, which aggregate about 7500 ft. in length. This includes commercial docks, docks intended primarily as repair wharves, and the coaling docks. Smaller shops are located at Cristobal on the old French canal, about three-quarters of a mile from the main commercial docks.

The panoramic view of the plant was taken on Sunday, but it shows the neat, well-kept condition of the plant and yard. These shops are arranged to perform all the locomotive and car work required for railroad equipment belonging to the Panama Canal and the Panama Railroad. The buildings in use for this purpose are located at the eastern end of the shops district, near the main line of the Panama Railroad and away from the repair wharves.

The machine shop, boiler shop and smithy are located with their axes at right angles to the water front and between the docks intended for use as repair wharves and No. 1 drydock. These shops are provided with heavy overhead traveling cranes, which by means of extension runways can be run out over two railroad tracks at either end, thus permitting the most efficient handling of material. There is also a railroad track through the center of the buildings. Ready and efficient access to all parts of the waterfront is available by means of railroad tracks.

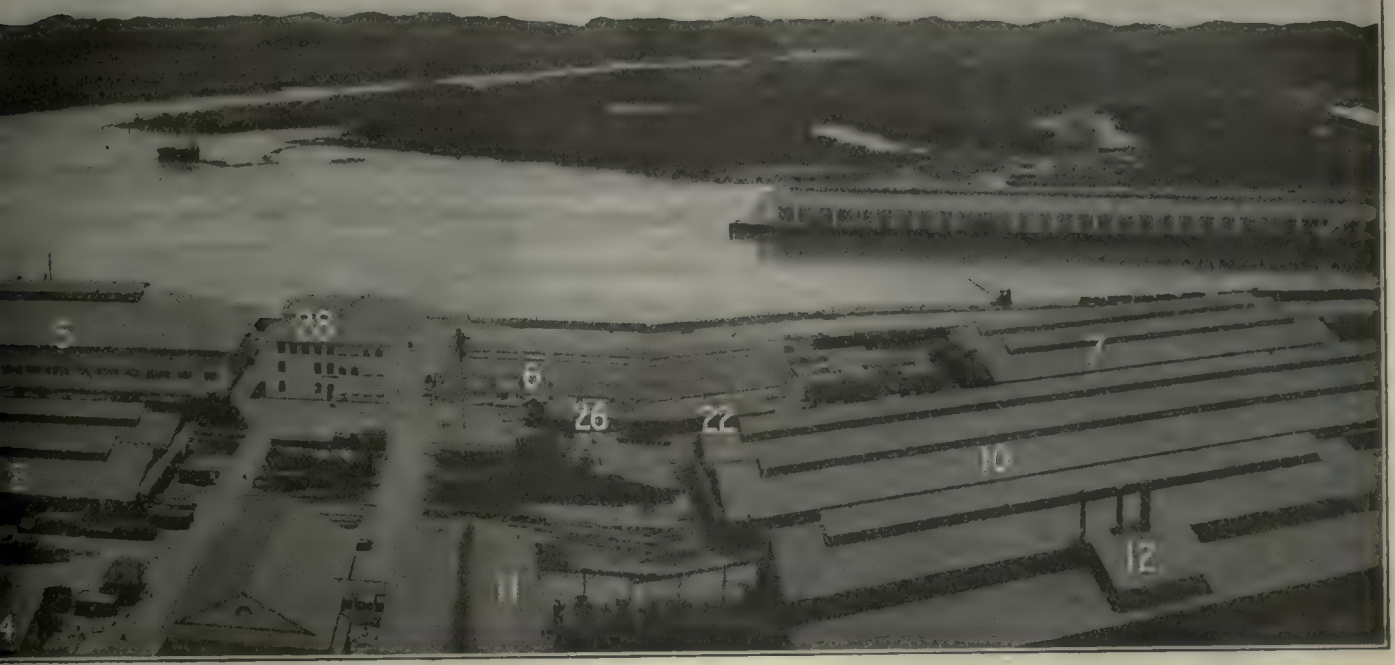
All of the shops are outfitted with tools either recently purchased on the most modern specifications or else lately remodeled and fitted with electric drive in accordance with most recent practice. The machine shop is provided with a vertical boring mill capable of working 18 ft. in diameter, with an open-side extension planing machine 16 x 32 ft., and with lathes, drill presses, shaping machines, presses, etc., such as are usually found in shops intended for marine work. The largest lathe is one of 65 ft. between centers, capable of swinging 156 in. over ways and 115 in. diameter over carriage.

The smithy is provided with a 500-ton steam hydraulic forging press, three steam hammers of about 2500 lb. each, together with smaller hammers, bolt headers, bulldozers, and other tools usually found in a first-class smithy. The forges and furnaces are fitted to use fuel oil exclusively, no coal being burned in the shop or, in fact, anywhere in the plant, except in yard locomotives and locomotive cranes. The tool-dressing establishment includes calcium-chloride tempering furnaces of the latest type, and there is a department for spring making and for car work.

DOCKS *and* REPAIR SHOPS

Naval Constructor

OF CANAL-ZONE



ing more to show in the way of assets than a ditch . There are unexcelled facilities for handling ery enviable records have been made during the ow many of us realize the size or capacity of our cannot become increasingly valuable?

The pipe shop is outfitted for plumbing work and for pipe, copper and sheet-metal work of the highest classes and largest sizes. The boiler and shipfitting shops, as at present outfitted, contain tools capable of working the heaviest plates found on ships, including heavy plate bending and straightening rolls and heavy punching, shearing and plate-planing machines. At present the shop is well able to perform all work on plates weighing 50 lb. and less.

The planing mill and joiner shops are outfitted with the usual wood-working machines, including a sawmill capable of handling timbers likely to be used in connection with canal or ship work up to 56 in. in diameter. The shop is fitted with a dust-collecting system, which delivers the sawdust and shavings to building 14, where they supplement oil fuel under the boilers.

The foundry is equipped with one 2-ton tropenas converter and one 2-ton and one 1-ton cupola, and the usual brass furnaces. There is an efficient sandblast system for cleaning castings; also gate saws, sprue cutters and other modern equipment, including annealing furnace, core oven and mold-drying oven. Two overhead cranes of 25-ton capacity each, with extension runways to cover the flask yard, are also provided. Steel castings up to 5 tons in weight and iron castings up to 10 tons can be made. During the construction period the output from the plant amounted to as much as 920,000 lb. a month of iron, 128,000 lb. a month of steel, and 38,000 lb. a month of composition. At present the product is running to a total of about 125 tons a month.

The instrument-repair shop is equipped for repairing all kinds of instruments, watches, clocks, adding machines, typewriters and cash registers, and the plating plant for silver, copper, nickel and zinc plating. The electric shop, belonging to the electrical division of the canal, is equipped for motor winding, switchboard work and all other work in connection with a large electrical plant.

The office building is a three-story, steel-and-concrete building located at about the center of the plant. The lower floor is assigned to offices for the superintendent and assistant superintendent of the mechanical division and to the main clerical and cost-keeping offices and the planning section. The second floor is assigned to the drafting force and blueprint room. The third floor is used by the general storekeeper, thus concentrating all the offices of the plant in a single building, which greatly expedites the handling of business. A part of the third floor is for a chemical laboratory to be in charge of a chemist and laboratorian capable of making all kinds of chemical and physical tests and analyses. Included in its equipment are a 100,000-lb.

Rhielé testing machine and equipment for analysis and test of fuel and lubricating oils of all classes, also for analysis and test of steel, iron and brass.

The Balboa plant includes the following buildings, of modern steel-and-cement construction, some of which are illustrated in the headpiece and which show a general view of the plant at Balboa, looking toward the canal:

No.	Name	Dimensions
1	Machine and erecting shop	190 ft. 0 in. by 358 ft. 5 in.
2	Smithy and pipe shop	90 ft. 1 in. by 358 ft. 5 in.
3	Storehouse for steel	50 ft. 4 in. by 358 ft. 5 in.
4	Boiler and shipfitter shop	130 ft. 0 in. by 358 ft. 5 in.
5	Storehouse	120 ft. 0 in. by 400 ft. 7 in.
6	Paint shop	50 ft. 4 in. by 253 ft. 0 in.
7	Car shop	122 ft. 4 in. by 316 ft. 3 in.
8	Planing mill, joiner shop and pattern shop	122 ft. 4 in. by 400 ft. 7 in.
9	Instrument repair, plating and polishing shop, and electrical repair shop	40 ft. 0 in. by 147 ft. 7 in.
10	Lumber shed and dry kiln	122 ft. 4 in. by 548 ft. 2 in.
11	Pattern storage	60 ft. 0 in. by 120 ft. 2 in.
12	Iron, brass & steel foundry	119 ft. 0 in. by 316 ft. 2 in.
13	Coke shed	20 ft. 0 in. by 168 ft. 8 in.
14	Boiler plant	50 ft. 0 in. by 50 ft. 4 in.
15	Locomotive roundhouse (25,200 sq.ft. floor area)	15 stalls
16	Oxygen and acetylene gas Generating plant	22 ft. 0 in. by 30 ft. 0 in.
17-25	Toilet buildings—	
	Nos. 17, 18, 24, 25	22 ft. 10 in. by 48 ft. 10 in.
	Nos. 19, 20	22 ft. 10 in. by 32 ft. 7 in.
	Nos. 21, 22, 23	22 ft. 10 in. by 81 ft. 5½ in.
26	Paint-mixing and grinding shop	22 ft. 10 in. by 48 ft. 10 in.
28	Offices (three-story building)	53 ft. 4 in. by 120 ft. 0 in.
	Two wings, each	36 ft. 3 in. by 47 ft. 6 in.
29	Air-compressor plant and Dry-Dock pump well	55 ft. 0 in. by 249 ft. 0 in.
	Wing	30 ft. 0 in. by 60 ft. 0 in.
30	Cleaning and pickling shed	20 ft. 0 in. by 20 ft. 0 in.

The storehouses, under the control of the Supply Department, are equipped for the storage of all classes of structural materials and the stocks are available for the use of shipping under practically the same conditions as commissary stores.

The wharves are of steel and concrete and provided with railroad tracks for efficient access to vessels berthed at them, and an ample frontage is arranged with special reference to the shop buildings, with a view of its use for repair purposes, thus bringing vessels under repair in close juxtaposition to the shops and permitting transfer of materials and labor.

Two drydocks were originally contemplated, of which the larger has been completed since August, 1916. The smaller is partly finished, but will probably not be completed for several years. The large dock has the same dimensions as the canal locks, namely, 1000 ft. clear length, 110 ft. clear width and 41.5 ft. over top of blocks at mean high water. It is excavated from solid rock, is lined with concrete, and is fitted with all modern appliances, including a 50-ton traveling crane with an outreach of 5 ft. beyond the center line of the dock. The crane will not only serve both drydocks but is capable of traveling along the face of some of the repair wharves, thus facilitating the prosecution of repairs to vessels.

The pumping plant for the docks consists of four electric-driven centrifugal pumps with 54-in. discharge pipes. The gates are identical with the lock gates, requiring only a minute and a half to close, and provision is made for use, in case of necessity, of the emergency caisson provided for use in connection with repairs to the lock gates.

All stop tools are operated by electricity. The larger tools are provided with individual motors and the smaller tools arranged in groups and driven from countershafts. The current is obtained from the hydraulic plant of the electrical division at the Gatum spillway, supplemented by a steam-driven plant at Miraflores. The 25-cycle alternating current is transmitted to the Balboa substation at 44,000 volts. At the substation it is transformed to 2200 volts and so distributed through underground duct lines to the various shops, where it is further transformed, when necessary, to suitable voltages for use. The variable-speed tools in the machine shop are driven by direct current from rotary transformers within the shop. All other tools are driven by alternating current, generally at 220 volts. Current at 220 volts is available at all points along the water front for power purposes and at 110 volts for lighting in the event that the ships' generators are out of use.

Compressed air for shop use is now obtained in part from new compressors of 8500-cu.ft. total capacity, and in part from a 2500-ft. steam-driven air compressor installed in the same building. These compressors are driven by electric motors at 2200 volts. Compressed air is available at all the repair wharves and in all the shops and will be available in the drydocks.

The steam plant is maintained for heating pickling tanks, dry kilns, etc., and as a reserve for operating smithy hammers ordinarily intended to be operated by compressed air. Incidentally it burns very little oil, but is fed almost entirely with scrap wood, etc., which would otherwise be difficult to dispose of.

Steam, compressed air, fuel oil and water are all carried in pipes led through the central tunnel extending from building 1 to building 7 with lateral branches to buildings 8, 14, 28, 7 and 12. The duct lines for electric conductors are built into the wall of this tunnel with suitable openings for junction boxes, etc. The main sewer for toilet fixtures is also carried through this tunnel. This concentrates all pipe lines in spaces readily accessible.

Best Sanitary Conditions

Particular pains have been taken to insure the best possible sanitary conditions in the shops. Concrete toilet buildings with high-class fixtures have been provided in ample number in addition to urinals in such shops as are not readily accessible to these toilets. In connection with the drydocks there will be special toilet buildings capable of accommodating the crews of vessels in dock, although it is probable that arrangements will be made to permit the ships' fixtures to be used without interruption.

Aside from the overhead traveling cranes in the individual shops and the large 50-ton crane mentioned in connection with the drydocks the Balboa plant is provided with a 100-ton railroad wrecking crane, a 75-ton crane of similar design, and several locomotive cranes of smaller capacity. A 75-ton railroad wrecking crane usually stationed at the Atlantic end of the canal can also be made available at Balboa on short notice, and the cranes usually stationed at Balboa may be transferred to Cristobal when required.

There are a number of floating derricks of various sizes, the maximum capacity of which, with the exception of the La Valley, Ajax and Hercules, is 20 tons. These smaller derricks are ordinarily in use for con-

struction purposes, but under conditions justifying their diversion from this work they may be made available for work on vessels. The La Valley has a capacity of 40 tons and is self-propelled and capable of enduring rough weather. The Ajax and Hercules are twin floating cranes, nonpropelling, mounted on pontoons 88 ft. by 150 in., with a boom capable of being revolved through 360 deg. Main hoists have a capacity of 250 tons at 20 ft. clear of the pontoon and 100 tons at 80 ft. clear of the pontoon. The drift under the main blocks is about 160 ft. in the position for maximum load, with correspondingly decreased drift as the overhang increases. These derricks, also the La Valley, while intended primarily for canal use, are available for work on vessels.

Cristobal Drydock Shops

The Cristobal shops are of smaller capacity than the Balboa shops, and are meant for repairs of less importance. They consist of three buildings of somewhat temporary construction, one of which houses the machine shop, smithy, pipe shop and power plant; another the boiler and shipfitter's shop; and the third the wood-working shop. The tools are of less modern construction than those in use at Balboa, no steps having been taken to modernize the plant pending more definite information as to exactly what the demands upon it will be. It is, however, capable of undertaking routine repairs to vessels and, in emergencies, such parts as require larger tools than are available here can be shipped to Balboa to be machined. Electric power is obtained through the Cristobal substation of the electrical division from the same source as that which serves the Balboa shops. Air compressors, with a maximum capacity of 4300 cu.ft. per minute, deliver air to all points of the shops and along the principal wharves in the vicinity.

There is available at these shops a small drydock, originally constructed by the French and later extended by the Americans after they took over the canal. This dock is now 300 ft. long, 50 ft. wide and 13 ft. 6 in. deep over the blocks at mean high tide. At spring tide there is generally available a depth of 14 ft., but this depth cannot be depended upon even at spring tide.

Americans Have Preference

Practically all skilled mechanics in service on the isthmus come from the United States, the law giving preference in employment to United States citizens. First-class men are allowed 91 cents gold, and over, an hour, the workday being eight hours; overtime work is paid for at time and a half. The composition of the force changes considerably from time to time, as is to be expected for a force so recruited and working in a tropical country. Workmen who are American citizens are allowed 61 days' leave a year with pay, if carried on the monthly roll; if carried on the hourly roll, they are allowed 51 days of similar leave. This leave may be allowed to accumulate for two years, beyond which additional leave not taken is forfeited. American citizens are also paid for seven holidays.

It might be imagined from the high wages paid to mechanics and from the amount of leave with pay granted them that the cost of mechanics' work in canal shops is high, but this is in part compensated for by the low cost of general overhead and the low wages of helpers and laborers, so that the actual cost as billed compares favorably with that in ordinary industrial establishments outside of the countries most highly industrially organized.

Laborers and helpers are almost exclusively West Indians, whose wages range from 16c. an hour to a maximum of 28c. an hour, only a small percentage, however, receiving above 20c. an hour. These employees, not being American citizens, are not entitled to leave with pay, but those on the monthly roll are allowed pay on holidays. Overtime pay at time and one-half for all time in excess of 10 hours in any one day is allowed those on the hourly roll.

Everything possible has been done to eliminate the red tape so likely to be found in connection with any Government-owned establishment. To this end any person desiring work done may arrange for it at the offices of the local establishment or, in case the offices are closed, with the foreman on duty. Ships subject to various formalities in connection with leaving port are excused from making deposits for work done, but other applicants for work to be done must place a deposit before the work is begun. Bills for work in the shops are rendered within a very short time after the work is completed and their payment seldom, if ever, requires more time than is necessary for settlement of port dues, etc. No contracts are made for work performed. The charges are at actual shop cost, plus a moderate percentage for general administrative expense and profit, and the total cost is believed to be less than in Asiatic or South American establishments, and in many cases even less than in many establishments in the United States.

A Question of Weight

By John Vincent

Some days ago I received what seemed to be a red-hot tip. To be sure, it came from an electrical man, but he said that he had it straight from a man in the machine-tool industry. Like all stories it may have been somewhat distorted by being tossed about by word of mouth, but it seemed good at the time and led to a letter from which the following paragraphs are extracted:

"I have been informed that you have been conducting certain mechanical analyses and tests on different types of engine lathes being built today which show that one type of these lathes which is 300 lb. lighter than its competitor has equal strength and rigidity. If this is so it should be of interest to all machine-tool builders of America at present, and since we are entering on the reconstruction period this matter will vitally affect us in our ability to meet foreign competition.

"I will greatly appreciate hearing something from you in regard to this subject and whether or not it would be possible to send me data regarding this matter which you would be willing to have published. If the material is not in such form that it would be readily available I would greatly appreciate an opportunity of seeing you and talking the matter over with you."

A few days later I received a reply, a part of which follows:

"Wish to advise that we have never conducted tests of this kind. However, without question there has al-

ways been a natural tendency of machine-tool builders to make things heavier than necessary and one of the great talking points of machine-tool salesmen is a comparison of weights. They always lay great stress on this fact when their machine is heavier than the other fellow's.

"We have recognized for a long time that machine-tool builders do not like to make radical departures from standard designs, and there has been such a tendency to copy that there is very little variation in machine tools built for similar purposes."

Recently I had an opportunity of visiting this gentleman and talking with him on the subject in question. His letter had exploded the idea that was contained in the "tip," but his comments on the matter of machine-tool design were even more radical than those in his letter.

Question of Additional Weight

In recent years I have found, as my correspondent pointed out, that some machine-tool salesmen always refer to the respective weights of their machines should they happen to be in the slightest above the weights of their competitors. It is a question whether this additional weight has been placed where it would be of service to the user or whether it simply shows lack of ability on the part of the designer to reduce unnecessarily large sections of metal which are placed in positions where they will not appreciably affect the strength of the machine. It may even be detrimental if wrongly placed.

The fact remains that if unnecessary weight is placed in the machine it adds to the cost of building it, and if the machine has hand-operated parts it slows down the speed of the operator and so causes a constant loss of production to the buyer. If we can obtain equal results from machine tools and still have them lighter in weight, and so less costly and more cheaply shipped, American machine-tool manufacturers will be in a better position to meet foreign competition.

Viewed from a Different Angle

There is another idea on the weight question, which was brought to my attention by a manufacturer who viewed it from a different angle. He had had an incident brought to his attention in the matter of the weights of the vises used in his shop.

Anyone who has worked on parts held in a bench vise knows how a light vise will give and spring from the blows struck on the chipping chisel or when a heavy file is pushed across the face of the work. This reduces the effectiveness of the work, and is the reason why a large and heavy vise in any part of the shop probably is in use twice as much as any of the lighter ones. In this case it is a question of the inertia of the vise which offers a firmer resistance to the vibration set up.

The manufacturer in question had a number of small tool-steel parts which were broken for service by being placed in a vise and struck with a hammer. The workman was able to judge the degree of the tempering of the parts by the way they tested out when he broke them, as toughness rather than hardness was an essential feature and indicated whether the temper had been drawn sufficiently.

This worked well until one day he came into the office and said that the parts were not tempered at all but that the hardener had left them glass-hard and brittle. The hardener energetically denied this contention and stated that he had made absolutely no change in his methods of treatment. On investigation the manufacturer found that the inspector had recently received a new vise to take the place of the one that had been worn out and that the new one was much larger and heavier. The resistance of this heavier vise to the blows of the testing hammer was so much greater that the pieces seemed brittle. Fortunately the old vise was still available, and as a final analysis of the situation it was brought into the test and the steel that had been found so brittle in the heavy vise seemed tough and well tempered when tested in the lighter one.

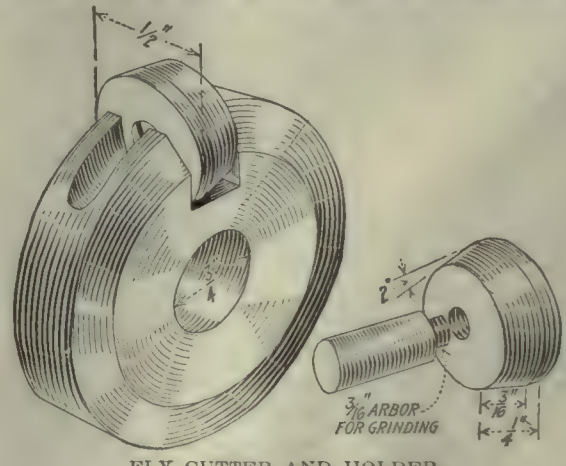
Of course this does not settle the question of weight, for inertia may be valuable in a bench vise and entirely unnecessary in the moving parts of a machine tool. Our vise builders may make a lighter type to go into South American and other foreign fields to meet the competition of the light and flimsy tools put out by such of our competitors as the Germans have been in the past, but let us hope that our own manufacturers will pay for enough additional weight so that they will not be losing more than the extra cost of the vise every day in the ineffectiveness of the workers' efforts.

So far as the machine tool is concerned, if it will stand up, have a long life and produce accurate machined surfaces free from chatter marks, the light-weight tool will be more valuable for service than one made large and clumsy simply to obtain additional weight for use as a salesman's talking point.

Fly Cutter and Holder

By Gilbert H. Calm

Here is a sketch of a fly cutter and holder that I have used successfully for milling fillets to exact radius and for milling grooves in forming dies. The tool is especially adaptable to this purpose when the exact radius is



FLY CUTTER AND HOLDER

not known in advance and must be found by trial, as the cutter lends itself readily to the necessary change in radius by merely screwing it onto the small arbor provided and grinding it down.

The cutters are easy to make, and from the method of their making must necessarily be truly circular in form. Different sizes of cutter within a reasonable range may be used on one-sized holder.



III—Thermit Welding Crankshafts, Mill Pinions, Etc.*

Previous installments have given detailed directions for making both plastic and fusion welds. This article gives specific directions for applying the principles of fusion welding to the repair of crankshafts and replacing teeth in large pinions, rudder stocks and the like.

WE WILL now take up the welding of crankshafts, mill pinions, rudder-stocks and other repairs which must be lined up as accurately as possible. It is not necessary to go into details as to the exact method of making the Thermit welds, as these have already been thoroughly covered. It is merely intended to go into the question of allowances for contraction, causes of inaccuracies in alignment after welding, effects of mechanically preventing the expansion and contraction and other possible difficulties.

Mechanically preventing the contraction of a weld, intentionally or otherwise, is a common fault in Thermit welding and can be prevented only by constant vigilance on the part of the operator. Most operators in repairing locomotive frames, for instance, will arrange to jack the sections of the frame apart or separate them by heating the adjacent members or in some similar way to allow for the contraction which they know will take place when the metal in the weld cools.

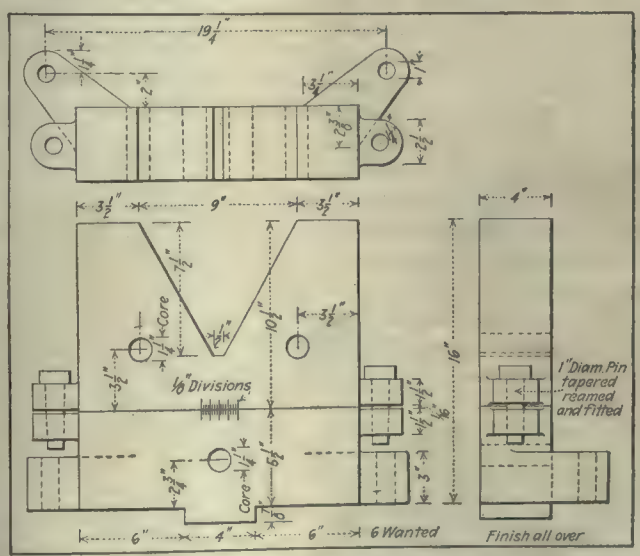


FIG. 27. DESIGN OF V-BLOCKS FOR WELDING CRANKSHAFTS

When, however, the Thermit operator is confronted with the problem of welding a shaft or similar part, he will very often make the mistake of strapping the shaft as tightly as possible to a bedplate or in V-blocks, which will prevent the weld from contracting if the clamps are efficient, although actually allowing ⅛ in. or ¼ in. for this contraction. One particularly bad case is reported of "preventing contraction" in which an experienced operator jacked a heavy steel section of a rudder frame apart to allow for contraction in a broken rib 8 x 4 in. and then proceeded to ram the jack up in the mold box. The result of course was that the section cracked alongside of the Thermit weld and the jack had to be cut in two in order to remove it. But in crankshaft welds the usual result of efficient clamping to keep the pieces in line will be the formation of holes in the weld which in all probability will be blamed on the Thermit, a new crucible, the breaking down of the mold or to other similar causes. Such holes can usually be easily distinguished from ordinary blowholes by the fact that their axes run parallel, or nearly parallel, to

*For the author's forthcoming book, "Modern Welding and Cutting." All rights reserved.



FIG. 28. TWO-THROW CRANKSHAFT—FRACTURE CUT AWAY FOR WELDING

the line of the contraction which, in the case mentioned above, is the axis of the shaft.

To show how prone operators are to make this mistake one operator who ordinarily would carefully release the clamps to allow for the contraction of a shaft weld neglected to do so in welding a small trunnion on the end of a heavy steel cross-head. This trunnion was defective and was replaced by welding a piece of 5-in. shafting onto the cross-head. The cross-head was laid on a bedplate and the trunnion was set up in position on a supporting block and strongly clamped in place. The mold was rammed and the weld poured in the usual way with the result that holes, or shrink-holes, occurred parallel to the axis of the trunnion.

Defects That Frequently Occur

As an illustration of the formation of these holes prick a small hole in an elastic band and then stretch the band. The hole at first is not noticeable, but it will be very noticeable if the band is stretched. The original hole corresponds with the pores that occur in cast metal and the elongated hole is the result of preventing contraction. A similar defect may be caused in a Thermit weld by having a riser with too great a flare, as the sand in the mold tends to prevent the riser from pulling in toward the weld. In this case of course the holes will run nearly parallel to the axis of the riser. This kind of defect frequently occurs and is difficult to overcome where, for instance, the part to be welded is in the crankpin of a shaft and where the slabs or throws are quite close together. In such a case if the sand is rammed tightly between the slabs it will prevent the contraction of the pin weld, and pull-holes parallel to the axis of the pin will be the result.

All of these defects can be corrected or rather prevented in one way or another. In the cross-head weld previously mentioned as well as all shaft welds, rudder-

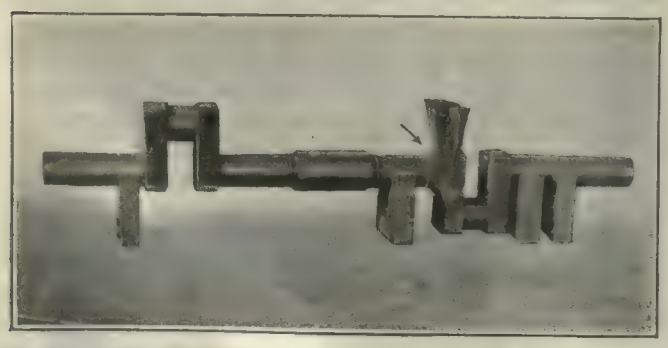


FIG. 29. TWO-THROW CRANKSHAFT WELDED—REPAIR MADE IN 72 HOURS

stocks, etc., the lighter part, or section, should be carefully supported on flat blocks so that it will be stable without any clamp and so that it can be moved backward and forward in the line of the weld without affecting the alignment. A strong clamp should then be set in place to hold the pieces in line while ramming the mold, but should be removed from the lighter piece before preheating and pouring. In repairing a break in a small section adjoining two heavy sections it might even be advisable to support one or both of the heavy sections on rollers, as their weight alone might very likely pull holes in the weld.

In welding crankshafts it is customary and best to align the shafts on V-blocks. These V-blocks are heavy pieces accurately machined and slide in a machined slot of a heavy bedplate. The V-blocks should be spaced along the slot of the bedplate so as to correspond with the journals of the crankshaft. Parallel to the main slot of the bedplate and on either side of it are smaller slots similar to those in planing-machine beds. The heads of the holding-down bolts are placed in these slots opposite the V-blocks and a short bar or channel placed across the shaft and clamped down by means of nuts on the holding-down bolts.

The V-blocks should be so placed on the main journals that the shaft can slide at least $\frac{1}{4}$ in. either way parallel to its axis without a shoulder or crank throw striking any part of the V-blocks. Experience has shown that crankshafts usually break in a main journal or in a pin journal close to a crank throw or slab, or the break may occur in the slab itself. It is usually desirable to line up the shaft with the throws in a horizontal position. Let us imagine a shaft with a break in one slab or throw close to the pin journal and the shaft lined up in V-blocks with the throws horizontal, the necessary gap cut out and the wax and mold in place ready to preheat. The operator would probably have a great deal of trouble trying to allow for the contraction and would probably attempt to do this by shifting one part of the shaft about $\frac{1}{8}$ in. along in the V-block and would place various-sized shims in the V-block to allow for the contraction along the line of the slab.

Inaccuracy of Alignment Explained

It would all be simple enough if after pouring the weld the shaft would remain dormant until the weld started to contract when the shims could be removed from one side and placed on the opposite side to allow the slab to contract, but from measurements that have been taken it has been found that immediately after pouring the weld there is a great deal of force exerted, as though a jack were placed between the sections that were fractured. This is of course caused by the intense heat of the Thermit steel conducting into the parts of the shaft adjacent to the weld, causing them to expand. One might suppose that there would be no great force exerted while the metal in the weld was molten, but this can be explained by the fact that the riser and pouring gate have become sufficiently sluggish to hold the more liquid metal below from forcing upward. However, the fact remains that the parts of the shafts are strongly forced apart so as to slightly tilt the V-blocks and raise the shaft out of line.

This may explain why the inaccuracy in alignment is not in the direction of the contraction of the weld but

almost at right angles to it. In a great many cases this tendency to separate will shift the parts of the shaft horizontally as much as ¼ in. and as the V-blocks resist this they are tilted by the force and the shaft thrown out of line.

It may be hours before any considerable contraction sets in, and by this time the shaft has been permanently set out of line. Heating the opposite slab will slightly counteract this, but not sufficiently, because the heat conducted from the Thermit steel will expand one slab a great deal more than any possible preheating on the opposite slab.

Crankshafts that are broken in such a way that they can be lined up with the throws in a vertical position will be almost as far out of line because the sudden expansion of the adjacent parts will have to shift part of the shaft and even sometimes lift it partly out of the V-blocks, and this force is being exerted through molten or perhaps plastic metal so that a certain amount of upsetting will naturally take place.

V-Blocks for Holding Shafts

In order to overcome these important defects the special V-blocks shown in Fig. 27 will allow a horizontal motion after the mold is rammed. If then the proper allowance for contraction is made the shaft should come back into line because the force tending to separate the fracture will not be resisted and will be subsequently offset by an equal contraction. On the other hand such V-blocks will permit of watching the contractions of the shaft so that different allowances can be made on the next shaft if necessary.

These V-blocks should be made in such a way that they will be divided in two parts horizontally. The upper and lower parts should each have divisions accurately marked on them next to the dividing line, the central division being longer and heavier than the rest. When the two parts of the V-blocks are central on each other, accurately turned pins, preferably tapered, may be inserted in reamed holes passing through the two lugs so as to securely fasten them together. This locates accurately the central position where the shaft is to be lined up "in line." Where a horizontal contraction is to be allowed for, the pin should be left out of certain V-blocks and the parts of these V-blocks slightly shifted on each other if necessary. If the V-block pins are not in place the holding down bolts can be relied upon to hold the shaft in a desired position during the ramming of the mold. When the preheating is started these bolts should of course be removed and the shaft allowed to move freely. Another advantage of this type of V-block is that flat shims can be placed between the halves of the V-blocks to allow for different journal diameters instead of placing the shims on the slanting face of the V-blocks. The thickness of the shims will of course be just half the difference in the diameters of the journals.

In allowing for contraction of a Thermit weld it must be remembered that the actual contraction of the small amount of Thermit steel in the space between the pieces is almost negligible, whereas the actual contraction of the weld may vary from $\frac{1}{16}$ to ¼ in. This is due to the fact that during the preheating operation the ends of the pieces at the fracture expand or approach each other by the amount of the expansion of the adjacent parts



FIG. 30. FRACTURE IN WEB CUT AWAY FOR WELDING A CRANKSHAFT

by the preheating. For instance, if the fracture is opened up ¼ in. to allow for the contraction and the expansion of the parts during the preheating approach each other almost ¼ in. (perhaps $\frac{1}{64}$ in. less) the parts should be almost exactly in line after welding. In welding large sections slightly greater allowances for contraction should be made than in smaller ones, because to bring the fracture to the proper heat takes a longer time and consequently the heat "soaks" further along the parts, causing a greater expansion and a greater tendency to close up the distance between the fractures.

A large two-throw crankshaft previous to welding is shown in Fig. 28. This same crankshaft after welding is shown in Fig. 29. A 6½-in. crankshaft broken in the web is shown in Fig. 30 and the finished weld in Fig. 31.

How to Locate Minute Cracks in Crankshafts or Other Parts

In the course of welding crankshafts and other important work it is often found that while the part to be welded is broken clear through there are other minute hairline cracks near by which are sure to give trouble later. It is probable that the strain thrown on the part when the break occurs is often sufficient to start these small cracks. They may also be caused by strains in the metal from improper treatment in the first place, and which may have been responsible for the first break.

In any case, however they may have been caused, the proper thing to do is to locate these cracks and so weld the parts as to eliminate them. As they are many times so minute as to be invisible to the naked eye some other means must be found to locate them. A very efficient method is to paint the entire section with a mixture of whiting and alcohol. The whiting and alcohol should be mixed so as to form a good white paint, but not too thin. This dries quickly and becomes discolored by the grease or dirt in the very fine cracks, so that these



FIG. 31. WELDED 6½ IN. CRANKSHAFT BROKEN IN THE WEB

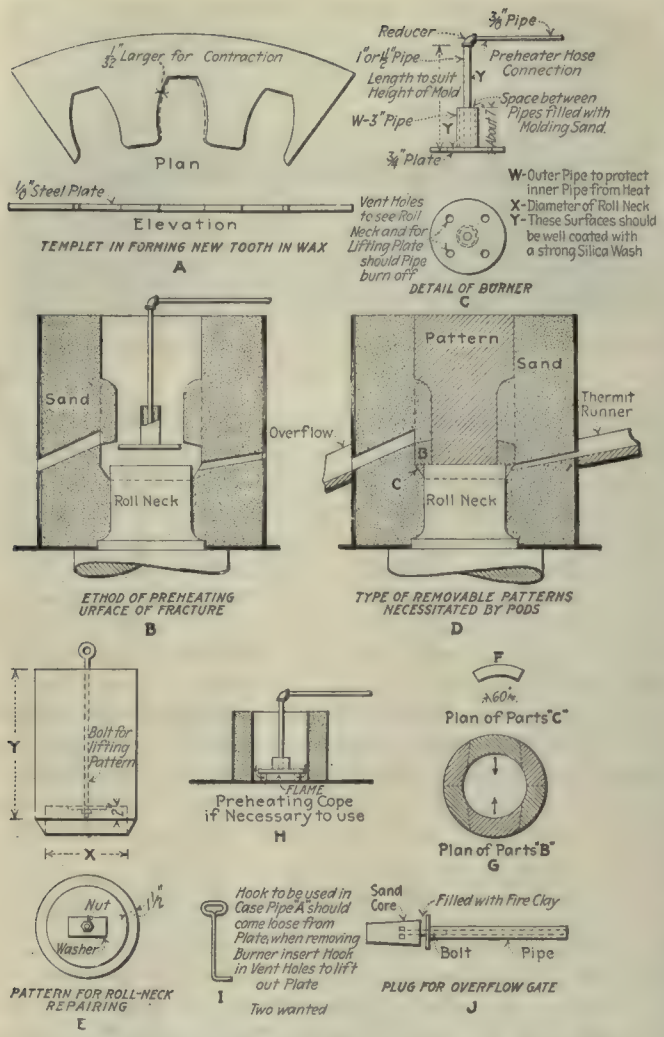


FIG. 32. DESIGNS FOR PATTERNS AND HEATING APPARATUS FOR REPAIRING STEEL PINIONS

cracks show up very distinctly. Since it is the oil or dirt in these cracks that causes them to show so clearly on the white paint it is not a good method to detect cracks in a new piece. The part to be painted should of course be cleaned of all the dirt and grease on the surface. It is a conservative estimate to say that probably one-third of all crankshafts will be found to contain additional cracks other than where the break is visible. If these are not found and remedied the chances are that they will develop into real breaks later.

Welding New Teeth in Large Pinions to Replace Teeth Broken Out

The Thermit process is coming into more and more general use in large steel works and rolling mills for welding teeth in heavy pinions, as it can be relied on to give a permanent, efficient and economical repair in the case of these very heavy sections.

The following instructions cover a method which has been in use for several years, and if they are carefully followed a satisfactory repair is assured. Many pinions weighing up to 17 tons have been repaired in this way and are now doing service.

The repairs usually consist of replacing teeth or parts of teeth which have broken out. They are peculiar in that the tooth is a comparatively small projection on an extremely heavy steel casting. For this reason, if the repair were attempted by the ordinary method, i.e., if the casting were preheated at the weld only as covered in previous instructions for making Thermit welds, the heat would be carried away into the casting so quickly, especially during the interval of removing the preheating burner and tapping the crucible, that in most cases a poor weld would result. Everything possible must therefore be done to conserve the heat at the weld, and to do this efficiently it is necessary that the whole pinion should be heated to a red heat. This may be done by bricking in the heaviest part and preheating it by means of oil or gas burners conveniently placed while the part to be welded is being preheated in the regular way. The Thermit company's flaming-burner preheater attachments are admirably adapted to this preheating work, as they give an extremely hot flame which may be adjusted to suit the conditions. Care should be taken, however, to bring up the heat slowly, as otherwise there is danger of cracking the pinion.

In making all welds where a relatively small amount of Thermit steel is to be added to a heavy steel casting or where one or both of the parts to be joined is considerably heavier and larger than the Thermit steel part it is necessary to take special precautions to secure thorough amalgamation of the Thermit steel with the heavier part, especially at the extreme edges of the line of junction where in service the greatest strain will come. The slightest imperfection at this line of junction or extreme fiber will cause a tear to start in service which will cause a fracture of the welded part. A perfect weld on this extreme fiber is made more difficult by the fact that the metal in the weld always shrinks a little more than the white-hot steel of the pinion due to the slight difference in shrinkage between molten steel and white-hot steel. It is necessary therefore that the fusion be obtained for a considerable depth even at the extreme edge of the Thermit steel. Fusion at this point is more difficult because the heat of the Thermit steel comes from one side only and not from all sides as it does near the center of the weld.

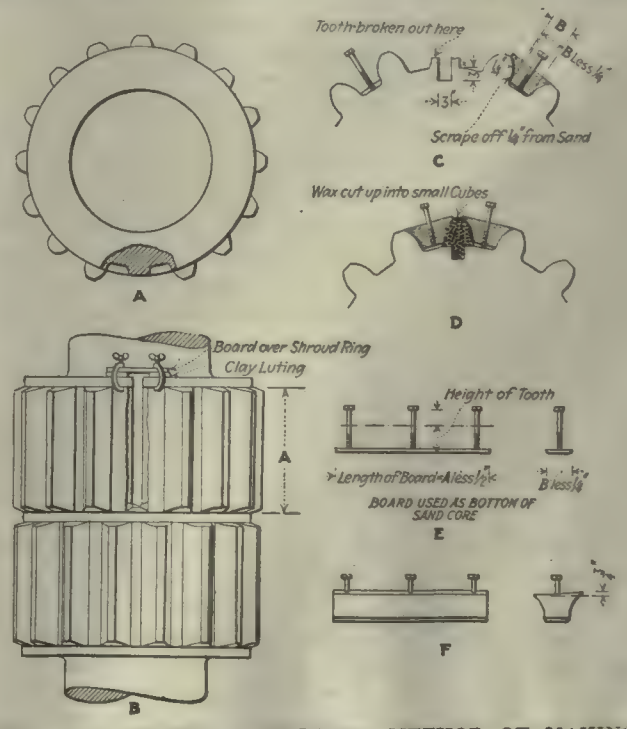


FIG. 33. RECENTLY DEVELOPED METHOD OF MAKING WAX TOOTH PATTERN

For all these reasons it is desirable to increase as far as possible the surface exposed to the Thermit steel in the width of the weld. This at the same time produces edges or corners which melt more readily and thus aid in the fusion. These edges may be readily produced by cutting out a groove or slot in the main body of the pinion at the center part of the root of the tooth broken out. This slot should be half the width of the tooth in depth and also in width, i.e., if the tooth to be welded in is 6 in. wide at its root the slot should be made 3 in. wide by 3 in. deep. The most economical way to cut this slot is to place the pinion on a planer and machine it out.

The cutting of such a slot also serves to bring the line of junction between the Thermit steel and the metal of the pinion well into the body of the pinion so that a strong and efficient weld is assured.

After the slot has been cut, the pinion in the vicinity of the weld should be carefully cleaned and then mounted vertically for the welding operation. In this mounting great care should be taken that the pinion is properly supported so that there will be no danger of its settling under the added weight of the mold box. This can be accomplished in the following manner:

First dig a hole in the ground the proper size to receive the neck of the pinion. Then lay two T-rails across the top of the hole so that they will come underneath the shoulder of the pinion. If the ground is not sufficiently hard to properly support the T-rails steel plates can be placed underneath in order to prevent the rails from settling into the ground.

With the pinion properly supported in this manner the next step is to provide the wax pattern for the new tooth. This can best be done by constructing a rough wooden box a little larger than the tooth in question. Place this against the pinion where the new tooth is to be added and lute around the edge of the box with fire clay. Next fill this box completely with molten wax. When the wax has set remove the box and shape to proper form by means of a templet as shown in *A*, Fig. 32.

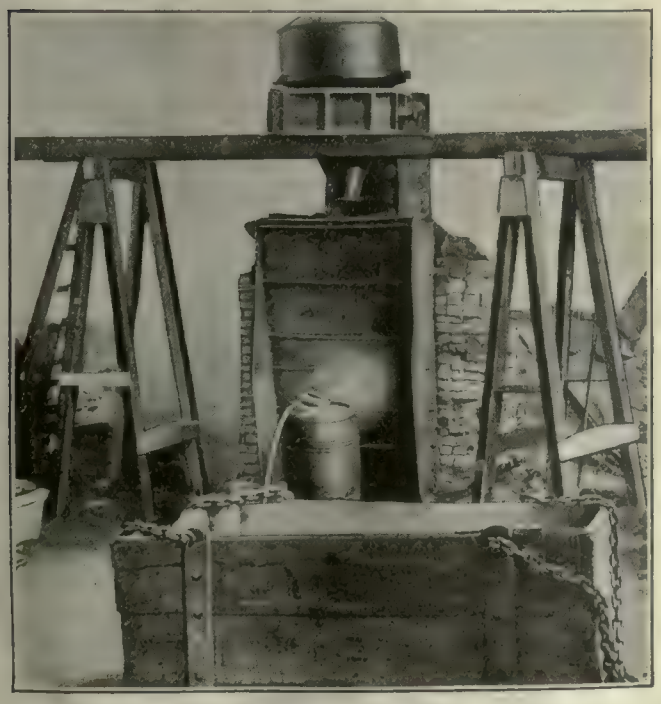


FIG. 34. MOLD BOX, BRICK FURNACE AND CRUCIBLE IN POSITION AND PINION BEING PREHEATED



FIG. 35. REAR VIEW SHOWING PREHEATING OF BODY OF PINION IN BRICK FURNACE

This templet should be made from $\frac{1}{8}$-in. steel plate and the outline of the teeth cut into it by using three good teeth in the pinion as a guide. The center tooth, however, which will be the guide for the tooth to be welded in, should be cut $\frac{1}{32}$ in. larger all around so as to allow for the contraction of the Thermit steel tooth. The two outside teeth of the templet engage with the teeth on each side of the wax pattern, and therefore when this templet is moved up and down it will cut the wax to proper shape and also assure that the new tooth is welded on in proper pitch.

One disadvantage of this method of making the wax core is that if the adjacent teeth are considerably worn the new tooth will not conform to their shape unless the templet is juggled considerably when shaping the wax pattern. A newer method has recently been developed by F. N. Keithley and used with success. This method gives a cast tooth of the same approximate shape as the others in the pinion, even if considerably worn, which is an obvious advantage.

Referring to Fig. 33 the broken tooth is slotted out as in the previous method and the adjacent teeth are cleaned and scraped. With the pinion in a horizontal position wooden strips are fitted to the bottoms of the tooth spaces, as shown at the left in *C*. Lag screws are screwed into these for handling purposes. Further details of the strips are shown at *E*. A mixture of two parts building sand to one of fire clay is sifted through a No. 4 mesh riddle and moistened a little more than for ramming a mold. If this mixture does not draw

well more fire clay may be added. The mixture is pressed between the model teeth on top of the board strips, as shown at the right in *C*. The mixture is rammed in firmly to a point $\frac{3}{4}$ in. above the top of the tooth on the side for the wax pattern, as indicated at *C* and at *F*. The idea is to provide sufficient height of wax to allow for shrinkage.

After the two parts are rammed they are lifted out and laid carefully on a board. One-fourth of an inch

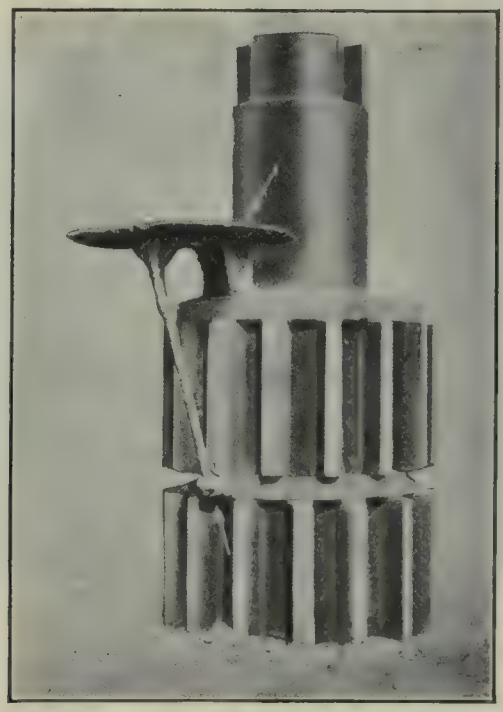


FIG. 36. FINISHED WELD, SHOWING METAL IN POURING GATE AND RISER

of material is then carefully scraped off of the side of each piece that does not come in contact with the wax, and the surfaces are slicked. This is to allow for shrinkage of both wax and Thermit steel. The two pieces are now placed in position as shown at *D*. Weights should be placed partly on the pieces and partly on the adjacent teeth to hold the pieces in place. The ends are then luted with fire clay and the space filled with small pieces of wax. The melted wax is then poured in, taking care not to have it too hot, as it will eat into the sand if it is.

The mold parts in position and the wax poured are shown at *D*. If the pinion is shrouded the wax pattern for the shroud can be put on at the same time that the wax tooth is formed. It is only necessary to roll a clay rod about 1 in. in diameter and lay it against the pinion 3 in. away all around from the space cut in the shroud. Back this up with a board large enough to extend above the top of the tooth and lute as indicated at *B*.

When the wax pattern is finished the mold box should be placed in position and securely clamped to the pinion, the clamps to be in a position so as not to come in contact with the fire when the pinion is being preheated.

This mold box should be wide enough to take in two teeth on each side of the tooth to be welded. Now ram up the mold box, allowing for a preheating gate, a pouring gate and a riser in accordance with instructions already given. When this is completed construct a brick furnace around the exposed part of the pinion and about 2 in. away from the teeth. Next place a sheet-iron casing around the exposed neck on top. This casing should be 6 in. larger in diameter than the neck and about 4 in. higher. Now ram sand between the casing and the neck and cover the top with a layer of sand 4 in. thick. In this way the entire pinion is insulated.

The next step is the preheating. Place a burner at the bottom of the brick furnace as shown in Fig. 34, and start with a very mild heat. This is to avoid heating the pinion too quickly, thus causing internal strains which might result in cracking the pinion. After the pinion has been thoroughly soaked with heat the fire can be increased to a good sharp heat so as to bring the entire pinion to a good blood red or about 1200 deg. Fahrenheit.

While the heating is in progress, as shown in the rear view, Fig. 35, place an automatic crucible of the proper size to hold the Thermit charge in position over the pouring gate and charge with the welding portion of Thermit. In case of very large welds it is sometimes necessary to use two crucibles and provide two pouring gates in the mold.

Repairs of this kind usually require anywhere from 350 to over 1000 lb. of Thermit.

In special cases it is advisable to make up a special steel mixture of essentially the same analysis as that of the pinion.

Continue heating in the brick furnace until the Thermit steel has cooled to about the same temperature as the body of the pinion, then remove the burner from the furnace, take off a few of the top bricks and fill in between the bricks and the pinion with dry sand, thereby protecting the pinion completely from the air currents.

The pinion should be allowed to cool slowly in this mold for at least six or seven days so as to thoroughly anneal the metal in the entire piece. The mold can then be dismantled, the weld trimmed and the pinion will be ready for service. A pinion previous to trimming is shown in Fig. 36.

Locating Knocks in Motors

By C. F. A. Siedhof

I am curious to learn the principle, mechanical or electrical, by which the vibrations from an engine are transmitted in the listening apparatus described by B. Z. Reiter on page 107 of the *American Machinist*.

The combination of copper tube, steel rod and telephone receiver connected by wires would imply electric means, but how the mechanical vibrations are transformed into electrical impulses with effect in the receiver is not clear, while if the vibrations are mechanically transmitted what is the particular virtue of the copper tube and steel rod combined with a telephone receiver—presumably electromagnetic—to say nothing of the lessening of effect (assumed of course) of flexible wires interposed in the path of the vibrations?

Is it possible for such flexible wires to carry the mechanical vibrations without such loss of volume as to make the tests valueless? Incidentally has the distance the steel rod is pulled out of the copper tube any bearing on the action of the contrivance?

A Successful Apprentice Toolmakers' School*

DEMANDS for operators for machine tools as well as for men who can make the tools have led closely to exhaustion of the supply of machinists, machine operators and toolmakers. How a large company manufacturing arms has met this problem by the successful organization of an apprentice toolmakers' school which, in a course of eight weeks, turns out men for precision work within limited lines is here given.

Beginning in March, 1918, and operating continuously since that time, the Apprentice Toolmakers' School was established by the Savage Arms Corporation, Utica, N. Y., to accomplish two objectives: First, to train new help for the operation of machine tools and subassembly work, and second, to afford an opportunity to the men employed as specialists on production to advance themselves to a more responsible position, broader service, higher earning capacity and more independent citizenship.

The employer faced with the usual employment problem, so intensified throughout the country by war conditions, hit upon the establishment of a training school through which all newly employed labor should pass for test of experience and capacity and if necessary for training upon their duties, and the use of the school for upgrading those operatives who desire the opportunity and whose past record and production experience qualifies them for advancement to the toolroom and perhaps to a foremanship.

Effect of Labor Turnover

The school has already benefited the factory. One important item is its effect on labor turnover. During the week ended Oct. 26, 1918, the number leaving was only one-half of the number employed, and was at the rate of 86 per cent. per annum. Compared with the general turnover of 200 per cent. or more this is a prominent consideration both in economy and efficiency.

The actual administration of the Training School comes directly under a labor manager, who also has general charge of the administration of factory welfare, protection and safety from accident and fire hazard, employment service and wage rates. The labor manager is under the direction of the factory production manager, general works manager and the vice president respectively. The success of the type of administration selected is perhaps largely due to the training as a production man rather than as a clerical official or sociologist of the labor manager. Problems have been met from a practical operating standpoint and solved with the surety of experience.

During the six months the school has been in operation 40 men have taken the toolmaking course and been promoted. Two have been returned to the work formerly done, one as a profiler and hand filer on regular production work; the rest are carrying their full share to entire satisfaction. The training department has a capacity for training 5000 operatives a year, or 400 a month, and the company purposes to increase this.

*From a report by Frank L. Glynn, superintendent of Training District No. 5, Training and Dilution Service, Department of Labor.

The toolmaking of the company is done in five departments: the small-tools, jig and fixture, punch and die, gage and model and service tool rooms. In general, the small-tools room is utilized to train toolmakers as well as for its regular purposes. Men having had several years' experience in one or other specialty are taken from various places in the establishment and given the opportunity to master the intensive course. The reason for this is to permit them to qualify for higher positions. The course is as follows:

	Days
SMALL ENGINE WORK	
Centering	1
Facing T-cutters	1
Backrest hollow mills, drilling, boring, reaming	1
Turning outside cylinder work	2
Turning tapers	1
LARGE ENGINE LATHE WORK	
Truing up work in chuck, drilling holes in center, boring and reaming	2
Turning cylinder work	2
Cutting threads, outside and inside and tapping in lathe	2
MILLING MACHINE	
Milling outside teeth in side-milling cutters	2
Milling side teeth in side-milling cutters	2
Milling spiral teeth in milling cutters	2
Milling keyways in arbors	1
Milling squares on tap shanks	1
Milling flat work in vise	4
SHAPING MACHINE	
Shaper flat work with pinch-downs	3
Shaping straight work without pinch-downs	4
Cutting keyways in shaper	1
Shaping work to lines	2
Shaping work square	2
GRINDING MACHINE	
Grinding tapers on cylindrical grinder	2
Grinding straight work on cylindrical grinder	3
Grinding on B. S. surface grinder	2
Cutter sharpening machine	2
Grinding inside hole work	2
Grinding on cutter facing machine	1
Total number of days in course	48

Additional Instruction

In addition to the regular shop instruction on machine tools blueprint reading and drawing is given one night a week for eight weeks by a highly qualified toolmaker for the purpose of conveying practical rather than theoretical information. The regular shop day ends at 5.40 p.m. The employees in training who remain for the evening instruction obtain their supper at the factory restaurant. Department supervisors give lectures from time to time, consisting of 40 minutes' discussion and the remainder of the time devoted to inspection of home work done since the previous meeting and laying out home work for the following week. The lectures cover the handling of materials, tools, equipment, routeing of workshop, methods, etc. The company furnishes a textbook on machine-shop operations entitled "Textbook of Advanced Machine Work," by Robert H. Smith, and published by the Industrial Text Book Co., Boston, Mass., and also Brown & Sharpe's "Treatise on Milling and Milling Machines."

At the close of this course the company provides each graduate with a complete set of tools necessary for his work, the employee reimbursing the company by small weekly payments. Each employee completing the course is also given a certificate stating that he has completed the prescribed work in the eight weeks' course of the Apprentice Toolmakers' School of the corporation with the average grade of —— and with the individual

grades stated below, and is entitled to receive this certificate in recognition of his achievement:

Mechanical Drawing ..... Machine-Shop Arithmetic.....
Shop Work..... .....
.....Factory Manager.
.....Supervisor of School.

By employing the small-tools room all machines used in the manufacture of small tools are available. All small tools required in the manufacture of the Lewis gun are made. These include form cutters, power-mill cutters, hand mills, reamers, hollow mills, arbors, taps and dies, broaches and all necessary cutting tools. No work is done in the course of training outside of regular production work. By putting the toolmaking on a production basis and passing it from operation to operation an opportunity is afforded to shift learners as described in the outline course given.

Although the training of toolmakers is being carried on in the small-tools room coincidentally with the regular work of the room and the learners actually produce tools for the use of the factory the production of the small-tools room has not decreased nor has the standard of spoilage increased. During the past three months this department has increased 100 per cent., and the outlook is that in the near future it will be again increased 100 per cent. There are at the time of preparation of this report (Nov. 12) 40 learners in this department, which is turning out three toolmakers a week without a cent of expense to the management, the value of the product turned out by the learners balancing all operating expenses.

The learners are taken from the production departments only on personal application for transfer to the school, through the employment office. Wages during instruction are lower than in the shop. On promotion the graduate is transferred upon requisition through the employment department to one of the toolrooms needing his services, and he is then placed on the full rates given regular toolroom workers. If he becomes dissatisfied or is found unqualified he may return to his former production employment through the employment office.

The opportunity given to work up from the ranks has promoted an appreciative spirit among the employees, it is stated, and the men strive to advance themselves. Men taken for training are more interested, and enter the school better prepared to appreciate the instruction given. The instructors are all experienced toolmakers selected from the regular force.

Training of Operatives

When the production departments in the factory want additional workers they make requisition on the employment office in the usual manner; but instead of selecting haphazardly from a list of applicants and sending those presumed to be suited to be "fitted to the job" or fired the employment office draws upon the training department for its trained men. This is done by advance notices to the employment department, which hires persons before they are actually needed, sending them direct to the training department for seasoning and practice.

The training of new help for the operation of machine tools and subassembly work is conducted on a separate floor. The equipment was taken from the regular production departments of the factory; it did not involve any outlay, for the company had been using it for training new help before in the old unorganized fashion. With regular methods of training, eliminating bad ways of working, guiding the new workers into right lines and the easiest ways, the time required to gain efficiency is remarkably reduced, wear and tear on machines lessened, spoilage greatly minimized and less machinery tied up under green hands than before.

How the New Employee Is Instructed

Instruction is given the new employee in milling, grinding, profiling, drilling, screw-machine operating, inspecting, assembling, general bench working, special and automatic machine operating, barrel making and lathe turning. During the war the new employees were instructed in only one operation before being subject to draft for regular employment from the employment department. The great pressure at that time for production prevented liberalizing the training of employees. It is hoped that broader training, at least related in operations, may now become possible. The more liberal the training the better, for the learner has a social right to broader possibilities for industrial service to say nothing of the increased value to his employer and to the nation.

Rate of Pay After Promotion

The material for work used for instruction comes from the regular production departments of the factory through the production engineering department. It passes out of the training department under the supervision of the factory inspection department, one of the departmental inspectors applying the tests. The finished product goes into the regular output.

The hours of the toolmakers' apprentice shop and the training department for operatives are the same as the factory hours, and in every possible particular the department is run the same as the factory so that learners insensibly acquire factory discipline, which they continue to observe after graduation.

The instructors in the training department have been selected in the main from the various departments of the factory, and must prove a high degree of proficiency before being appointed. After this primary requirement comes personality, adaptability to learners—tact—and ability to impart information.

The rates paid to employees after promotion from training are materially higher than those paid during learning, and become effective on promotion. This not only establishes a standard up to which the training department must measure, but also provides the learner with a material advance in wages to look forward to as soon as proficiency is obtained. If the employee after promotion does not maintain the requirement as to production, in quality or quantity, he is returned to the training department instead of being dismissed. Should an employee after being certified by the training department to the employment office as proficient and after placement in some production department become dissatisfied, he may return to the training department to qualify for another line. This system reduces the

percentage of "quits" and makes the training department a strong aid to the employment office in maintaining contentment. The training department is ranked by the company as coördinate in responsibility with the employment department and the welfare and protection work.

A third division of the training department relates to the training of machine and tool adjusters. These men are required by the factory to set up machines for the operators in each gang. The course of instruction is short but intensive, covering approximately two weeks. The course is for men who have had experience in the operation of machine tools and in general bench work. Only those who have had production experience in the factory are given the opportunity which leads to foremanship. During the course wages are lower than the factory scale on piece rate, but adequate to excite interest in the training.

Training is conducted on the floor devoted to training machine operators. Learners are required to take machines apart and reassemble them, at the same time learning the names and functions of each part. Setting up on profilers, power mills, hand mills, lathes and screw machines is thoroughly gone into.

No promotions have yet been made from this course, which has only recently been started. Twenty men were taking the course on Nov. 12.

Employment of Handicapped Workers

The Savage Arms Corporation has been able to give employment to two blind men, who are now engaged on production work in one of the shops, earning living at regular wages, instead of being condemned to official charity or beggary. As other blind men apply at the employment office further attempts to train them for occupations that experience suggests will be made. One of the speediest men in the factory, now a machine demonstrator, has one leg. One of the firemen, who keeps pace with the rest of the men and is proud of it, has lost an arm. There are many vocations in which handicapped men may enter and do their share. These instances show the possibilities that any establishment may discover and open to soldiers or victims of industrial accidents, thus saving useful lives from cold charity or the scrap heaps of society.

Conclusion

Training is being recognized more and more as a necessity to every industrial establishment. Very simple processes have slight need of it; but no process however simple but will be the better for well-thought-out methods of training. The training department need not be elaborate and costly. Whether heralded or not every factory perforce sets aside some regular machinery for training green hands. Without studied methods and an experienced teacher the green hand blunders through many wasted hours, or even weeks and months, learning how to produce, and only by accident does he attain the expert's method. There is a best way to do anything, and the company's training department sees to it that every new operative hired knows that best way before entering the production floor.

The dividend in satisfaction to worker, foreman and management is good payment, without counting the immeasurably increased efficiency of the plant. Hiring by usual methods, for semiskilled and skilled workers, is estimated to cost from $50 to $200 for each worker. The company obtains enough saleable product from its training room to meet the entire cost, so its hiring is free. Besides, the opportunity to freely change to another job within the plant, with training available at will, tends to make the employee more contented. This is reflected in the lowered turnover and the heightened plant morale. In this way the training department coöperates with the employment department, and the employment department is relieved from guessing the value of new employees. The means of absolutely testing and establishing their qualifications, without expense, is provided. The employment department is relieved from danger of sinking into a mere labor-recruiting agency and becomes an engineering element of the staff, scientific and profitable.

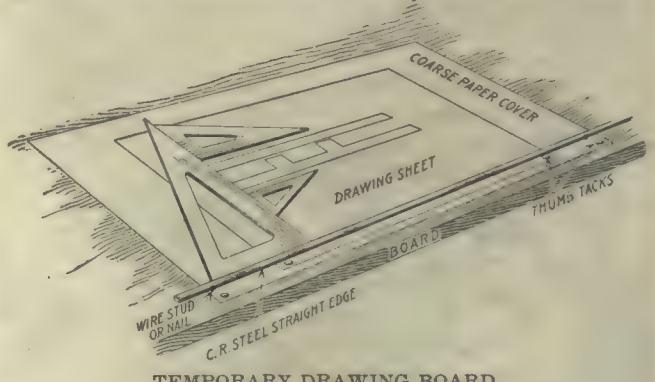
The possibility of training competent toolroom workers in eight weeks, until this successful experiment of the company was made, could hardly have been admitted. The secret probably lies in their rule of admitting only high-grade machinists of long experience to the course, and those only who have served long with the company and themselves ask for the opportunity. The training is thus made a real reward and an incentive for every employee in the plant to look forward to.

A Temporary Drawing Board

By E. C. Fritch

While the drawing table here described may not be a new one it may be found convenient when temporary drawings are to be made in the shop or home where a regular drawing table is not available.

On any flat smooth-surfaced board or bench a piece of coarse paper is tacked as a cover. Two nails or studs are driven in the board near the lower edge and allowed



TEMPORARY DRAWING BOARD

to project about ½ in. above the surface. Against these two nails a proper length of ¼ x ½-in. cold-rolled steel bar is placed, resting against the two nails.

The drawing paper is allowed to reach ½ in. below the steel bar and there tacked at both corners. Two triangles complete the outfit.

When the board is used horizontally on the table or the bench a slight pressure of the triangle downward against the straightedge will always keep it in position and the triangles can be moved back and forth, the steel bar serving as a guide and straightedge which can readily be removed or replaced at will when finishing or lettering the drawing.



WAR-TIME HUMOR

Official Correspondence Re Rats and Airplanes

SUPERINTENDING CONSTRUCTOR OF AIRCRAFT
U. S. NAVY
Boston, Mass.

October 4, 1918.

To: Bureau of Construction and Repair.

Subject: Rats, and Casein Glue.

1. It has been noticed that since the use of Casein Glue at the Burgess plant, the rats have increased in alarming numbers. After the workmen quit in the evening, the rats immediately appear on the floor and make a raid on the Casein glue cans. In the opinion of this office this could be very serious as no doubt rats could destroy a wing panel in their attempt to get the glue. It is suggested that some poisoning be introduced into the glue or something be done to make the Casein Glue less delicious to the taste of rodents. It would be dangerous to leave machines in storage which were made up with Casein Glue.

Inspector

160-Z-20 (A)

Washington, D. C.
October 8, 1918.

To: Superintending Constructor of Aircraft, U.S.N.
Boston, Mass.

Subject: Edibility of Casein Glue.

Reference: (a) Supt'g. Constr. Buffalo, letter 3-F dated Oct. 4, 1918.

1. It is noted that rodents apparently consider casein glue luscious, and that they express a preference for it as compared to hide glue. This may be due to the lacteal origin of the former. Since the components of casein glue usually include caustic soda and lime, it is natural to believe that the mastication of any considerable amount would have the same effect as a rat exterminator. However, the manufacturers will be advised of your experience, and suggestion will be made, that if feasible, a small quantity of toxic ingredient be incorporated in the glue.

By Direction - Chief of Bureau.



160-Z-20 (A)

Washington, D.C.
October 10, 191

To: Superintending Constructor of Aircraft, U.S.N.,
Boston, Mass.

Subject: Edibility of Casein Glue.

1. In further reference to the matter of rodents, and their apparent relish for casein glue, it is suggested that an attempt be made to rid the Burgess factory of the pests. The following procedure is recommended as having given most successful results in various shops:

Procedure

First encourage the rodents to congregate at one central point in the factory by placing at such point every evening, ham sandwiches well spread with lard. This type of food will cause the rats to swarm in every evening and proceed to the refreshment center. After having continued this treatment four or five days in order to avoid arousing the rats suspicion that an attempt is being made to dislodge them, the food should be treated by thoroughly mixing about 20% of Barium Carbonate with the lard previous to spreading upon the bread

2. The Bureau is forwarding a pound of Barium Carbonate which may be used for the above purpose. It is believed that if the above procedure is carefully followed out, the Burgess Company may be rid of the rats at an early date.

Chief of Bureau

SUPERINTENDING CONSTRUCTOR OF AIRCRAFT
U. S. NAVY
Boston, Mass.

November 25, 1918.

To: Bureau of Construction and Repair.

Subject: Disposition of salvaged material.

References: (a) Sup. Con., Boston, letter 3-F of October 4, 1918.
(b) Bu. C&R letter 160-3-20 (A) of October 8, 1918.
(c) Bu. C&R letter 160-Z-20 (A) of October 10, 1918.

1. Information is requested in regard to the disposition of the following material at the Burgess Plant, manufactured in accordance with instructions contained in reference (c):

Four completely assembled three-ply ham sandwiches.
Fabricated parts of seven ham sandwiches.

The four assembled sandwiches are rejected material, two having been rejected for spiral fibre in the centre ham lamina, it being the opinion of this office that material containing spiral fibre would not prove attractive to an Aircraft rat. Two were rejected on account of pronounced warping of the two outer laminae which were of slash sawn material.

2. It is suggested that assembled and fabricated parts be crated and shipped abroad to Mr. Hoover for distribution, the assembled parts to be delivered to the most deserving of the suffering Germans, and the fabricated parts to the starving Belgians. The assembled sandwiches were treated with barium carbonate, while the fabricated parts were untreated.

3. No disposition is necessary for the balance of one pound of barium carbonate and the carcasses of fifteen rats who had sampled the sandwiches, as they were destroyed in the fire at No. 2 Plant.

Superintending Constructor of Aircraft



Special Pullers for Bearings

By Harry C. Satterthwaite

In building various machines and machine parts it is frequently necessary to diassemble the machine partially in order to replace a damaged or defective part or to make a necessary adjustment, but owing to the use of antifriction bearings of the ball or roller type in some machines it is often a very unhandy and difficult operation to perform.

In many shops the special equipment for such work consists of a heavy hammer and a "driving bar," which may be anything from a bastard file to a copper rod. This manner of removing such bearings has nothing to commend it as a time saver, and it certainly does not improve the condition of the raceways to subject them to this violent concussion.

Having several bearings of this type in almost inaccessible places their removal became a serious manufacturing problem and the pullers described herewith were designed for this purpose.

In Fig. 1 is shown a puller for removing the outer race of a tapered roller bearing from its seat. This race is approximately 5½ in. in diameter by 2¼ in. long. The counterbore at the bottom of the seat, ⅛ in. deep, provided the only means of getting behind the bearing. The two swinging arms were turned on their outer surfaces to the small diameter of the race, leaving the wedge-shaped end to expand under the race. These arms were expanded by means of the T-headed bolt acting against their sloping inner surfaces. A shoulder on this bolt acted as a stop against the cross-arm to prevent distorting the race so as to cause it to bind in the seat.

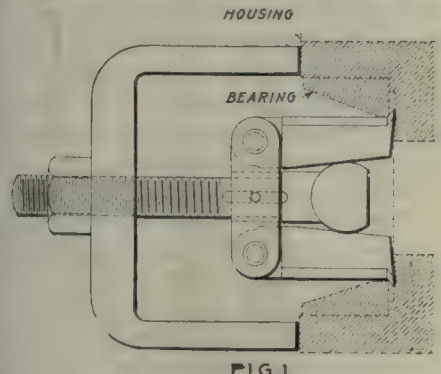


FIG 1

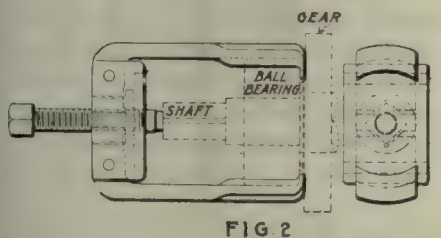


FIG 2

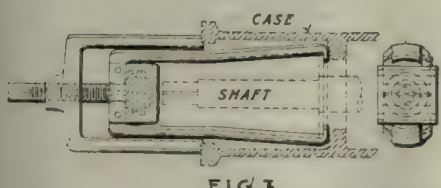


FIG 3

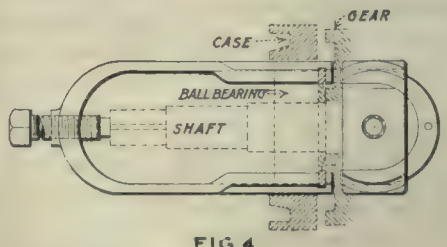
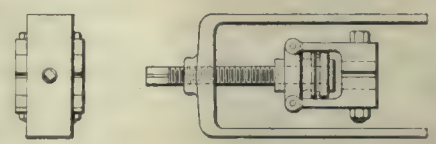
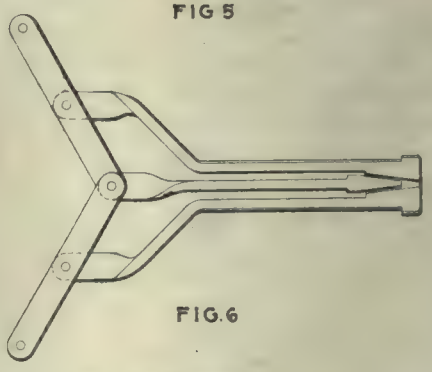


FIG 4


FIG 5


FIG 6

FIGS. 1 TO 6. SPECIAL PULLERS FOR BEARINGS

In Fig. 2 is shown a puller for removing a double-row annular ball bearing from the end of a transmission shaft assembled in a housing. One-eighth of an inch space between the back of the bearing and an adjoining gear with a round corner on the bearing makes a special puller a necessity. The channel-shaped piece in which the swinging arms are hinged serves as a tie bar for the puller arms and also holds the square nut in position when the puller is not in use. This nut fits loosely between right-angle notches cut in the short leg of each swinging arm, which prevents the nut turning when the screw is tightened against the end of the shaft. The flange on this square nut applies pressure to the swinging arms to hold them firmly behind the bearing against their tendency to open up on account of the radius on the corner of the bearing. The ends of the swinging arms are forged about 4¼ in. in diameter to fit the outside of the bearing. This stiffens the puller arms, gives a wider contact behind the bearing and applies the pressure close to the corner of the hooked end.

In Fig. 3 is shown a tool for pulling a malleable-iron

bearing housing out of the aluminum case and off the bearing on the shaft. The bearing housing is first driven back one quarter of an inch by means of a brass rod inserted through an opening in the case. This allows the puller to be slipped in sidewise behind the flange, as shown. The channel body and swinging arms are similar in construction to the puller shown in Fig. 2, but since the pull needs to be against the case instead of against the shaft a spider is provided to take the thrust againt the end of the case and a ball thrust bearing is used to prevent undue twisting when pressure is applied.

After the housing is removed and the bearing remains on the shaft, the puller shown in Fig. 4 is used to remove the bearing. Three-eighths of an inch between the outside of the bearing and the bore of the case, with a gear shouldered within ¼ in. of the end of the bearing, gives little room to apply a puller. The puller arms were machined to a slip fit between the bearing and case so as to project past the bearing into the recess on the side of the gear and so that the U-shaped washer could be slid into the slots in the ends of the puller arms behind the bearing to be pulled. Tightening the screw against the end of the shaft readily removed the bearing.

The puller shown in Fig. 5 is used for removing a stub shaft with integral gear, assembled with radial and thrust bearings and bearing housing.

The only projecting part is the squared end of the shaft which is clamped between the swinging arms by the two bolts shown. The spider has legs to thrust against the case and is threaded to take the pulling screw.

The tool shown in Fig. 6, while not a bearing puller, is somewhat similar in action and a very handy tool for various assembling operations. It is used for assembling a heavy differential assembly endwise into the differential housing of a rear axle. Two arms are pivoted at their inner ends to an expanding bar with a wedge end. This wedge end works between two tapered surfaces at the lower end and in the inner sides of the two side bars. The top ends of these side bars are offset and attached one to each of the pivoted arms a short distance on either side of their pivoted ends. A chain is attached to the outer ends of the pivoted arms, and when hooked over a hoist pulls the ends of the arms up and toward each other, thus forcing the wedge firmly between the tapered surfaces of the side bars, causing them to expand under the lower end of the assembly being lifted or to grip the bore firmly as the case may be.

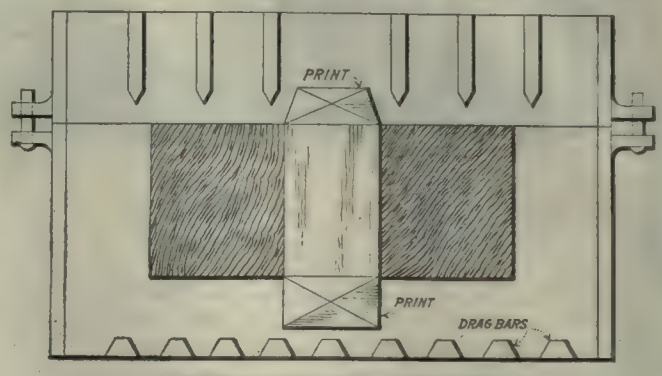
If there is clearance room under the assembly the side bars may have hooks at their lower ends, otherwise they should be machined to the arc of the bore and knurled. The hook ends and working surfaces of these pullers are hardened to stiffen them and prevent wear.

"How Would You Make This Casting?"

By John Compo

On page 510, Vol. 49, of the *American Machinist* M. E. Duggan pays me a compliment by declaring my method the best he had seen for the production of this casting in quantities, and goes on to say that quantity is not to be considered—it is speed that is wanted. Well now, I'm sure he will agree with me that quantity and speed go hand in hand.

The ability to produce large quantities in quick time by any well-thought-out and successful method spells speed, but I take it that Mr. Duggan refers to a "one off," or repair, job, which is a different matter entirely, and had I known, I could have given him a dozen rough but speedy ways of getting one casting. On the same



CORING WITHOUT A CORE BOX

page appears another sketch from my friend's able pen, in which he describes his method of making a square block, with a cored hole, without making a core box. I suppose this is a hurry-up job also, and only one casting is required; but that really doesn't matter, as my system or method of making is quite good for either one or six. I agree with him that there is no need for a core box; neither is there any need for the elaborate system of tailprints shown in the sketch.

In the first place you seldom get a casting from a pattern of this style without the ugly mark of the tailprints. I very often have similar castings to produce, and in all cases adopt the following method, which is simple, quick, quite commonly used and very satisfactory, leaves no marks and produces a perfectly sound casting. I simply box up the block pattern and put ordinary draw prints on top and bottom, the top print being made about half the length of the bottom print and well tapered, so that the core will center itself easily when the top part or cope is being placed in position. A standard round core from stock is used, and all the molder has to do with it after cutting to the length required is to rub a little taper on the top end, which is a very simple task.

This, in my opinion, is a far simpler and more satisfactory job than that shown in the sketch by Mr. Duggan, and it certainly can be turned out quicker and cheaper by both pattern shop and foundry than it possibly could be were his method employed.

Molding a Large Casting

By M. E. Duggan

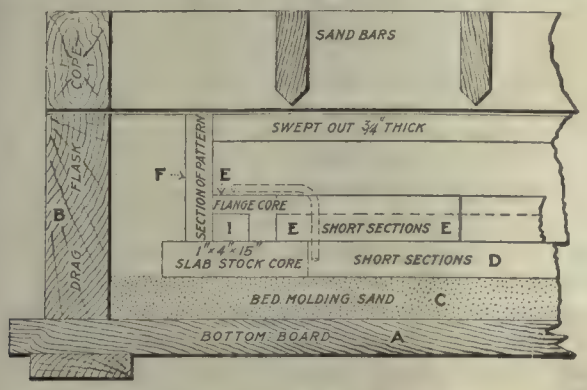
Some time ago I described how the pattern for a furnace door 20 in. wide and 48 in. long was molded. Recently we had occasion to cast a door identical in design but much larger and there is a great difference in the way in which the patterns were made and molded.

For the small casting a full pattern was made, but for the larger one, which measured 4 ft. 6 in. wide by 7 ft. 3 in. long, a skeleton pattern consisting of the two

sides and two ends was used so that it could be molded in the drag and thus avoid the necessity for rolling over after the mold was completed.

The skeleton pattern, a core box for the flange cores which were in sections 14 in. long, and a "strickle board" constituted the outfit. The sketch shows the manner in which the mold was made.

The bottom board *A* was laid on the floor of the foundry and leveled. The drag flask *B* was then placed



MOLDING A LARGE DOOR CASTING

in position, and molding sand filled in and struck off to the required depth to form the bed *C*.

Stock slab cores *D* were laid on top of the sand bed all around the mold in the position indicated in the sketch, and on these cores the pattern was placed so that the top edge of the pattern came flush with the top of the flask.

The flange cores *E* were laid on the slab cores and against the pattern *F*. Sand was then filled in up to the top of cores *E*.

In order to make the cores *E* secure so that the metal forming the flange would neither shift nor raise them the base of the cores should have been made 2 in. wide at least. These were ¾ in. wide, and to secure them against shifting it was necessary to place 48 gaggers over the cores as shown. Sand was then filled in and the mold finished in the usual manner. The cope was made and lifted hinge fashion, and the part of the mold forming the front of the door was "swept out." The time for two molders was 7 hours. The casting weighed 825 pounds.

Counterbores

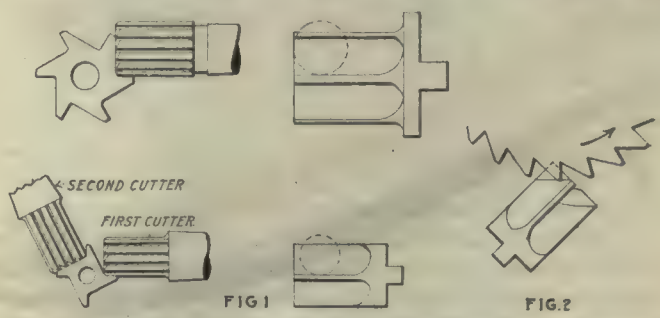
By W. P. Lotz

In order to fill the demand for a counterbore that would cover almost any size that would be required in our work, the interchangeable counterbore described herein was designed. As shown in the table there are five classes of counterbores described. One shank will take any cutter in its class, and any cutter or pilot can be interchanged with another in its class.

The cutters can be ground about two-thirds of their length, giving much longer life than the average counterbore. This style cutter is also very economical, as a very small amount of high-speed steel is required for the cutter. Another feature in the design of this cutter is the ease of resharpening, as there is very little clearance to be ground away.

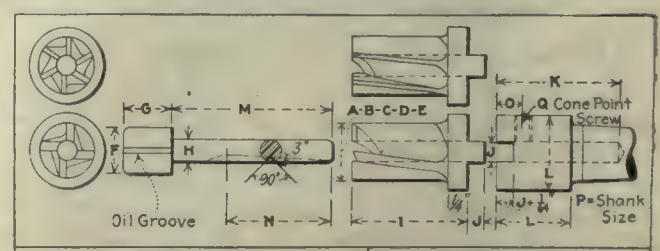
Fig. 3 shows that the size *E* shank can be used with cutters from ¼ to $\frac{11}{32}$ in. inclusive; size *D* shank can be used with cutters from $\frac{3}{8}$ to ½ in. inclusive; size *C* shank can be used with cutters from ⅝ to 1 in. inclusive; size *B* shank can be used with cutters from 1⅛ to 1½ in. inclusive, and size *A* shank can be used with cutters from 1⅝ to 2 in. inclusive. Also pilots $\frac{5}{32}$ to $\frac{5}{16}$ in. can be used with cutters from ¼ to $1\frac{1}{32}$ in.; pilots from $\frac{7}{32}$ to $\frac{7}{16}$ in. can be used with cutters from $\frac{3}{8}$ to ½ in.; pilots from $\frac{5}{16}$ to ⅞ in. can be used with cutters from ⅝ to 1 in.; pilots from ⅞ to 1⅛ in. can be used with cutters from 1⅛ to 1½ in., and pilots from ½ to 1⅝ in. can be use with cutters from 1⅝ to 2 inches.

In milling the counterbore an end mill of suitable diameter is used for milling the flutes as shown in Fig.



FIGS. 1 AND 2. MILLING FLUTES AND CUTTING RELIEF

1. By this method the flutes can be milled either straight or spiral. After the flutes are milled the relief for the cutting edge is milled as shown in Fig. 2. This same procedure is followed with a grinding wheel instead of a milling cutter, giving additional relief after the counterbore is hardened. In sharpening the counterbore the cutting edge is all that requires grinding.



CUTTERS UP TO 1½" DIAM. HAVE 4 FLUTES
1½" DIAM. AND ABOVE HAVE 6 FLUTES

A	H	I	J	K	L	M	N	O	Q	P
2	7/16	2	7/16	2	2	3	1 3/8	5/8	3/8	No.4 Morse Taper
1 7/8	7/16	2	7/16	2	2	3	1 3/8	5/8	3/8	
1 3/4	7/16	2	7/16	2	2	3	1 3/8	5/8	3/8	
1 5/8	7/16	2	7/16	2	2	3	1 3/8	5/8	3/8	
B										
1½	5/16	1½	5/16	1¾	1½	2 3/8	1 3/8	½	5/16	No.3 Morse Taper
1 3/8	5/16	1½	5/16	1¾	1½	2 3/8	1 3/8	½	5/16	
1¼	5/16	1½	5/16	1¾	1½	2 3/8	1 3/8	½	5/16	
1⅛	5/16	1½	5/16	1¾	1½	2 3/8	1 3/8	½	5/16	
C										
1	¼	1½	¼	1¾	1	2⅛	1⅜	13/32	¼	No.2 Morse Taper
⅞	¼	1½	¼	1¾	1	2⅛	1⅜	13/32	¼	
¾	¼	1½	¼	1¾	1	2⅛	1⅜	13/32	¼	
5/8	¼	1½	¼	1¾	1	2⅛	1⅜	13/32	¼	
D										
½	3/16	1¼	3/16	1¾	¾	1¾	1	5/16	3/16	No.2 Morse Taper
3/8	3/16	1¼	3/16	1¾	¾	1¾	1	5/16	3/16	
E										
11/32	1/8	1	1/8	1¼	5/8	1⅜	¾	¼	3/16	No.1 Morse Taper
5/16	1/8	1	1/8	1¼	5/8	1⅜	¾	¼	3/16	
9/32	1/8	1	1/8	1¼	5/8	1⅜	¾	¼	3/16	
¼	1/8	1	1/8	1¼	5/8	1⅜	¾	¼	3/16	

PILOT AND SHANK DIAM. FOR "A" DIAM. CUTTERS

F	G	F	G	F	G	F	G	F	G
½	½	¾	¾	1	1	1¼	1	1½	1
9/16	9/16	13/16	13/16	1 1/16	1	1 5/16		1¾	1
5/8	5/8	7/8	7/8	1⅛	1	1⅜	1	1⅞	1
11/16	11/16	15/16	15/16	1 5/16	1	1 13/16	1		

FOR B DIAM. CUTTERS

3/8	3/8	5/8	5/8	7/8	7/8	1⅛	1	1 3/8	1
7/16	7/16	11/16	11/16	15/16	15/16	1 5/16	1		
½	½	¾	¾	1	1	1¼	1		
9/16	9/16	13/16	13/16	1 1/16	1	1 5/16	1		

FOR C DIAM. CUTTERS

5/16	5/16	9/16	9/16	13/16	13/16				
3/8	3/8	5/8	5/8	7/8	7/8				
7/16	7/16	11/16	11/16						
½	½	¾	¾						

FOR D DIAM. CUTTERS

7/32	7/32	5/16	5/16	7/16	7/16				
¼	¼	3/8	3/8						

FOR E DIAM. CUTTERS

5/32	5/32	5/16	5/16						
3/16	3/16								
7/32	7/32								
¼	¼								

FIG. 3. DETAILS OF COUNTERBORES

The "Coverage" of the Compensation Acts—III

By CHESLA C. SHERLOCK

The compensation acts of this country are in great measure based on the English laws, but as the divergent conditions in the two countries became manifest the application of the laws have had to be modified. In this article, which is the final one of the series on "The Coverage of the Compensation Acts," the distinction between accidents occurring "out of" and "in the course of" employment and at other times is technically construed by citations from American and English courts.

OUR compensation acts were largely borrowed from the English act, in which recovery was limited to cases arising out of accidents, but as the English courts had taken so many liberties with the word accident we had either to accept the English legal meaning of the word or formulate a meaning of our own. As a result conflicting definitions and decisions have arisen regarding the meaning of the term.

Lord Macnaghten's definition is probably oftener quoted in this country than any other. Said he: "Accident is used in the popular and ordinary sense of the word as denoting an unlooked for mishap or an untoward event which is not expected or designed." And, in general, recovery of compensation is limited to those injuries caused by accident arising out of and in the course of employment.

American Interpretations of the Term Accident

The North Carolina court has said that it is "an event resulting from an unknown cause, or an unusual and unexpected event from a known cause; chance; casualty." The Louisiana court defined it as follows: "The word 'accident' per se means an unforeseen and unexpected event." The Minnesota act defines an accident to be "an unexpected or unforseen event, happening suddenly or violently, with or without human fault and producing at the time injury to the physical structure of the body."

In Wisconsin the court said: "The term 'accidental,' as used in compensation laws, denotes something unusual, unexpected and undesigned. It contemplates an event not within one's foresight and due to purely accidental causes." In this case it was shown that a workman contracted typhoid fever by reason of bacteria in the drinking water furnished by the employer, and the court held that this constituted an accident within the meaning of the act.

In some states, particularly Massachusetts, the word accident has no place in the statute. Recovery is based on "personal injury," and it has been held that anything constituting a personal injury entitles a workman to compensation whether it resulted from an accident or not. It is not necessary that the disability or incapacity be caused at the time of the accident. If the latter is the proximate cause of the injury compensation is payable although the accident itself was trivial.

An example often found in compensation cases is as follows: A workman accidentally cuts his finger while at work, and, due to the causes which intervened or were superinduced by the accident, he loses his arm. He is entitled to compensation because the proximate cause of blood poisoning was the cutting of his hand.

Frequently workmen receive slight injuries while at work, of which at the time they think nothing. Later developments show that they have suffered severe injury and may even be incapacitated. They are entitled to compensation if they can link up the original injury with the incapacity.

A workman may receive a slight injury and the nature of his employment be such that it is greatly aggravated and serious consequences ensue. Such an instance is called to mind where an elevator operator wrenched his ankle. He suffered little inconvenience and continued at work, but his weight on the lame ankle brought about a condition that permanently disabled him. He was entitled to, and received, compensation.

Hernia a Matter of Divided Opinion

Diseases are not accidents in the ordinary meaning of the term, but where the disease is the direct result of an accidental injury compensation is payable. Hernia has caused a great deal of discussion in the courts. There is also division of opinion on this subject among medical men, one camp asserting that it is a disease to which we are more or less predisposed and not necessarily the result of an accident, while the other claims that it is of traumatic origin only.

If a workman can prove that hernia resulted from an accident and can definitely fix the time of the injury and that it was received while he was engaged in the duties of his employment, he may be compensated, but if he merely discovers this condition, has suffered no pain or does not know just when it occurred, he has no claim on his employer.

Lightning, Frostbite and Sunstroke Question

The question has arisen again and again whether lightning, frostbite and sunstroke are accidents within the meaning of the compensation acts, and they may and they may not be.

In a Wisconsin case it was said: "Lightning stroke is not popularly spoken of as an accident where it comes from the action of the elements without the agency of man. When, however, the agency of man combines with the elements and produces injury to the employee by lightning stroke it may be said that the injury grows out of the employment and is accidental."

In a Scotch case it was said: "To be struck by lightning is a risk common to all and independent of employment, yet the circumstances of a particular employment might make the risk sufficiently exceptional to justify holding that the accident arose out of the employment."

This rule is quite generally accepted where the injury was caused by the elements, such as lightning, frostbite, and sunstroke. If the workman is subjected to no greater hazard by his employment than is commonly ex-

perienced by others in the community from the same cause then his injury is not compensable. If a workman is overcome while working on a metal roof on an extremely hot day he would be entitled to compensation, but if he was overcome on the street he would not be entitled to it. If a workman is forced to work in a room having a high temperature he is likely to receive compensation to which under ordinary circumstances he would not be entitled. The "course of the employment" therefore will determine just what accidents call for compensation.

A Risk Common to All

Must the employer compensate employees who are injured by accident while on their way to work? Generally the employer is not required to do so, as the street hazard is considered a risk common to all. However, if the workman's employment subjects him to street hazard greater than that assumed by the average person he will be entitled to compensation. A moot question is whether an employer is liable for the payment of compensation to a workman who was injured while passing from his place of work to the street but while still on the premises of the employer. As to this the courts seem to lean to the view that the employer is liable.

An injury is none the less an accident arising out of the employment because it is caused by the horse play of a fellow workman. A workman was passing from his bench to the street and when he started down the stairs a fellow workman tickled him with a folded newspaper, causing him to jump so that he lost his balance and fell, sustaining injuries. The court held that this accident "arose out of" and "in the course of the employment" and that compensation should be paid.

An accidental injury does not arise in the course of employment when it is the result of the employee's wilful intention to injure himself or of his "serious and wilful misconduct." The statutes exclude these classes of injuries on the ground that no man can be allowed to profit by his own dishonest motives.

The Lord Chancellor in an English case said, speaking of "the course of employment": "I think an accident befalls a man 'in the course of' his employment if it occurs while he is doing what a man so employed may reasonably do within a time during which he is employed and at a place where he may reasonably be during that time to do that thing." It follows that while accidents arise "in the course of" the employment they do not all arise "out of" it, and employers should keep this distinction in mind. They must not arise out of the one or the other, but they must arise out of and be in the course of the employment in order to be compensable.

Distinction Between Accidents

For instance, a workman was employed in a machine shop to operate a simple machine. During noon hours he had a habit of tinkering with a complicated machine of which he had little knowledge. He was warned to let it alone, but he persisted until he received an injury for which he sought compensation. He did not obtain it, however, as his injury, while arising in the course of the employment, did not arise out of it.

Lord Justice Farrel, an English authority, has said that while many accidents occur in the course of employment and not out of it he was unable to think of any arising out of the employment that were not also in the course of employment.

Ordinarily if a workman leaves his employment and is injured he cannot recover compensation, a case of this kind, known as the "bug" case, being in substance as follows: A workman was wheeling raw material from his employer's basement to an elevator, and while on his way with a load a large bug ran across the floor. He dropped his work and ran after the bug, smashing it on the floor with his foot; he lost his balance and was thrown to the floor, sustaining severe injuries to his back. It was held he was not entitled to compensation because as he had dropped his work he had got outside the course of his employment. The mere fact that only a few paces separated him from his employment made no difference.

Some Exceptions to the Rule

If a workman is employed on a machine and goes to another part of the shop to operate another machine, unless such act is within the scope of his employment and sanctioned by the employer he is outside his employment and has no right to compensation. The exception to this rule is that in emergencies an employee may drop his own work to go to the aid of a fellow workman because the courts recognize that emergencies are unusual occurrences in which the ordinary rules cannot be applied.

In this respect a man working at his machine heard a fellow workman scream, and on rushing to the latter's assistance he fell through a hole in the floor and was scalded to death by the steam in the apparatus below. Compensation was awarded. Another case is that of a workman in a factory that caught fire, who while crossing the street to turn in an alarm was run down by an automobile and injured. It was held that his employer should pay him compensation.

It is the essence of compensation practice that rules cannot be formulated by judicial decisions and precedents as under the common law. Each case must depend upon the circumstances surrounding it and should be viewed alone in its relation to the statute. No other case or decision should be considered as an authority unless it is identical with the case in hand.

Employers Must Sift Each Case

Lord Shaw, an English judge, has wisely said: "I think it is a dangerous thing in the sphere of law to conjure out of analogies a principle or proposition arising upon judicial dictums which are in any way in conflict with the clear proposition and text of a modern statute." Employers should look to their own statute and interpret each case arising in the light of the statute, together which such judicial aid as may be necessary to make the meaning of the statute clear.

The "coverage" of the compensation acts determines the whole question of right and liability. It is the very root of the system. It fixes the right of the workman to compensation and it determines whether the employer is liable for its payment, and employers who get a good idea of the "coverage" of the acts will not be troubled with understanding what the compensation acts propose to do.

To sum up. (1) The employer is primarily liable for the payment of compensation and that liability is not discharged until the injured workman has been paid. (2) There must be a contract of service, express or implied, where one person stands in the relation of employer and another in the relation of employee. (3) Dependents who can prove that the deceased made actual contributions toward their support are entitled to compensation from the employer. (4) Only injuries arising through accident are compensable, and recovery is further limited to those accidents arising "out of" and "in the course of" employment.

Hand Versus Power Feeds in Surface Grinding

By Arthur W. Suiter

An article by Donald Baker on page 901, Vol. 49, of the *American Machinist*, discussing the relative merits of hand and power feeds on surface grinding machines, was of interest to me because personal experience and observation have led me to much the same conclusion as Mr. Baker in regard to this matter. Therefore it was rather a surprise to find on page 10, Vol. 50, a criticism of the above-mentioned contribution in which the suggestion is treated with thinly veiled sarcasm with some rather irrelevant remarks thrown in for good measure.

As the writer of the first article makes several references to toolmakers and tool shops it is surely to be taken for granted that he is discussing this question in its relation to toolroom work only, therefore all arguments based on manufacturing requirements are inapplicable to this particular matter.

Others Prefer Feed Disconnected

It may be of interest to readers of the *American Machinist* to know that there are others who, like Mr. Baker, when using surface grinding machines such as Brown & Sharpe No. 2 on tool, gage and die work prefer to have the automatic-feed mechanism either disconnected or removed altogether. Mr. Senior admits a suspicion that there might be points that have escaped his observation and I can confirm this by referring him to at least three firms that have removed the operating parts of the automatic feed on their surface grinding machines that are used for tool work. The smallest of these shops keeps three such machines in practically constant operation; the largest has about 25 that have received this alteration; in the other place at least 12 machines are in use with the power feed removed. Does anyone suppose that these changes have been made merely on account of a whim?

Some Good Points

Mr. Baker brings up some good points in his article, which may be summed up as follows:

1. A light depth of cut and a liberal cross-feed will distribute the heat very evenly throughout the piece. Compare this with the heavy-cut, fine-feed method, where a hot band gradually creeps across the work, greatly increasing the difficulty of keeping hardened pieces from warping.

2. A shallow depth of cut fed across rapidly by hand is analogous to the practice of using a fast table traverse in the cylindrical grinding of shafts, etc. This method is preferable principally because the even distribution of the wear nearly eliminates the tendency of the face of the wheel to round over.

3. Work is often encountered where some portion of the surface to be ground can stand a materially less length of traverse than is required for the remainder. Is it customary to reset the power feed stops in such cases? No; but with hand feed the table travel is unconsciously adjusted to just cover the work and no more, for human nature abhors the idea of moving a grinding-machine table a single inch farther than is absolutely necessary. With automatic feed, however, "We should worry" is the verdict.

4. It can hardly be disputed that for intricate or delicate parts hand feed gives better results every time. As Mr. Baker intimates, the hand-feed method will be of assistance in guiding the workman to the selection of proper wheels, for the "feel" will often tell him whether the wheel is really grinding or simply rubbing off the stock.

The Psychological Phase

As to the psychological phase of this question I am of the opinion that the omission of the power feed on these machines makes the workman much more attentive to his business. Another point that is well worth considering is the saving in the cost of building these machines in case the automatic feed were omitted. When not required these unnecessary parts are not only useless and represent needless outlay, but they form excellent dirt traps as well.

There is reason to believe that a surface-grinding machine properly designed and accurately made, but entirely devoid of the automatic-feed feature, would be a very salable machine tool where the work is of such a nature that the constant attention of the operator is desirable.

The automatic feed, in my belief, could advantageously be confined to machines intended only for manufacturing where one operator is required to handle two or more machines.

One Point Open to Criticism

There is only one point in Mr. Baker's article that seems open to criticism. The reference to the machine in question as being unpleasant to run and the inference that the workman will be ambitious to get the job done as quickly as possible, principally to get off such a nasty machine, are sorry compliments to both machine and management. If it is connected to an exhaust fan and the work is of an average grade there is but one thing that is likely to make it a disagreeable machine to work on, and that is the failure of those in charge to see that it is kept clean and properly supplied with wheels.

No Logical Reason

In the perusal of Mr. Senior's article it is apparent that while all sorts of other matters are brought in not a single legitimate reason is advanced as to the actual advantages obtained from the use of automatic feeds on surface grinding machines used on tool and similar lines of work. It would be interesting and profitable to our readers, I am sure, to learn on what grounds Mr. Senior bases his conclusions.



IT IS proposed to base education and training in the Ordnance Department on the following general considerations:

The outstanding feature of the recent war is the tremendous extent to which science and engineering have been applied to warfare. It will not be disputed that future warfare will to a still greater extent consist of civil, mechanical, chemical and sanitary engineering operations on a stupendous scale.

The operations in France have hinged time after time on the development of new methods of warfare which were but the application of engineering knowledge to fighting. In general the tendency was to bring out the new methods of warfare prematurely, and thus allow the opponents an opportunity to meet them with counteractive measures. For instance, if the Germans had delayed the use of poisonous gases until the technique of their use had been further developed, the war would probably have terminated in favor of the Central Powers prior to the entrance of the United States into it. Similar remarks apply in a greater or lesser degree to submarine warfare, aerial warfare, the use of tanks and caterpillars, etc.

The lesson to be drawn is that a nation hoping to maintain its place among the powers must in time of peace prosecute the development of new methods of warfare continuously and with vigor. The success of this development depends directly on having proper personnel properly trained assigned to the work. It is to be noted in this connection that the United States entered the war with the benefit of the war experience of the allied powers and with much greater deliberation than can be expected in the event of future wars.

The quantities of war material required by a modern army are tremendous. It is impracticable to accumulate more than a small portion of this material in time of peace. Therefore the first and most urgent necessity of a nation when war is imminent is to begin the manufacture of munitions. Experience has shown that soldiers can be trained for fighting very much more rapidly than new factories can be placed in operation and necessary equipment and supplies turned out. Moreover it requires a much greater personnel to fabricate the munitions for an army than is required for the army itself. The efficiency of the Ordnance Department at any given time is of course the composite efficiency of its personnel, and is particularly dependent on the personnel in the higher grades. The future efficiency of the department is at all times being determined by the character of personnel being recruited in the lower grades and the training being given. From the standpoint of the ultimate requirements the most important work of the department is the selection of proper personnel and its training. Recruitment cannot be satisfactorily separated from training, and in the scheme of education and training contemplated the two are intimately connected.

Education and Training in the Ordnance Department

The war has proved to the most confirmed optimist that the length of the night required for a million freemen to spring to arms is somewhat greater than was anticipated and that shortage of arms does not help matters. As the munition-making industry must wait until war is imminent before actually getting started it is essential that the development of new methods and devices and the training of the personnel to direct their manufacture when the emergency arrives be carried on in peace times. This outline of the training scheme proposed by the Ordnance Department is comprehensive and shows a keen appreciation of the needs of the situation.

It should be understood that the project outlined is subject to such change as may be imposed by the General Staff, the War Department or legislative action, but it represents the ideal it is desired to approach.

Personnel to Be Trained

The following classes require ordnance training: Officers of the regular establishment (ordnance); officers of the regular establishment (line); officers of the reserve; enlisted personnel (ordnance); enlisted personnel (line); undergraduates in colleges (R. O. T. C.), and civilians and enlisted men at arsenals (vocational training).

In order to get a logical viewpoint of the development of the proposed scheme of training these various classes will later be discussed in turn, but not in the order given above.

It is proposed to make use of the following educational agencies for ordnance training:

An Ordnance School of Technology to be established at the Watertown Arsenal to handle the following subjects: Metallurgy and metallography; metallurgical

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chemistry; testing materials; shop work (machine shop, smith shop, foundry); steam power and compressed air, and administration.

Watertown Arsenal is selected for this school because of its splendid machine shop, foundry and steel-making facilities, its status as an establishment on a production basis and its nearness to civil educational institutions of the highest grade.

An Ordnance School of Application to be established at the Aberdeen Proving Ground to handle the following subjects: Military training for officers requiring it; advanced mathematics; ordnance engineering; ballistics; optics; gasoline engines; electricity; chemistry, explosives, etc., and ordnance-drafting practice. Aberdeen Proving Ground is selected for this school because it will be the center for development work for the department; it will have a personnel expert in the subjects named, and is a place where the necessary practical work of the courses can be carried out.



A FIELD GUN IN ACTION

The Various Service Schools will be utilized to assist in keeping officers of the department in close touch with the line and to bring into the department the latest ideas of the line troops in respect to ordnance material. This is thought to be especially important.

Civil Educational Institutions.—These institutions will be utilized by (a) establishing ordnance units in the R. O. T. C.; (b) by sending selected officers to take advanced specialized work in such institutions, and (c) by securing from time to time the services of professors from these institutions to give instruction in the schools of the department. The work under *b* will not only include technical instruction but also instruction in business administration, economics, etc.

Commercial Organizations.—It is hoped that from time to time opportunity may be found for selecting officers to study both the technical and executive sides of large commercial organizations. Under war conditions the major part of the commissioned personnel of the department will consist of reserve officers accustomed to the conduct of business as it is carried on by civilian agencies. It is extremely important therefore that the methods of the department shall be adjusted to agree with those customarily employed in commercial life as closely as conditions will permit. This will enormously accelerate the conduct of affairs in the early stages of entering on a war basis.

An Ordnance Operation, Maintenance and Repair School to be established at the Raritan Arsenal primarily for the instruction of enlisted personnel. This school is intended to amplify the work which has hitherto been done in giving instruction in the machine-gun schools, schools for saddlers, etc. Details are given below.

Vocational Schools at Arsenals.—It will be necessary to continue the training of apprentices at arsenals as heretofore. It will probably be found desirable to extend this training to include enlisted men. It will have to be conducted in vocational schools at the respective arsenals to suit the local needs.

Training of Undergraduates in Colleges (R. O. T. C.).—The Reserve Officers' Training Corps is being reestablished under the direction of the General Staff. It is expected to have ordnance units included. It is felt that the regular courses given in high-grade technical schools and colleges in the subjects of mechanical engineering, chemical engineering, etc., meet the needs of the department fairly well. It will be desirable to have a certain amount of military drill and instruction and to have ordnance subjects introduced into the regular courses. Texts for this purpose are in course of preparation. For instance, if a text is supplied on the subject of "Recoil Brakes," the subject can be introduced into standard courses on mechanical engineering without in any way interfering with the value of the course from a nonmilitary standpoint.

In general it will be satisfactory if the students in the first two years take any of the line courses (artillery, however, preferred). This will insure that they get the basic purely military training. For the advanced course (lasts two years) it is planned to allow the college authorities to elect from certain types of courses a sufficient number to make up the required amount of work. For instance, a junior physics course, which embraces the usual undergraduate work in optics and includes range finders, panoramic sights and other ordnance optical apparatus, would be allowed R. O. T. C. credit. The amount of credit would be arranged with the college authorities through the General Staff and would depend on the ground covered, and especially upon practical laboratory work. Similarly a course in applied mechanics, which includes certain ordnance subjects as for instance "Recoil Brakes," would be allowed R. O. T. C. credit. As will be explained later the Ordnance Reserve Corps should be composed of specialists. The larger number of reserve officers should be graduates in mechanical, metallurgical or chemical engineering, but a certain proportion of

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graduates in physics, mathematics and other subjects is desired.

In general the instruction in the advanced course should be given by the regular college faculty, texts and data being furnished by the department, but the instruction being entirely under the control of the college authorities. Courses for O. R. C. credit would be subject to approval by the department as to general scope only.

The end to be sought in maintaining a reserve corps of ordnance officers is that having such an organization and classification on the imminence of war the department will be able to expand with rapidity and place itself on a war basis almost immediately. It will need to obtain at once inspectors, production managers, designers, men qualified for research and development men for repair and maintenance and men for many other lines of effort. The proper way to do this is to have in the Reserve Corps men who are specialists and as far as practicable trained in time of peace for the various duties they are to assume in war. For instance, if the department needs a man to assist in the production of gun forgings in a new plant it should be able to obtain at once from its classified records of reserve officers one who has had the necessary experience and training and the proper personality to take over this work. It can do this only if it maintains a large reserve of officers and keeps in touch with these officers at all times so that the reserve list will mean more to the officers charged with making the selection than a list of names.



MACHINE-GUN INSTRUCTION

The department will find itself on reorganization with a reserve list of officers who have had ordnance experience during the recent war. These men are known to the department and will form a good nucleus on which to build. This present discussion relates only to obtaining additional reserve officers.

It is hoped that the department will be able to get each year at least 250 recent graduates of technical schools and colleges who have taken ordnance courses in the R. O. T. C. and who can be taken into the department for one year of training. These men should be recommended by the various college faculties. The training to be given each officer should as far as practicable be along the line of work he intends to pursue in civil life. This will serve a double purpose. It will give to the individual experience that will be invaluable to him in obtaining a position on leaving the department, in which he can exercise his particular talents to the best advantage. This will be of economic value to the individual and to the country at large. It will also enable the department to give the officer training which will serve to make him immediately useful in the event that the officer is ordered to active duty.

This training is to be given either at the Ordnance School of Technology or at the Ordnance School of Application, according to the particular specialty of the officer concerned. For instance, an officer who has taken a course in metallurgy and who intends to follow this line in after life would be sent to the school at the Watertown Arsenal. He would get into overalls and work for a year in the foundry, at the cupolas, converters, open-hearth and electric furnaces, etc.

This, however, is but the beginning. The great need of the department will be for officers of more mature years, and each individual who has had service with the department is to be carefully followed up. He is to be supplied with data concerning recent developments in the department along the line of his specialty, and when he comes up for recommission at the end of his five years in the reserve careful scrutiny will be given to the work which he has accomplished in civil life and he will be recommended for recommission in the same grade, commission with advanced rank or for discharge according to his record. This is to be done at the end of every period, and in this way it is expected the department will obtain a reserve of strong men who are known to the department.

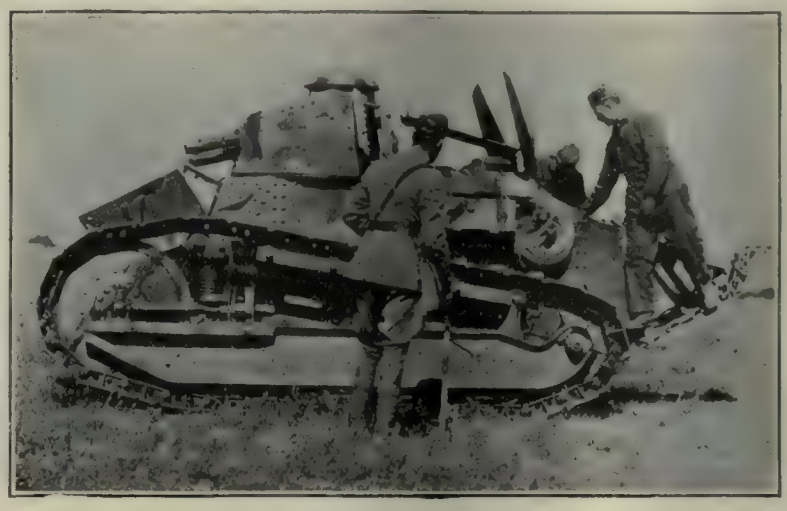
It is probable that a portion of the officers in the reserve will not continue to pursue the line of work which it followed when commissioned, but this need cause no embarrassment. The needs of the department are so varied that the men could be assigned to the division where their former experience could be utilized in connection with the line of work they are at the time engaged in.

It is anticipated that on again assuming a peace basis the department will have a large number of vacancies to fill immediately. These should be filled from the temporary officers now holding reserve or national army commissions in this country and abroad, and the vacancies should be distributed in all grades from colonel to second lieutenant inclusive. The department cannot afford to lose the opportunity which is now presented of obtaining men whose abilities have been demonstrated by war experience, in many cases on the actual field of battle.

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The vacancies hereafter occurring in the regular establishment should be filled from two sources. The highest graduates of the Military Academy should be allowed to come into the Ordnance Department on the same basis as they go into the Engineer Corps. All remaining vacancies should be filled from the Reserve Corps officers who have had a year's service with the department.

The latter will include men from different parts of the country and from all walks of life. It would be an intensely democratic method of selection in that the poor boy would have exactly the same chance as the rich one of ultimately obtaining an ordnance commission. It is believed to be very desirable that a considerable portion of the vacancies occurring in the regular establishment should be filled from nongraduates of the Military Academy. The department needs both graduates and nongraduates. Each class brings into the department its particular point of view and training and the best results will be received by a proper proportion of each type. An officer first entering the regular establishment as an officer of ordnance should receive basic military training similar to that hitherto given provisional officers at the Coast Artillery School, Fort Leavenworth or elsewhere, unless he has had such prior training.



A LIGHT TANK

As soon as practicable after the military training mentioned above has been completed, the officer should be given instruction which will make him acquainted in a general way with all classes of material handled by the Ordnance Department and with all the duties assumed by the department in connection therewith. To do this in a manner at all adequate will require two years of special training. This training may or may not be consecutive, but it is thought that in general it is preferable for the officer to get this training at as early a stage as practicable.

The subjects in which he should receive instruction are in general the following: Advanced mathematics; ordnance engineering; ballistics; optics; gasoline engines; electricity; chemistry, explosives, etc.; ordnance-drafting practice; metallurgy and metallography; metallurgical chemistry; testing materials; shop work (machine shop, smith shop and foundry); administration, and steam power and compressed air.

Having completed the above courses the officer may be considered to have the basic training requisite for ordnance officers. He is in no sense of the term an expert, nor is it thought to be possible for any officer at any time to be an expert in more than a very few of the many activities of the Ordnance Department. Recent experience has shown that it is essential that ordnance officers should specialize along some lines of ordnance effort rather than become officers with a general all-round knowledge but without a special knowledge of some one subject.

When the department again reaches a permanent basis there will be in it in the various grades many officers essentially without military experience and with a knowledge of only a part of the activities of the department. It will be necessary to make courses to fit the needs of these officers, and this will be done at the two principal ordnance schools.

Officers of the department that show special aptitude for given subjects should be given opportunity to specialize in the same by taking advanced courses in the department, in civil technical schools and colleges or in commercial establishments. These special courses should embrace not only the engineering phases of the department but should take up questions of administration, finance, shop management, etc. It is considered essential that ordnance officers of the regular establishment should maintain close touch with the line of the Army, and that to acquire this touch and to bring to the department a knowledge of the needs and desires of the line full use should be made of the various educational activities of the Army outside of the Ordnance Department. It is thought that at all times there should be ordnance officers in each of the following schools: Army War College, Army Staff College, Coast Artillery, Army School of the Line, School of Fire for Field Artillery, School of Musketry and such other schools as may later suggest themselves.

It is thought too that selected officers of the department should give lectures on ordnance subjects at the following schools: Coast Artillery, Engineering, Army Signal, Army Field Engineering, School of Fire for Field Artillery, School of Musketry, Signal Corps, Aviation and United States Military Academy.

These lectures should furnish a liaison with the line of the army that would be of great value to the department and to the line itself.

The department should maintain courses of instruction for officers of the line of the army for the purpose of giving them instruction on the theory and operation of all classes of ordnance material. For instance, courses could be given in small arms, machine rifles

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and other infantry equipment, field artillery, railroad artillery, coast artillery, tanks and caterpillars, etc.

These courses should embrace the theory of the material and its mechanical operation only. The tactical use of material is a subject for line schools. They are considered very important. It is certainly equally essential that the officer of the line should appreciate the ordnance standpoint as that the officer in the ordnance should appreciate the line standpoint. The fullest coöperation cannot be obtained unless there is a thorough understanding and sympathy between the ordnance and the line and the line and the ordnance. Proper development of material cannot otherwise be carried on.

The vocational schools at the arsenals and the Operation, Maintenance and Repair School at Raritan Arsenal will take care of the training of the enlisted personnel of the Ordnance Department. At the arsenals instruction will be given to meet local needs. The purpose of the school at Raritan Arsenal will be to furnish qualified men to operate the divisional repair shops, to handle such supply material as is charged to the Ordnance Department and to act as instructors in the divisional schools described in the next paragraph.

It has been found necessary in the past to maintain machine-gun schools, schools for saddlers, etc. This should be amplified. In each division a school should be established to which line organizations could send selected noncommissioned officers (and perhaps officers) to be trained in the care and operation of ordnance material. This instruction should be confined to elementary theory and operation, but should not embrace tactical use.

Personals

Maj. Ray W. Fuller was engaged in the export business with W. R. Grace & Co. of New York.

* * *

Maj. Thomas Kirk was formerly manufacturing manager with the Columbia Manufacturing Co., Columbia, Penn., and was in the service nearly 14 months.

First Lieut. Peter V. Kolb was employed by the Tennessee Coal, Iron and Railroad Co. at Birmingham, Ala., as steel works manager.

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Lieut.-Col. Elmer E. Ware entered the service in October, 1917, as a major. In civil life Mr. Ware was with the Acme White Lead Works of Detroit, Michigan.

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Capt. Robert H. Fulton, Jr., Washington, Penn., was commissioned in August, 1917. He was formerly purchasing agent for the Aluminum Co. of America.

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Capt. Sidney Bevine is a mechanical engineer and was employed by Fiske Bros. Refining Co., State St., New York.

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First Lieut. Ralph F. Symonds was employed by the N. E. Structural Co., Boston, Mass., as works manager. He had been in the service 13 months.

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Capt. Harold C. Strohm was employed by the Bethlehem Steel Co. at the New York office, and was commissioned first lieutenant in July, 1917.

* * *

First Lieut. Alfred J. Carniaux before entering the service was with the Mexican Petroleum Transport Co., New York, as mechanical engineer.

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Capt. Samuel F. McIntosh was a consulting and contracting engineer before entering the service a year ago. His home is in Providence, R. I.

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Second Lieut. Philip H. Haselton was assistant treasurer of the Newman Clock Co., 178 Fulton St., New York. He was in the service for a year.

* * *

First Lieut. Francis R. Larkin, discharged after 13 months' service, was formerly a salesman for the Amalgamated Machining Corporation of Chicago, Ill. Mr. Larkin before entering the service was connected with the New York office of that company.



HEAVY-ARTILLERY TRACTOR

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Capt. Herbert S. Kimball of Boston, Mass., was a chemical engineer with offices at 75 State St. before entering the service. Captain Kimball was commissioned in June, 1917.

* * *

First Lieut. Alan A. Wood of Providence, R. I., a mechanical engineer and formerly with the Builders' Iron Foundry of that city, has been located at the Watertown Arsenal since entering the service a year ago.

* * *

Capt. Claudius Lee will return to the Virginia Polytechnical Institute, Blacksburg, Va., where he was professor of electrical engineering before entering the service in July, 1917.

* * *

Maj. Sherman M. McFedries of Milwaukee, Wis., who was with the Cutler-Hammer Manufacturing Co. before entering the service, was commissioned in December, 1917.

* * *

First Lieut. Jasper W. Nicolls entered the service in November, 1917. He was formerly employed by the Standard Oil Co. at Bayonne, N. J., on the operation of crude-oil stills.

* * *

Second Lieut. Fred L. Cook entered the service on Nov. 22, 1917. In civil life Mr. Cook is a mechanical engineer and was employed by Fayette R. Plumb, Inc., of Philadelphia, Penn.

Personal History of Col. J. C. Heckman

Col. J. C. Heckman of the Ordnance Field Service, who did such good work with the Supply Division, came to the Ordnance Department in May, 1917, from the Larkin company, Buffalo, at which plant he was in charge of manufacturing, warehousing, shipping, the purchasing of raw materials and the development of new departments and extensions. Colonel Heckman went with the Larkin company in June, 1900, as chemical engineer, later becoming plant engineer, during which time he built up the technical staff of chemists and engineers that handled the wide variety of industrial problems both for the Larkin company and its allied interests.

Colonel Heckman's early technical experience was with the William Cramp & Sons Ship and Engine Building Co., where he spent two years in electrical and drafting work after graduating from the Central Manual Training School of Phillipsburg, N. J.; he also spent his summer vacations as draftsman and engineer in the shipyard of this company while attending Lafayette College.

After graduating from Lafayette in 1899 Colonel Heckman took a post-graduate course in chemical engineering at the Massachusetts Institute of Technology in 1899 and 1900.

Colonel Black of Procurement Back With Ford, Bacon & Davis

Col. Charles N. Black, until recently with the Procurement Division of Ordnance, has returned to Ford, Bacon & Davis, engineers, New York, of which firm he is and has been a member. Colonel Black graduated from Princeton in 1888 with the degree of A.B., following this with a post-graduate course in engineering from which he graduated in 1890. His first engineering experience was with the Brush Electric Co., with which concern he remained six years, becoming general superintendent. In 1896 he entered the employ of the Walker Manufacturing Co. of Cleveland and was put in charge of its New Haven factory. This firm was acquired by the Westinghouse Electric and Manufacturing Co. in 1899 and Colonel Black entered the sales department of that company. In 1899 he entered the firm of Ford, Bacon & Davis, severing his connection with them in 1904 and becoming vice president and general manager of the Kansas City Railway and Light Co., holding this position until 1907, when he became vice president and general manager of the United Railroads, San Francisco. From June, 1917, until June, 1918, Colonel Black was in the export department of J. P. Morgan & Co.

Colonel Black became a member of the firm of Ford, Bacon & Davis in 1912, and since that date has been a partner in the concern, although up to the present time not directly connected with the New York office. His present duties will keep him in active contact with the business of the firm.

Scrap Inventory of Ordnance Material

The estimated value of Ordnance scrap material on hand Dec. 31, 1918, by classes has been reported by the Stores and Scrap Section of the Ordnance Department to the Director of Sales. It should be noted that scrap inventories vary every day. The list is as follows:

	Lb.
Aluminum scrap, all kinds	46,608
Brass scrap, all kinds	5,842,351
Cupro-nickel scrap, all kinds	781,392
Copper scrap	691,580
Machine-shop borings and turnings	9,714,139
Steel, heavy melting scrap	20,771,061
Steel, low-phosphorous scrap	5,988,477
Nickel steel, heavy-melting scrap	5,518,359
Nickel steel, borings and turnings	15,654,919
Cast and malleable iron scrap	13,692,718
High-speed borings	
Turnings, scrap tools	63,365
Mixed and miscellaneous iron and steel scrap	5,195,748
Miscellaneous scrap, consisting of rags, waste paper, etc.	803,956
Lead-dross scrap	153,005
Lead scrap	322,355
Brass, ashes and sweepings	1,067,571
Burlap	256,063
Spent acid	1,495,250
Amatol	269,847
Ammonium picrate	5,000
Tetryl	18,660
Total	88,352,324

EDITORIALS

Readjustment in the Automobile Field

Detroit, the center of automobiledom, bears out the conclusion that the automotive industries are likely to be the first of all machine industries to resume normal proportions. And because Detroit is the center of this industry it is perhaps more fortunate at this time than many other manufacturing centers.

One large automobile concern employing about 7000 men is practically back to normal at this writing, turning out approximately 70 large motor cars every day and is still behind on orders. Others that have been even more largely on war work are getting back as fast as materials can be obtained and the chain of operations taken up once more. Those building trucks are in some cases still filling large Government orders, which is helping to stabilize the organization until the pleasure-car end can be put on a going basis.

In the meantime as many men as possible are kept at work of various kinds, the tendency being to utilize all the men possible while the change is under way. It takes longer than might be imagined to get the tools and fixtures out of storage, to see that they are all in working order and getting material enough lined up to keep the work going.

The Liberty motor contracts are just being wound up, the Lincoln Motor Co. completing its order for 6500 motors in January, and the Packard still having a number yet to build. In the former case this has prevented the sort of a readjustment hoped for, because all plans had been made on the assurance that a much larger number (17,000 to be exact) was to be built. The work of readjustment will be pushed, however, as this organization knows how to push it, and it will be but a few months when a peace product will be under way.

The Ford readjustment is going on rapidly, with about 1000 cars a day output at present, and there is every indication that spring or early summer will find this and other large plants in full swing and with a better equipment than ever, for new machinery is being bought in large quantities by some of the larger automobile factories, and we may look for a tremendous output of motor cars, especially of the smaller types and lower-priced cars. The Chevrolet company is taking a large plant at Saginaw, Mich.; the Studebaker is to have a larger plant at South Bend, Ind., and the Willys-Overland is planning an increased output. Even with the decreased production of 1918 the output ran up to 926,388, which was only a little over half of the output of 1917.

All this is being reflected in the buying of machinery of various kinds and many lines are taking orders that are gratifying in the extreme. This will increase when the Government payments are settled, as this is delaying many of the smaller concerns in getting back to a peace footing.

Some of the large firms which are blessed with very sizable bank accounts are doing all they can to settle with subcontractors and are doing the waiting themselves. This they realize will hasten the return of normal business and they will benefit in the end along with the industry at large. We are learning how really interdependent we are and how a benefit or injury to one affects us all.

The sooner Government bills are paid the better for all concerned, although we all recognize that it is a large task to know what is right as long as the departments try to do all the deciding themselves. It would seem far more rational to pick a small committee in each business center, men of known business ability and integrity, and let them decide on the merits of the contracts in their districts, with which they are more or less familiar already. This would get action, will relieve the Washington officials of responsibility, and get business moving at an early date.

There is every indication of the large builders entering a selling campaign which will try the stamina of all but the best organized, the best equipped and the best manned concerns. This all means new and better equipment, as in no other way can this competition be made or met.

Personnel is going to count as never before, as well as working equipment, for without personnel the right equipment cannot be obtained nor can it be properly operated. As an indication that the question of personnel is being considered the following quotation from a recent interview with the head of a large concern is both interesting and illuminating:

"I've been trying to get in touch with labor to the best of my ability," said John N. Willys, president of the Willys-Overland company, "and I want to say the day's pay is not all that labor is thinking about. We must work out some plan whereby labor will share in the profits of the business. We are going to try that system in our plant. Henry Ford never lost a dollar when he started to pay ordinary laborers $5 a day, because he got the best labor possible. We are going to follow him. I believe in the future. The farmer will have as much luxury as the city man. As a nation too we are going after the world's business. We are going to prosper for years."

Another angle is given by George M. Graham, sales manager of the Pierce-Arrow Motor Co., who predicts that the farmers alone will buy $10,000,000 worth of trucks within the next 10 years. He also says:

"Business problems, it is true, are looming large. We may have a bit of depression, but in a short time the tide will turn and business will go ahead at greater speed than ever before. On the other side they need us every minute and they must have every car we can give them. Wages cannot be reduced until the cost of living comes down."

We've got to keep things moving, and the automobile industry seems to offer the first opportunity.

The Daylight-Saving Plan

By Capt. H. L. Wittstein

The daylight-saving plan tried out for seven months in this country during the spring and summer months of 1918 proved a great success. In connection with the plan and the eight-hour day the illustration of the old time-table used in the United States Armory, Springfield, averaging 10 hours for each day, and adopted Jan. 1, 1855, which has just come to light and which we are here reproducing, may be of interest to the readers of the *American Machinist*. The schedule shown on the document of course has been for a long time obsolete.

TIME TABLE.

United States Armory, Springfield.

Averaging Ten Hours for each Day. Adopted January 1st, 1855.

TIME TO COMMENCE AND TO CEASE WORK.

Days of Month	JANUARY. A. M. Com. Work.	JANUARY. P. M. Cease Work.	FEBRUARY. A. M. Com. Work.	FEBRUARY. P. M. Cease Work.	MARCH. A. M. Com. Work.	MARCH. P. M. Cease Work.	April, May, June, July, August. A. M. Com. Work.	April, May, June, July, August. P. M. Cease Work.	SEPTEMBER. A. M. Com. Work.	SEPTEMBER. P. M. Cease Work.	OCTOBER. A. M. Com. Work.	OCTOBER. P. M. Cease Work.	NOVEMBER. A. M. Com. Work.	NOVEMBER. P. M. Cease Work.	DECEMBER. A. M. Com. Work.	DECEMBER. P. M. Cease Work.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	7.30	4.35	7.00	5.12	6.30	5.48	6.00	6.00	6.00	6.00	6.30	5.40	7.00	4.52	7.30	4.2[illegible]
2	7.30	4.36	7.00	5.13	6.30	5.49	6.00	6.00	6.00	6.00	6.30	5.39	7.00	4.51	7.30	4.26
3	7.30	4.37	7.00	5.14	6.30	5.50	6.00	6.00	6.00	6.00	6.30	5.38	7.00	4.50	7.30	4.26
4	7.30	4.38	7.00	5.15	6.30	5.51	6.00	6.00	6.00	6.00	6.30	5.36	7.00	4.48	7.30	4.25
5	7.30	4.39	7.00	5.17	6.30	5.52	6.00	6.00	6.00	6.00	6.30	5.34	7.00	4.47	7.30	4.25
6	7.30	4.40	7.00	5.18	6.30	5.53	6.00	6.00	6.00	6.00	6.30	5.32	7.00	4.46	7.30	4.25
7	7.30	4.41	7.00	5.19	6.30	5.55	6.00	6.00	6.00	6.00	6.30	5.31	7.00	4.45	7.30	4.25
8	7.30	4.42	7.00	5.21	6.30	5.56	6.00	6.00	6.00	6.00	6.30	5.29	7.00	4.44	7.30	4.25
9	7.30	4.43	7.00	5.22	6.30	5.57	6.00	6.00	6.00	6.00	6.30	5.27	7.00	4.43	7.30	4.25
10	7.30	4.44	7.00	5.23	6.30	5.58	6.00	6.00	6.00	6.00	6.30	5.26	7.00	4.42	7.30	4.25
11	7.30	4.45	7.00	5.25	6.30	5.59	6.00	6.00	6.00	6.00	6.30	5.24	7.00	4.41	7.30	4.25
12	7.30	4.46	7.00	5.26	6.30	6.00	6.00	6.00	6.00	6.00	6.30	5.22	7.00	4.40	7.30	4.25
13	7.30	4.47	7.00	5.27	6.30	6.00	6.00	6.00	6.00	6.00	6.30	5.20	7.00	4.39	7.30	4.25
14	7.30	4.49	7.00	5.28	6.30	6.00	6.00	6.00	6.00	6.00	6.30	5.19	7.00	4.38	7.30	4.26
15	7.30	4.50	7.00	5.30	6.30	6.00	6.00	6.00	6.00	6.00	6.30	5.17	7.00	4.37	7.30	4.26
16	7.30	4.51	7.00	5.31	6.30	6.00	6.00	6.00	6.00	6.00	6.30	5.16	7.00	4.36	7.30	4.26
17	7.30	4.52	7.00	5.32	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.14	7.00	4.35	7.30	4.26
18	7.30	4.53	7.00	5.34	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.12	7.00	4.34	7.30	4.27
19	7.30	4.55	7.00	5.35	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.10	7.00	4.33	7.30	4.27
20	7.30	4.56	7.00	5.36	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.09	7.00	4.32	7.30	4.28
21	7.30	4.57	7.00	5.37	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.08	7.00	4.32	7.30	4.28
22	7.30	4.58	7.00	5.39	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.06	7.00	4.31	7.30	4.29
23	7.30	5.00	7.00	5.40	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.05	7.00	4.30	7.30	4.29
24	7.30	5.01	7.00	5.41	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.03	7.00	4.30	7.30	4.30
25	7.30	5.02	7.00	5.42	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.02	7.00	4.29	7.30	4.30
26	7.30	5.03	7.00	5.44	6.00	6.00	6.00	6.00	6.00	6.00	6.30	5.00	7.00	4.29	7.30	4.31
27	7.30	5.05	7.00	5.45	6.00	6.00	6.00	6.00	6.00	6.00	6.30	4.59	7.00	4.28	7.30	4.31
28	7.30	5.06	7.00	5.46	6.00	6.00	6.00	6.00	6.00	6.00	6.30	4.58	7.00	4.28	7.30	4.32
29	7.30	5.07	7.00	5.48	6.00	6.00	6.00	6.00	6.00	6.00	6.30	4.56	7.00	4.27	7.30	4.32
30	7.30	5.09			6.00	6.00	6.00	6.00	6.00	6.00	6.30	4.55	7.00	4.27	7.30	4.33
31	7.30	5.11			6.00	6.00	6.00	6.00			6.30	4.54			7.30	4.33
Quarters.	9.45	2.56	9.30	3.15	9.08	3.28	9.00	3.30	9.00	3.28	9.15	3.08	9.30	2.48	9.45	2.41
Length of Day.	8.22		9.29		10.12		11.00		10.53		9.46		8.37		7.37	

Intermission of One Hour — from 12, Noon, to 1, Afternoon.

NOTE.—From the 1st of April to the 1st of October — 26 Weeks — cease work Saturday Afternoons at Five o'clock.

James S. Whitney Superintendent.

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Some Avoidable Dangers in Airplane Construction

By WALTER O. ADAMS

The failure of one of the four pins used in some airplanes to attach the wing structure to the fuselage and center section means an almost inevitable crash and the death of the occupants. The more frequent failure of the engine which seems so much more important a part is really far less serious because of the gliding ability of the modern planes. Standardized inspection, which will surely eliminate the defective small part, is an essential factor in the success of the commercial airplane.

IT IS a very general trait of human nature when considering any subject to view it as a whole rather than in its component parts. That this should be true with the general public is not surprising, but that those more technically educated should be so inclined is remarkable. I preface my article in this way to emphasize the importance of bolts and pins, which otherwise might seem, when considered in relation to the whole structure of the airplane, to be rather insignificant parts. To a great extent the construction and quality of the small parts have been overshadowed by the more striking parts of airplane construction. A closer analysis of the conditions shows that these parts are vital to the structure of the plane, as there may be from a few hundred to several thousand per ship, depending on the size and type.

It is not my intention to criticize what has been accomplished in the niceties of aircraft construction under the pressure existing during the war, for my experience with those engaged in the production of aircraft has shown that there were few who did not give all they had to the solution of the problem.

While engine trouble is dangerous and to be avoided it does not necessarily spell disaster. Breakage of parts is, however, a serious menace, and too great stress cannot be laid on the integrity of every piece entering into the construction of the plane.

Shortly after our entry into the war the amount of inspection by the Government and by the manufacturers was greatly increased. To improve it in quality took time and required the development and adoption of known standards. Many points of standardization have been improved during our war experience and fixed quite satisfactorily, but the enforcement of their observation in commercial work must be made universal.

Aircraft that is liable to failure not only menaces the lives of those who use it, but is also dangerous to persons and property over a wide area. Makers of automobiles have only the reputation of their cars for reliability to consider. Their factors of safety can be great and honest construction will keep serious accidents at a minimum, but with the airplane the chance of error is tremendously multiplied and the resultant dangers more than correspondingly increased.

Of the faults that are most difficult to control in the making of aircraft bolts and pins the worst are those relating to the interior structure of the piece. It is well known that even the best makers of steel have not been able to wholly eliminate pipes and seams. These, when existing in small-diameter bars, are very difficult to detect.

One method which is capable of only a percentage detection is to break from the end of every bar a short piece. Should a pipe or seam be apparent the bar is broken farther back until it shows solid. If on breakage the bar is found to be solid and of proper grain the assumption is that it is usable. While this is not conclusive it does, in pieces turned down from the bar, greatly reduce the chances of fault. The process is not expensive and its cost is negligible as balanced against loss of life or property.

Up to this time most bolts and pins requiring close dimensions have been turned from the solid bar. Some experiments on pieces with heads welded to the shank and on pieces with upset heads have been made, but in my opinion considerable care should be taken before such pieces are relied on, as the reliability of a weld is none too great and the upsetting of material of the tensile strength and other qualities usually required for such pieces sets up interior strains as yet not sufficiently determined.

Roughly speaking from one-half to two-thirds of the diameter of a bar is turned off in the process, thus eliminating from the shank metal in which cracks are most likely to appear. Cracks in the remaining metal which reach the surface are rolled in during turning and are not easily distinguishable.

Heat treatment opens the cracks, but at the same time darkens the surface so much that they are as hard to find as before. I have found that by dipping these parts in a sulphate of copper bath the slight deposition of bright copper renders the cracks readily visible and consequently easy of elimination by inspection. Since no entirely satisfactory method of covering pieces for rust prevention has been devised, the Army accepted my recommendation that this thin covering of copper be used also as a rust preventive during the processes of manufacture and of transportation.

While heat-treating methods are usually sufficiently exact it must be borne in mind that to prove a small piece physically entails the destruction of the piece under test. The usual method of testing such pieces is by the use of a test bar, supposedly of the same material as the pieces in production, which is heat treated with the pieces and tested as representing them.

This is satisfactory if the test bar really is of the same material, especially if a percentage of the pieces is also tested. There have come to my observation, however, many instances where the production material was so badly handled and accounted for that the test bar represented nothing but itself. It is obvious that without careful control of material from its initial source, through stockrooms and production to the actual point

of heat treating, it may become badly mixed and practically unidentifiable and the heat treatment supposedly proper may be quite wrong for a large percentage of the pieces.

In some cases makers of these parts have heat treated the bars before machining or at an early stage in the machining process. This tends to simplify the maintenance of sure physical properties but introduces certain elements of difficulty in the heat treating and straightening of long bars and in obtaining cutting tools that will stand up.

I do not attempt to outline a definite system to cover these points, for such systems must differ in detail in accordance with layout and processes. I do, however, strongly emphasize the principle that some efficacious system must be employed if airplane parts of this nature are to bear the high responsibility constantly thrown upon them.

The foregoing shows the dangers that exist in the integral structure of these important pieces. Only the utmost care can eliminate them, and it seems of great importance that steps should be taken to guard against them. Even though every maker of planes intends that every precaution shall be taken it is difficult to enforce these precautions in his shop.

It would seem to be not only the duty of, but good business for, the interests which now control airplane manufacture to adopt a standardized system of inspection, and to create a force of inspectors proportionate to present activities, which could be augmented as necessity arises.

Unless some well-developed and uniform method of general inspection is created the progress of the airplane as an aid to industry and civilization will be necessarily retarded. It is not too early to take steps to enforce uniform safety of methods and construction.

Equipment and Maintenance Factors in Cost Accounting During Transition Period

By L. W. ALWYN-SCHMIDT

Careful watching of prices is one of the things that will have to be constantly kept in mind by manufacturers and others, but especially those among them who are transacting their business on a contract basis. And now that the race for trade is to be renewed with keenness it would also be well for machine builders and owners to take into their calculation the incorrect cost of equipment and maintenance charges that have so long and with so many been the sump into which their profits have filtered.

AMONG the problems to be met by machine shops during the transition period is that of readjusting prices. People will think that now that the war is over there should be a decline in prices, and the danger is that the machine shops, especially those engaged in contract work, will give way to this belief, which would result in a general downward movement in the charges for job work. On the contrary, however, there has never been a period of our industry when conservative cost accounting was more necessary than now.

The usual practice in contract work is to charge on the basis of material, plus labor, plus profit, the latter including overhead, depreciation, maintenance, selling cost and profit. With values changing as frequently as they have during the last few years, and as they will likely continue to do, the danger is that the total charge will not cover the shop against variations in overhead expense, and the plant will have to be operated on a too narrow profit margin. Few machine shops know what they should charge as profit, having no itemized system of cost accounting, and they continue from year to year to make the same uniform profit charges, which probably is the principal cause why many of them are operated at a loss.

The fault seems to lie in making a general and uniform charge for maintenance and depreciation based on the purchase price of the equipment, instead of on present-day conditions. This practice is not only fundamentally wrong but absolutely dangerous at the present time, and should be abolished.

The war has put an exceptional strain on the machine-tool equipment. Many machine shops have been working night shifts, making the tools to do double work. There has also been less time for repair and maintenance work, with the result that depreciation has been more extensive and progressive. It must, therefore, be expected that a number of machines are not working at the peak of efficiency and need renewal or overhauling, a matter that should have considerable influence on the general charge policy of the shops.

The Book Value of Equipment

Take, for instance, a modernly equipped machine shop established in 1912, doing a normal business up to 1916 and then engaging in general shop work as a subcontractor on Government business. Suppose the new equipment of this shop had cost $100,000 and that no additions had been made until 1917. At that date its equipment would have depreciated about $30,000, taking an average of 6 per cent. per year as a safe depreciation factor. If this shop had worked night shifts from 1917 until the end of the present year its depreciation would have been at least 12 per cent., which would make necessary further deductions of about $24,000, so that the book value of the equipment would stand at $46,000 at the beginning of 1919.

There would be still some life left in the equipment at that date, but the day when it would have to be renewed has advanced more rapidly than under normal circumstances. The shop that has failed to take into consideration this uncontrovertible fact will probably lose if it continues to charge for its services at the current rate of depreciation only, and there is even doubt

whether a deduction of 12 per cent. would be sufficiently large to offset the loss in efficiency.

If this shop has bought new equipment to handle the increased volume of work considerably more had to be paid for it, and its purchase remains a heavy liability. What is the actual value of this new equipment to the machine shop? Is it the price paid at the purchase? Is it the price at which it can be purchased now, or the price at which it might be purchased in the future? A correct answer to these questions is very important.

Readjusting Equipment for New Work

In the general readjustment of the industry the first question is a consideration of the equipment that was bought for doing work requiring specially constructed machinery. The industrial history of two previous wars—the Boer war and the Russo-Japanese war—shows that numbers of special-purpose machines were thrown on the market after the conclusion of peace. The late war having exceeded all others with respect to the magnitude of industrial effort, it is expected that the number of machines that have outlived their usefulness will be exceptionally high. Machines costing thousands of dollars will be sold as scrap, and it is hoped that their owners have provided against this by including their price in the yearly expense, so that this charge may be written off without a big loss. Of course there may be a market for some of these machines in arsenals and armament plants, but the opportunities for disposing of them in this manner are small when compared with the number of machines becoming obsolete.

Machines that have become unusable in first-class construction work and those that have seen six years or more of service might still do work in shops where less speed and precision are required, and frequently some of them may be sold at a fair price in the second-hand market or may find a ready sale in smaller shops and in foreign countries.

Revaluation of All Equipment Recommended

Having cleared the shop of dead equipment the next procedure is the revaluation of the remaining equipment. This should be done with two ideas in view, namely, to get its original cost price less depreciation, and to get its present purchase price, and on the result of the second will depend the future cost-charge policy.

Machine equipment costing $100,000 in 1912 can now hardly be bought for $200,000, and likely this tendency to rise will continue. Production engineers should therefore guard against it when evaluating the existing equipment. The cost and size of a machine shop naturally influence the operation cost. A large and expensive equipment not used to full capacity tends to preclude competition and so will insufficient equipment.

It would be a technical impossibility to compare the work done on new tools with that done on older ones, but it is absolutely necessary in the interest of correct cost accounting that the present value of the total machine equipment should be known so as to form a basis for depreciation.

To return to the example of our machine shop. After having been in operation for six years it now has an original machine equipment valued at $46,000. It has provided an equipment-purchasing fund of $54,000, being the amount set aside to make up for depreciation. If no new equipment has been purchased since the shop began to operate there would be in hand for the purpose of renewal $54,000 and $46,000, which, theoretically at least, is the value of the existing equipment. To buy the same equipment now, however, would require at least $200,000, which shows that the shop has been operating at a loss of $100,000.

If the equipment had been revalued from year to year at the then existing prices, and depreciation charged on the basis of the values for which the machine tools would have to be purchased, a more satisfactory result would have been obtained. Say that beginning with 1917 the machine equipment had been booked at its 1917 value, the account would have stood as follows: Original cost, $100,000, less $30,000 depreciation up to the end of 1916; book value, $70,000; equipment revalued at the then purchase prices, $200,000; depreciation for 1917 and 1918 at the rate of 12 per cent., $48,000. The shop then would have $78,000 in cash for the purchase of additional machinery and an equipment valued at whatever it may be worth at the beginning of 1919.

Charges for Depreciation

In other words the charge for depreciation of machine equipment on contract work should not have been 12 per cent. of $100,000, or $12,000, but 12 per cent. of $200,000, the real value to date, $24,000; or if a machine unit cost $5000 five years ago it would now have a book value of $3500, taking the rate of depreciation at 6 per cent. To purchase the same machine today would probably cost $10,000, and therefore the charges against it would be not $300 a year but $600, the depreciation on its present-day repurchase value.

Without considering accidents depreciation is a gradual process, but it is different with maintaining an equipment, which is influenced not only by loss of efficiency but by the price of general supplies required for maintenance, to which might be added the higher cost of labor. A shop that expended $7200 for general maintenance in 1916 had to pay nearly $12,000 last year, and if it has followed the custom of charging a uniform amount for maintenance based on the average of the preceding years or, as it is also done, corresponding with the general depreciation of the equipment, it would be several thousand dollars out of pocket.

As it is impossible to apportion to each job the exact amount spent for maintenance during its making, and as it would also be unfair to the customer to do so, how may this best be done?

How Can Each Job Be Apportioned?

Several methods have been proposed by accounting experts, but none of them is absolutely reliable, while most suffer from inability of application to actual conditions. The following, however, seems to be a good plan, and its adoption will at least remove the danger of undercharging due to lack of information about the specific cost. Establish clearly what charges, such as labor, repair work, supplies, renewal of minor parts, are properly attributable to maintenance. These enter under maintenance, and draw the average expense of the last three months and use the result as the basis for estimating the gross of shop expense for the coming month. This method requires, of course, the an-

alytical cost-accounting system, which fortunately is now found in most machine shops.

Never was there a time when careful expense accounting is more essential to the efficient and profitable operation of a machine shop than today, and the shop that is not well informed about its financial position stands in danger of incurring heavy losses, if not failure.

Readjustment in Different Sections

EDITORIAL CORRESPONDENCE

It seems to be generally believed that the automobile and motor-truck industry will be the first to get back to a normal basis. There is, however, a tendency to hold back orders for materials because of the belief that they are being held at abnormally high prices, hence orders for forgings and other parts are not as extensive as they might be.

One of the best-known truck builders has, nevertheless, gone right on with his program; has ordered materials for six to eight months' use, obtaining a reduction of approximately 10 per cent. from prevailing prices; has guaranteed his men that no reduction will be made in wages and is planning for a big year's business. Others are following suit, especially the large builders, which again brings up the question of survival of the fittest in the automotive industry as in all others. There are about 300 builders of motor trucks and there is market for probably 150,000 trucks, or an average of 500 trucks per company, which means that there is room enough for 10 or 12 large concerns and that the rest are pretty sure to have hard sledding in the next few years.

This condition, however, does not apply to the machine-tool industry and must not be so construed, as the variety of machine tools necessary makes it a very different proposition. And we must never overlook the fact that the machine tool is the basic machine, or implement, of all industries; all other industries are but the product of the machine tool.

Those industries that were reëquipped to manufacture other products besides their own, as for example, the automobile shops that changed over to airplane-engine work, are now going through complete readjustment. The machinery installed by the Aircraft Production Board is being appraised and either sold to the shop it is installed in or removed for disposal elsewhere. Some of the officers in charge have approved, in some cases, offers of 60 per cent. of the list price for machines that have not been taken out of their original crates, but this has been disapproved in Washington, as it should be, and a better price is to be obtained. This is not so much to prevent the concerns interested from getting machines at a low rate as it is to forestall any serious break in the market price of machine tools.

There is no doubt that some of the shops that patriotically went into war work had a careful eye on the future by selecting so far as possible the best equipment for their needs on standard product. This was good business, and they should be perfectly willing to pay a fair price for it. But even if we (the Government) do not get back all that we should on all the tools we can console ourselves somewhat by the fact that whatever improved equipment goes into the shops adds to the nation's assets as a manufacturing competitor of the rest of the world and that we can get back in taxes of various forms whatever rightfully belongs to us as a whole. The main thing is to get to work and absorb the unemployed labor that is daily increasing in many localities.

In this connection some of the best-posted men in the manufacturing line are keen for a program that will act as an insurance policy for the future—not to pile up armament, but to retain our capacity for production and have it ready at a moment's notice. To be concrete, this means to slush and store all special machinery, tools and fixtures for guns, shells, fuses, etc., preferably near the plants where they were used or in some place where they could be taken out and put to work at short notice. Most of this is already the property of the Government and the rest has been paid for in overhead charges on the first order if the manager knew how to charge costs.

With this machinery, etc., properly protected and stored we should be able to begin actual work on 155-mm. guns in a few weeks after the necessity arose instead of waiting months for the machinery to be built. These machines, tools and fixtures have only a scrap value in the commercial world of machinery, and they should not be allowed to go to waste at this time. Later if the permanent peace of the world is assured, as we all hope, they can be melted up into the proverbial plowshares, but for the present it seems wise to hold them in readiness for any emergency that might arise.

It is also advocated that some of the war program be completed for the same reason. A case in point is that of the tanks that were being built when the armistice was signed. There is no doubt as to the tank having become a great factor in many military operations, and even peacefully inclined engineers are advocating the completion of say a thousand of the large 40-ton tanks, which are in reality land battleships, and an equal number of the small tanks, or whippets. These, it is suggested, might be stored in suitable garages, or whatever they may be called, along the Mexican border just as reminders that invasion or raids by outlaws or others might not be healthy for the raiders. Furthermore it should help considerably to stabilize business in these lines. We all want to save every dollar possible on the expenditure for and about war, but we must all deprecate the attempt to make a showing for political purposes. It is sometimes cheaper to spend money than to pay the cost of not spending it later.

Square Stock in Three-Jawed Chuck

BY E. KERN

A good way to hold short pieces of square stock in a three-jawed chuck when no two- or four-jawed chuck is available is to bore out a bushing to a diameter just large enough to allow the square piece to be pushed in and then split the bushing lengthwise with a hack-saw.

Being careful to put the bushing back in the same position it occupied when being bored, pressure on the chuck jaws will hold the square stock quite firmly and fairly true.

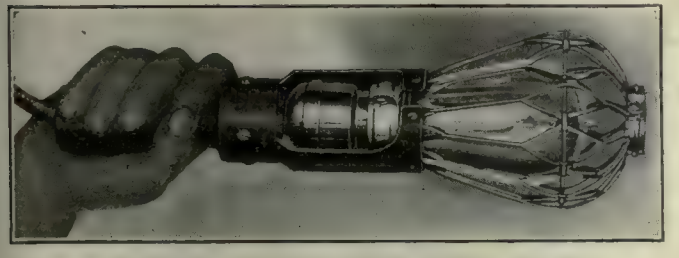


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

"Flexco" Lamp Guard With Split Handle

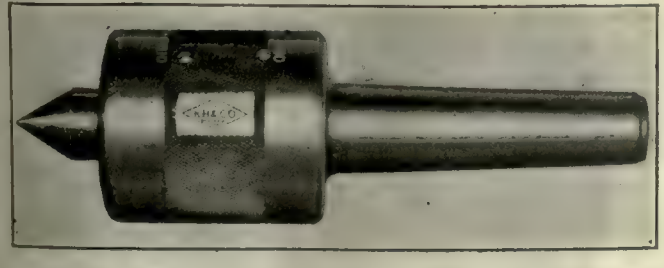
The Flexible Steel Lacing Co., Chicago, Ill., has recently placed on the market the "Flexco" split-handle lamp guard shown in the illustration. This device has been made to fill a demand for a substantial handle guard that does not have to be wired. The halves of the guard, including the handle itself, open wide from the hinge at the end of the guard and can be instantly closed and locked around any socket at the end of an extension cord, the cord itself running through grooves in the sections of the handle. The hinge pin is located in the end of the guard and can be equipped with a hook for hanging up the complete device if this is desired.



"FLEXCO" SPLIT-HANDLE LAMP GUARD

Kell, Hock Ball-Bearing Centers

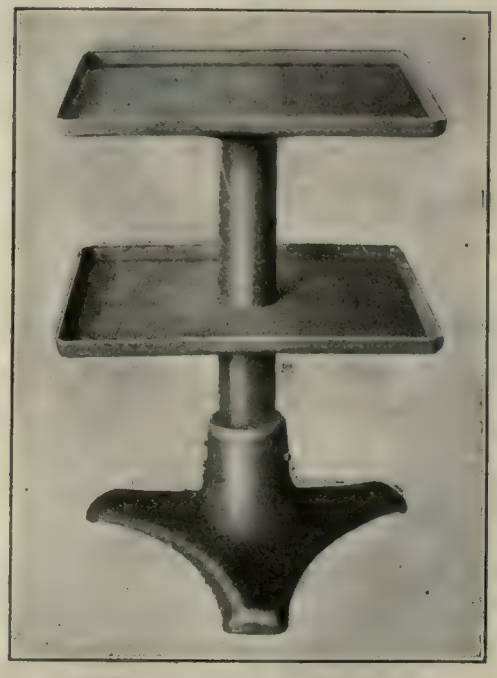
The illustration shows one of a line of "Alive" ball-bearing tailstock centers that have recently been placed on the market by Kell, Hock & Co., 354 Mulberry St., Newark, N. J. The centers are made in three sizes, with Nos. 2, 3 and 4 Morse taper shanks and are regularly supplied with 60-deg. centers, but special centers of various types can be furnished if desired. Each center is mounted on two annular ball bearings, while end thrust is taken by a ball thrust bearing. The construction is such that no chips or dirt of any kind can enter the bearings. Two oil holes are provided, which are of such size as to contain an amount of lubricant sufficient for a month or more of use.



KELL, HOCK BALL-BEARING TAILSTOCK CENTER

Kent Metal Shop Table

The Kent Machine Co., Kent, Ohio, has recently placed on the market the all-metal shop table shown, which will be found useful for holding tools, fixtures, arbors, jigs, etc., in connection with machine work.

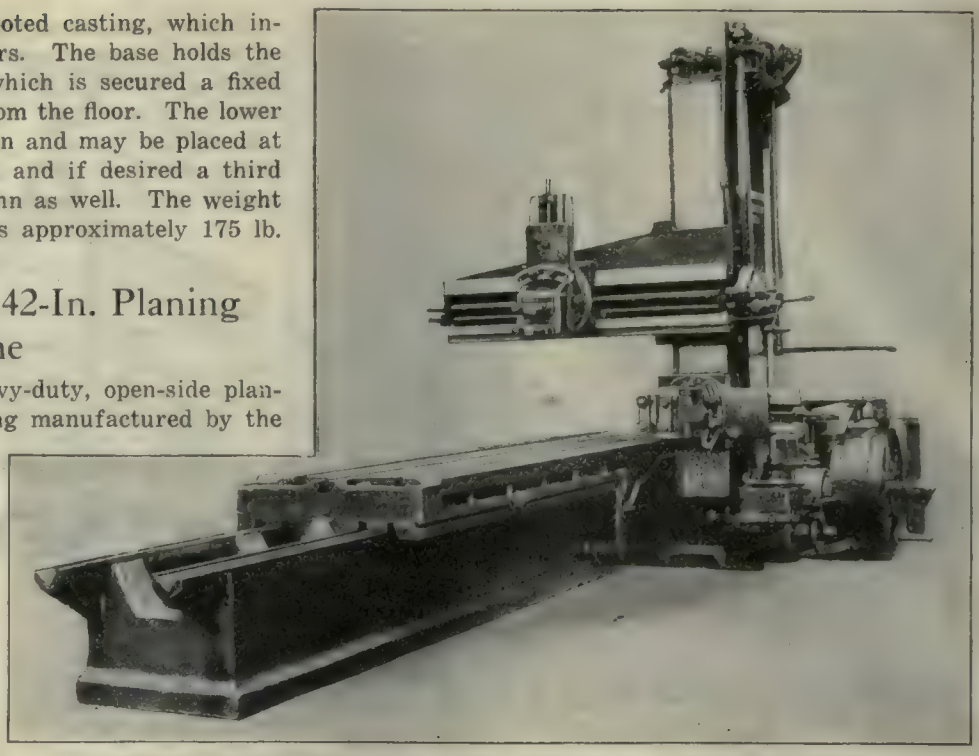


KENT ALL-METAL SHOP TABLE

The base consists of a three-footed casting, which insures steadiness on uneven floors. The base holds the central column, at the top of which is secured a fixed table 24 in. square and 33 in. from the floor. The lower table is adjustable on the column and may be placed at any height, as most convenient, and if desired a third table can be placed on the column as well. The weight of the device with two tables is approximately 175 lb.

Simmons Open-Side 42-In. Planing Machine

The 42 x 42-in by 12-ft. heavy-duty, open-side planning machine illustrated is being manufactured by the Simmons Machine Co., Inc., Albany, N. Y. It will actually handle work slightly larger than its rated capacity, the exact size of work being 42 in. wide, 46 in. under the cross-rail, and 13 ft. long. The bed is made extra deep and is braced with box-girder ties placed at short intervals and inclosed to prevent chips falling through. The tracks, or ways, are of extra length and are self-oiling. The table is of hollow, double-deck section type with cross-ribs to insure stiffness. Three T-slots are provided, the center one extending the entire length of the table. Stake holes are also provided, and the chip pockets at each end are deep.



SIMMONS HEAVY-DUTY 42 x 42-IN. OPEN-SIDE PLANING MACHINE

The housing is of box-section type with reinforcing ribs on the inside. It is locked to the cheek piece on the bed and is securely bolted with turned bolts in reamed holes. The cross-rail is supported by a heavy brace of box section and is locked and bolted in position to resist the stresses set up by heavy cuts. Both the cross-rail and brace have a long contact on the housing in order to reduce vibration. Power is used for raising or lowering the cross-rail.

Two heads are used, one on the cross-rail and one on the upright housing. All sliding parts are fitted with adjustable gibs to permit taking up wear, and all nuts are securely locked and bolted to the moving parts. The feeds are driven directly from the main driving shaft and its action is positive and not dependent upon the close adjustment of friction surfaces. The friction feature is used only to engage the pawl that drives the feed. The feeds are regulated by the adjustment of a sliding block in a slotted faceplate, this adjustment being possible while the machine is in motion. The slotted faceplate permits the feed to be made at either the beginning or completion of the cut as is desirable to suit the work at hand.

The drive is through spiral gearing. The rack and pinion are of gray iron, while the pinion is of steel. The bearings for the pinion driving shaft are bronze bushed and provided with suitable oil cups. The take-up key for the end thrust is placed on the outside of the bed, and adjustments can be made while the machine is in operation. On the belt-driven machine the belts can be shifted from either side and can be locked on the two loose pulleys, trip dogs being fitted with latches that can be raised with the finger. Motor drive can also be furnished if desired, a reversing motor being used; also the cross-rail can be furnished with two heads and the bed may be built in any length.

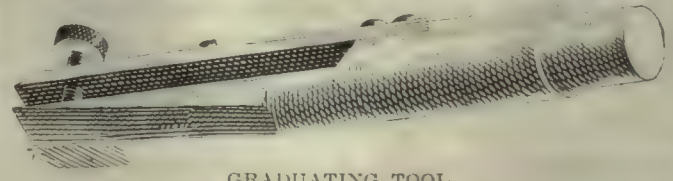
A Graduating Tool

By N. Renwick
Lithgow, N. S. W.

Desiring to make a protractor and having no means of graduating it I devised the tool here illustrated, which did the work with a fair degree of accuracy.

The body is made of $\frac{3}{8}$-in. drill rod $3\frac{3}{4}$ in. long filed to a chisel shape and tempered. A piece of ground stock $\frac{3}{32}$ in. thick by 2 in. long, hardened and drawn to a spring temper all over, is attached to the body as shown. A screw $\frac{1}{4}$ in. in diameter is used to adjust it to whatever size is required.

To use, find the distance between each graduation on the article to be marked, say 0.031 in. as in my case.



GRADUATING TOOL

Then with a piece of drill rod 0.031 in. in diameter adjust the cutting edges of the tool till the rod just fits between them, thus giving the exact width of each graduation. Next find the starting point on the job and mark it with a sharp small chisel. Put the adjustable edge of the tool in this mark and tap the tool with a hammer till as deep an impression as desired is left. Repeat this operation until the job is finished.

When sharpening the tool always grind on the outside, as the inside should be left as nearly parallel as possible for setting.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



A motor-truck manufacturing plant with an annual capacity of 5000 trucks will be erected in Canada by the Republic Motor Truck Co., Alma, Mich.

The Fulton Motor Truck Co. has decided to enlarge its plant at Farmingdale, L. I., to greatly increase the output of 1½-ton trucks during 1919.

The Croix de Guerre was awarded by the French government for distinguished service to French motor transport. One of the units operated more than 2500 motor trucks built by the White company, Cleveland, Ohio.

Up to Nov. 11, 1918, approximately 174,000,000 board feet of spruce and fir had been produced by the spruce-production personnel of the United States Army, which consists of 18,305 officers, enlisted men and civilians.

In the months between July and October, 1918, when the weather conditions were the most favorable for aviation, in 71 flying days 207 trips were made across the English Channel. The mileage traversed was 8085 and 1843 passengers were carried in these flights.

The Studebaker Corporation's production plans for the current year call for an output of 40,000 cars. The company closed a contract with the Stromberg Carburetor Co., by which the Studebaker Corporation adopts the Stromberg carburetor as the regular equipment on its passenger cars.

The manufacturing of a rubber substitute from raw material found in Norway is the monopoly of a company in Christiania, Norway. It is said that the manufacturing of this substitute has been tried for many years and is expected to be of great importance to rubber consumers, as it costs not more than a fraction of the price of real rubber. The company was incorporated with a capital of $576,000.

The *Daily Telegraph*, London, reports that a gigantic airplane designed and built by Caproni and in which it is intended to fly from Italy to America is nearly finished. The machine is a triplane of 3000 hp., with ample accommodation for a number of passengers. The proposed flying route is Italy-Cadiz-Azores (islands) and thence to the American coast, landing near Washington, D. C.

The Government of India has lifted the import restrictions on motor trucks, chassis, accessories and other automotive products.

The $68,000,000 raised by bond issue passed in November is now available in the State Treasury for highway improvement in Illinois next spring. For first improvement the following roads are designated by the Illinois State Chief Highway Engineer: The Lincoln Highway, the Chicago-to-Springfield section of the Dixie Highway and the Chicago-Wisconsin Highway. Nearly $6,000,000 is available for work on these three roads.

According to a ruling of the Treasury Department under the provisions of the present war revenue bill only those exported motor trucks are taxable which were sold to domestic concerns and subsequently exported at the instance of the buyer. On motor trucks sold by the manufacturers on a direct export order the tax cannot be collected.

At the University of Washington, Seattle, a wind tunnel of the type used by the National Physics Laboratory, England, has recently been installed and will be used to give students training in aeronautical investigation and research. The tunnel is 4 x 4 ft. and the wind is drawn into the tunnel by a low-pitch air screw with four blades 9 ft. in diameter. The entrance of the tunnel consists of a nest of 256 pipes 2⅜ in. in diameter. The weighing spindle is of the same design as the one used by the Curtiss Airplane and Motor Corporation, Buffalo, N. Y.

During the war two attempts were made to replace fabric as an airplane-wing covering by using in one case wood veneer and in the other cellulose-acetate sheets. The National Advisory Committee for Aeronautics had made sand-loading and other tests on an experimental plane using veneer for wing covering, and it was found that the internal drift wires may be eliminated in this kind of construction and the same weight per square foot of service obtained as in the ordinary wing. The use of cellulose-acetate sheets for wing covering was a foreign experiment and it was asserted that at a height of a few thousand feet the machine was almost invisible. A further advantage was that the field of vision of the operator was much increased. Cellulose-acetate sheets in a thickness of 10/1000 of an inch have the same strength as the ordinary fabric wing cover and weigh only a little more than most doped fabrics as the weight of a square yard of cellulose sheet is about 9 oz. The chief difficulty in using them is that a tear once started spreads very rapidly. This difficulty was remedied by reinforcing the transparent sheet by means of a fabric such as loosely woven silk. A wing of this sort would be waterproof, airproof and noninflammable and would give no trouble from stripping or peeling. There seems to be no doubt that if it can be obtained in the proper weight and strength it will prove to be a very good wing covering.

The kerosene-burning tractor is credited with being a big factor in raising kerosene prices. Ordinary kerosene is now 17½c. a gallon against 14½c. in August, 1918; best grade kerosene is now quoted at 20½c. a gallon compared with gasoline at 26c. At present the country's reserve stock of kerosene is said to be considerably below normal. Production was higher this year than last, being 1,329,410,679 gal. up to Oct. 1, 1918, against 1,226,118,996 gal. for the first nine months of 1917. The increase in demand, however, has been much greater than the increase in production.

Dirt is one of the worst enemies of an internal-combustion engine. P. T. Dasey, sales and research engineer of the Buda company, tells of an engine of a 5-ton truck in which six sets of bearings had been burned out in six weeks. The owner of the truck stated that the engine was defective. An examination of the crankcase showed that the oil contained 6 oz. of sand, in addition to 4 in. of mud at the bottom of the case. Further investigation showed that the owner, who was a contractor, used his truck for hauling crushed stone, which worked into the engine.

Mrs. Louis Bennett, mother of Lieut. Louis Bennett, who lost his life in an air battle, has offered to the Aero Club of America $500 to be awarded as a prize or prizes in a parachute competition. The Aero Club of America, accepting the offer, has appointed a committee of experts to draw up the rules and regulations for the contest. During the war a large number of parachutes have been evolved, from which two types, the Goodyear company's and L. B. Sperry's, had given excellent results. The competition will be international in character and will afford a thorough test of every kind of parachute.



Sparks from the

One Million Homes Needed in the United States

Shortage Made Known by Representatives of Building and Loan Associations in Conference

Twenty-five representatives of building and loan associations from almost every section of the United States in a recent conference in Washington formulated the following statement on building conditions:

"In normal times, under normal conditions, it required the building of about 600,000 homes a year to meet the normal growth of the country and replace the losses occasioned by fire and other destructive agencies. For the past two years, owing to causes growing out of the world war, this normal construction of homes has been practically suspended. What housing construction has been accomplished has been for the major part that which was demanded to meet war conditions. Shortage of labor and restrictions on building material stopped the work.

"At this time there is a shortage of nearly a million homes, to which must be added the normal requirements of the year just opening. Most of the shortage has not been abandoned, but has been merely wholly postponed and the pressure to inaugurate and complete this delayed construction will be felt as soon as climatic conditions make such work feasible.

"The demobilization of the military and naval forces now in progress and the release of workmen from shipbuilding and munition plants and other war industries will furnish the labor the lack of which has hampered building for the past two years. The removal of restrictions on the use of material and on transportation, which largely contributed to block home construction, will make the resumption of home building possible."

The Division of Public Works and Construction Development, Information and Education Service, Department of Labor, is now working with the building and loan interests endeavoring to find a way to make liquid the associations' assets to the end that more money may be available for loans.

* * *

Old Roads of France Ruined

The highways of France have always been so famous everywhere for their high quality that it seems hard to realize that French highway engineers should come to us for advice on permanent pavements. The wear and tear of the heavy trucking incident to the moving of the vast quantities of military material have ruined the old roads and made clear that some better surface must be adopted for the future with its ever-increasing volume of commercial motor travel. The same difficulty is apparent in England where it is estimated that fifty million dollars must be spent to return the highways to their condition of 1914.

* * *

To Hold Tractor Show

The fourth annual National Tractor Show will be held in Kansas City Feb. 24 to Mar. 1 under the direction of the Kansas City Tractor Club, of which Guy H. Hall is secretary.

Southern Machinery Dealers To Meet at New Orleans

The eighteenth annual convention of the Southern Supply and Machinery Dealers' Association will be held in the Grunewald Hotel, New Orleans, Apr. 7-9. During the same week, beginning Tuesday, the Southern Hardware Jobbers' Association will meet in the St. Charles Hotel, New Orleans which will enable these two jobbers' organizations doing business in the South to hold several joint sessions, in which trade problems peculiar to the South in the machinery and hardware lines can be discussed. Invitations have been extended to the American Supply and Machinery Manufacturers' Association to meet jointly with the former, and as usual the National Hardware Association will hold a meeting with the Southern Hardware Jobbers. The National Supply and Machinery Dealers' Association has also been invited.

* * *

Opens Polish Industrial Bureau

The Commercial and Industrial Bureau of the Polish National Department has opened offices at 33 West 42nd St., New York, the object being to start commercial connections between the United States and Poland and to collect all data and information which should form a basis for the work of the future official Polish commercial agencies in this country and to facilitate mutual economic relations. All information concerning trade conditions and business possibilities in Poland will be taken care of by this department.

Cranes at the Big Hog Island Shipyard



Reproduction of a Photograph in the "Hog Island News" Showing Part of 98 Cranes in Use in the Hog Island Yard

World's Industrial Forge

By E.C.Porter, News Editor

Civil Engineers Return From Paris

The delegation of the American Society of Civil Engineers together with representatives of the other three national engineering societies has returned from the joint engineering congress, held in Paris. An informal report of the work of the congress was made to a meeting of the four societies at the Engineering Societies' Building, New York, on Feb. 10. The reconstruction problems before the French government, most of which are of a civil-engineering nature, and the plans for attacking them, were discussed.

* * *

National Foreign Trade Council to Meet in Chicago

The annual meeting of the National Foreign Trade Council will take place at Chicago on Apr. 24, 25 and 26. A large committee on arrangements has been formed to provide adequate accommodations and suitable entertainment for the delegates to the convention. John J. Arnold, vice president of the First National Bank, Chicago, is chairman of the committee, and the other members include labor leaders, bankers and prominent industrial and commercial men. R. H. Aishton, Northwestern regional director at Chicago, is a member of this body.

* * *

Tractors Needed in Greece

Greece is suffering from a shortage of agricultural machinery, particularly tractors. The government has just placed an order with an American company for 15 motor plows and 200 tractors fully equipped with plow, harrow, hoe and thresher. Greece cultivates more than 1,300,000 hectares (1 hectare equals 2.47 acres) of land and has at its disposal only 160 threshers, 1200 reapers, 100,000 plows and no tractors.

* * *

Moves to More Extensive Quarters

The Professional and Special Section of the United States Employment Service, formerly located at 239 South La Salle St., has removed to new and more extensive quarters at 63 East Adams St., Chicago. This section, formerly known as the Division of Engineering, will enlarge its service to include all kinds of professional and technical men and women.

During the war this section did much work in placing engineers and technical men in various branches of the Government. Now its activities will be directed toward reconstruction and peace needs. It will serve employer and registrant alike and will strive to place the best man in the place where he is most needed. No charge is made for this service.

Engineers and professional men and women desiring the services of the Professional Section are requested to write to the foregoing address for registration blanks. In order to obtain quick service applicants are advised to communicate with the branch of the professional service which has jurisdiction over their district. Those living in Illinois, Indiana, Iowa and surrounding territory should register with the Chicago office.

* * *

Money in Circulation

Money in circulation at the beginning of January totaled $5,951,000,000 compared with $5,944,000,000 the month before and $5,120,000,000 a year ago. The population of the United States is estimated at 106,733,000 compared with 105,006,000 a year ago, making the money circulation per capita $55.76 compared with $56.23 a month ago and $48.76 a year ago. The general stock of money in the United States is $7,781,000 compared with $6,256,000 a year ago.

* * *

U. S. Chamber of Commerce Will Convene at St. Louis

The seventh annual convention of the United States Chamber of Commerce will be held at St. Louis the week of Apr. 28, according to Paul V. Bunn, secretary of the St. Louis Chamber of Commerce. It is expected that 3000 delegates will attend. Headquarters and probably sectional meetings will be held at the Hotel Statler, but the general meetings will be conducted at the Coliseum.

Bureau of Standards Takes Up Safety Codes

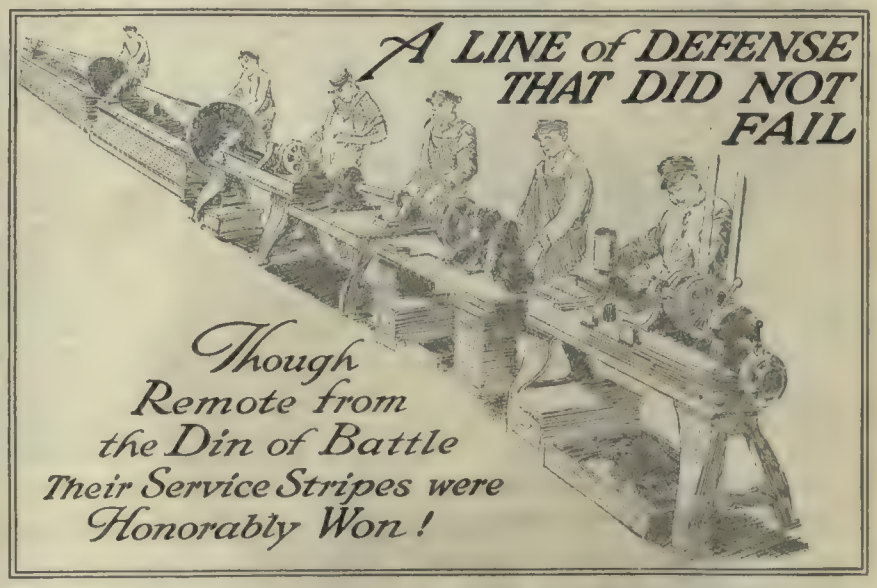
Aims to Include Every Trade and Occupation to Prevent Industrial Accidents

Investigations which may require two years or more for their completion have been put under way by the Bureau of Standards, Department of Commerce, and the Working Conditions Service, Department of Labor, in order to establish a series of industrial-safety codes for the protection of workmen from injury and to unify safety work throughout the country.

At present there is little uniformity in the safety codes of the various states, although working conditions for the same industry may be practically identical in all parts of the country. Manufacturers are greatly hampered by the lack of uniformity and will be benefited no less than the workmen by a unification of safety codes.

A tentative list of codes to be formulated shows no less than 55 lines of work that must be covered. The aim is to include every trade and occupation in order that everything possible may be done to prevent injury to employees and economic loss to the nation through industrial accidents

Some of the subjects to be considered, according to the tentative plan, have many subdivisions. Plant arrangement, for example, calls for consideration of methods of routeing material and product, the design of buildings and the layout of a plant, exit and entrance gates to yards, railways and walkways, roadways, material piles, clearances and illumination There is also the matter



of fire hazards to be dealt with, and this will necessitate consideration of fire-fighting equipment, water mains and hydrants, spacing between buildings and material as related to occupancy of buildings.

A second safety code will deal with construction work, including demolition work, excavation and trenches, retaining walls, construction, frame, masonry, concrete and steel, scaffolds, ladders, stairways and runways.

Perhaps the suggestions made for a study of elevator safety codes illustrate best for the general public the care that will be taken in the investigation and formulation of a code. Passenger and freight elevators will be studied, and among the appurtenances to which special attention will be given are shaftways and hatchways, shaftway equipment, cables, counterweights, guide rails and bumpers, landings, landing doors and gates, cars, machinery, safety devices, control and signals and escalators.

Through this work on safety engineering and through stimulation of state organizations to coöperate the Working Conditions Service hopes to reduce industrial accidents to a minimum.

Codes already drawn up by states and private institutions will be examined and compared, and the best features of all will be incorporated with the results of the original investigations undertaken by the Service.

The Bureau of Standards will take the initiative in the comparison and formulation of the codes, and the Working Conditions Service will exert its influence in gaining the coöperation of other organizations and in obtaining the adoption of codes agreed upon. The closest coöperation will be maintained by the two bureaus.

* * *

Oliver Machinery Co. Reports Large Shipments

The Oliver Machinery Co., Grand Rapids, Mich., states that its shipment for January, 1919, was the largest in its history. Part of this was due to the fact that its export business has replaced some of the domestic business of previous months. Old export orders were allowed to be filled because of shipping conditions improving. Orders received by the company during January were within 10 per cent. of its average monthly business for the past year.

* * *

Statistics on Engineering Graduates

Figures taken from a circular of the United States Bureau of Education show that the number of mechanical-engineering graduates from 1895 to 1916 inclusive was 11,291; civil engineering, 11,621; electrical, 6357; mining, 3195; chemical, 1172; general engineering, 1897; metallurgical, 150; marine, 15; textile, 48; agricultural, 31; total, 35,777.

New Officers of the Material Handling Machinery Manufacturers' Association

The board of governors of the Material Handling Machinery Manufacturers' Association recently elected the following officers: President, Calvin Tompkins, former dock commissioner of New York; vice president, James A. Shepard, Shepard Electric Crane and Hoist Co., Montour Falls, N. Y.; treasurer, Lucien C. Brown, Elwell-Parker Electric Co., Cleveland; acting secretary, Fred Stadelman, Wellman-Seaver-Morgan Co., New York. Until such time as Mr. Stadelman can serve a paid secretary will be employed.

* * *

French Face Revenue Problem

The French people are faced with the problem of raising an annual revenue of two billion dollars greater than that raised in 1914. When the devastation of agricultural, mining and manufacturing regions where most of the wealth of the country is centered is considered the situation looks serious in the extreme.

* * *

New Alloy Reported

On account of the high temperature required for suitably hardening fine-edged tools of tungsten high-speed steel Sheffield toolmakers have sought a substitute material. A new alloy produced by adding cobalt to chromium-carbon steel is reported to be best hardened by a temperature not exceeding 1200 C. For most purposes the hardening needed is obtained when the tool is cocled nautrally in draft-free air. In a comparative test saws of "cobalt crom," as the new steel is called, continue cutting four days, it is stated, without regrinding, while saws of tungsten high-speed steel were dulled in two days and those of carbon steel in half a day.

Personals

PERCY M. BROTHERHOOD, vice president of Manning, Maxwell & Moore, Inc., sailed on Feb. 8 for England, France, Italy and Belgium.

ROBERT H. SCHUTZ has been made president and treasurer of the Smyth Manufacturing Co., Hartford, Conn., to succeed the late JOHN C. WILSON.

H. W. ULLMAN is now sales representative in the St. Louis territory for the Rich Tool Co., Chicago. The St. Louis office is located at 203 Security Building.

DAVID BULLARD has returned to the service of the Jones & Lamson Co. and will be in charge of the Pacific Coast territory with headquarters in San Francisco.

CHARLES T. MAIN, past president of the A. S. M. E., on his return from France attended a welcoming meeting and dinner at the Engineers' Club, Boston, Jan. 31.

A. W. SAWYER, recently of the *Western Farmer*, Spokane, Wash., has been made advertising manager of the Hart-Parr Co., manufacturer of tractors, Charles City, Iowa.

JAMES N. HATCH, consulting engineer, Chicago, Ill., has formed an association with Henry C. Eckland, architect, to be known as Henry C. Eckland & Co., architects and engineers.

C. F. SULLIVAN, former special factory representative of the Overland Auto Co., has been appointed organizer for open territory for the Hart-Parr Co., Charles City, Iowa.

H. H. BOETTGER, formerly with the Northern Rock Island Plow Co., Minneapolis, has been appointed manager of the branch office at Great Falls, Mont., of the Hart-Parr Co.

LIEUT. FRANK WOLLAEGER, JR., has been honorably discharged from the army and has resumed his duties as secretary of the Kempsmith Manufacturing Co., Milwaukee, Wis.

J. L. CROWLEY has been appointed special railroad representative of the Rich Tool Co., Chicago, with headquarters at the company's main offices, Railway Exchange Building, Chicago, Ill.

GEORGE E. DIX, assistant general sales manager of the Midvale Steel and Ordnance Co., Philadelphia, Penn., has joined the sales organization of the Consolidated Steel Corporation, New York.

L. F. PHIPPS, who has been president of the American Frog and Switch Co., Hamilton, Ohio, since its organization, has retired from the presidency and become the chairman of the board of directors.

HARRY C. CROMWELL, for 20 years with the Baltimore & Ohio Railroad Co., has become mechanical engineer and general superintendent of the Boyden Co-ordinating Car Corporation, Baltimore, Md.

AMEL R. CARLSON has severed his connection with the purchasing staff of the Wright-Martin Aircraft Corporation, and has taken a position with the Commonwealth Motors Co., Chicago, Ill., as assistant general manager.

RICHARD P. TELL, president and general manager of the National Brake and Electric Co., Milwaukee, was re-elected president of the Milwaukee Metal Trades and Founders' Association at its annual meeting on Jan. 30.

PAUL CAMPBELL has been made factory manager of the Electric Service Supplies Co., Philadelphia, Penn. He was formerly connected with the New York district office of the Bureau of Aircraft Production as a special investigator of production problems in the New England states.

J. CORBUS BUSHNELL, formerly with the Business Men's Clearing House, Chicago, Ill., and until recently connected with the United States Employment Service as special agent of personal methods in vogue at Vickers,

Ltd., and Woolwich Arsenal, England, has been engaged by the Central Engineering Agency, Pittsburgh, Penn., as special director.

ARTHUR F. BRAID has been appointed sales manager of the metal and alloy department of the Metal and Thermit Corporation. Mr. Braid came to the company seven years ago as a traveling salesman and was soon made assistant superintendent of the Jersey City plant. When the United States entered the war he assumed active charge of the metal sales at the New York office of the company.

Business Items

The Milwaukee Electric Crane and Manufacturing Co. has removed its Pittsburgh office from 704 Empire Building to room 2201, Farmers' Bank Building.

The Columbiana Foundry Co., Columbiana, Ohio, at its annual meeting held recently, elected the following directors: F. C. Sullivan, F. B. McConnell, J. W. Blackburn, C. Fuhrman and F. O. Funk.

The Alexander Milburn Co. has opened a branch office at 998 Monadnock Building, San Francisco, Calif., under the management of E. F. Walter. A complete line of stock will be kept.

Pasquale Nieke & Co., Scali d'Azegelic 7, Leghorn, Italy, handle the importation of machinery and tools and certain lines of chemicals. They would like to establish connections with American manufacturers in these lines.

The Leland-Gifford Co., Worcester, Mass., has leased space at 621 West Washington Boulevard, Chicago, Ill., for the sale and demonstration of its high-speed sensitive drilling machine. Clarence H. James is in charge.

Enrique Laroza & Cia., Lima, Peru, P. O. Box 792, will handle the installation of industrial plants in their territory. They solicit correspondence with American concerns with a view to becoming Peruvian representatives.

Economous Agapito Junior, Florianopolus, Brazil, P. O. Box 3, desires to represent in his territory American lines of hardware, tools, lubricating oils, locomotives, concrete mixers, electrical machinery and similar items.

C. H. Westerberg & Co., Inc., is the new incorporated name of C. H. Westerberg of 9-11 West Broadway, New York. The officers are C. H. Westerberg, president; A. M. Maddox, vice president; Charles Westerberg, treasurer; E. Goehrig, secretary.

The Duntley-Dayton Co. took over the entire output of the Dayton Pneumatic Tool Co., Dayton, Ohio, on Jan. 1. O. W. Duntley, former president of the Chicago Pneumatic Tool Co., is president of the new concern, and his son, Capt. C. A. Duntley, is vice president. The offices of the Duntley-Dayton Co. are located in the Westminster Building, Chicago.

Obituary

HERBERT WOODRUFF MERRILL, secretary and treasurer of Mitts & Merrill, Saginaw, Mich., died on Jan. 26, 1919.

New Publications

Safety in Woodworking.—Published by the National Workmen's Compensation Service Bureau, 13 Park Row, New York. Loose leaf; cloth binding; 11 sections; size 6 x 9 in. Price $1.10 postpaid.

The standards, illustrations and explanatory notes presented in this book are intended primarily for the information of employers and employees engaged in the woodworking industry, but as wood in some form enters into the plant maintenance if not into the actual manufacturing operation of most industrial establishments practical information and advice with regard to safeguarding woodworking machines should be of general value. In the foreword it is stated that the illustrations are from photographs of devices in actual service, which is an indication that these devices are practical rather than theoretical. The volume is divided into 11 sections under the following titles: General Principles and Standards; Logging; Saw Mill, Planing Mills, Saws, Jointers, Planers, Shapers, Sanding, Boring, and Miscellaneous Machinery, such as automatic lathes, miter chopper, stave crozier, and veneer clipper. It is assembled in loose-leaf form in order to make it possible to insert additional pages as new matter is obtained, this form also permitting the withdrawal of matter that has become obsolete.

Catalogs Wanted

The Bryan Harvester Co., manufacturer of steam tractors, trucks and automobiles, Peru, Ind., desires to receive catalogs covering metal-working plant equipment and supplies.

E. M. Dunbar, 15 Rowena St., Boston, Mass., wants catalogs on power-transmission machinery, shafting, bearings, couplings, pulleys and friction clutches for a British customer. Any manufacturer having new catalogs along these lines may forward them to the above address.

Trade Catalogs

The Sullivan Drill Sharpener—Sullivan Machinery Co., Chicago, Ill.; Bulletin 72-C. Pp. 24; 6 x 9 in. The Sullivan drill sharpener is described and illustrated in this bulletin.

Saphil Grinders.—Saphil Manufacturing Co., Chicago, Ill. Circular. This is an illustrated circular describing Saphil tool, cutting and surface grinding machines and equipment.

Besly Grinders.—Chas. H. Besly Co., Chicago, Ill. Catalog. Pp. 60; 8½ x 11 in. This catalog is made up of bulletins describing a complete line of Besly disk and wheel grinders and their accessories. It is fully illustrated.

X-Ray Indirect Lighting for Offices.—National X-ray Reflector Co., Chicago, Ill. Catalog. Pp. 15; 8 x 10 in. This outlines the uses and advantages of X-ray indirect lighting, and gives several illustrations showing its installation.

A Textbook on Babbitt Metals.—The Ajax Metal Co., Philadelphia, Penn. Booklet. Pp. 18; 3½ x 6 in. This briefly describes the various types of babbitts, tells the right method of babbitting and gives six points to remember when pouring.

A Textbook on Ingot Metals.—The Ajax Metal Co., Philadelphia, Penn. Booklet. Pp. 36; 3½ x 6 in. This describes the various kinds of standard Ajax ingots and gives suggestions for their proper use and advantages to users of Ajax process ingots.

Universal (Horizontal) Boring Machines.—Universal Boring Machine Co., Hudson, Mass. Catalog. Pp. 48; 9 x 10½ in. Universal horizontal boring machines are described and illustrated. Photographs showing these machines at work are also reproduced.

Sullivan WA-5 Air Compressor.—Sullivan Machinery Co., Chicago, Ill. Bulletin 75-D. Pp. 12; 6 x 9 in. This bulletin gives a general description of the Sullivan single-stage, steam-driven, straight-line air compressors, class WA-5. A table of dimensions is also given.

Sullivan WB-3 Air Compressors.—Sullivan Machinery Co., Chicago, Ill. Bulletin 75-E. Pp. 12; 6 x 9 in. This bulletin describes the Sullivan straight-line, simple steam and two-stage air compressors, class WB-3. It is fully illustrated and contains a table of dimensions.

Economy Drawing Tables and Sectional Filing Cases.—Economy Drawing Table and Mfg. Co., Adrian, Mich. Catalog N. Pp. 32; 7 x 10 in. This illustrates and describes the various types of drawing and reference tables and drafting-room furniture. A complete price list is also included.

Francis Flexible Couplings. Smith Serrell Co., Inc., New York, general sales agent for the Francke Co. Bulletin 26. Pp. 12; 6 x 9 in. This illustrated booklet describes the construction and operation of Francke flexible couplings; it also gives specifications and directions for installing.

Portable Mine-Car Air Compressors.—Sullivan Machinery Co., Chicago, Ill. Bulletin 75-I. Pp. 8; 6 x 9 in. This bulletin describes the Sullivan motor-driven portable air compressors, class WK-2, mounted on a special truck. Illustrations and a table of details are given.

The Six-Spindle Automatic Screw Machine. The New Britain Machine Co., New Britain, Conn. Catalog. Pp. 48; 8½ x 11 in. A general description of the automatic and illustrations of work done on this machine are given, together with production tables and specifications of various-sized machines.

Small, Belt-Driven Air Compressors.—Sullivan Machinery Co., Chicago, Ill. Bulletin 75-G. Pp. 12; 6 x 9 in. This bulletin describes the Sullivan small, belt-driven air compressors, class WG-3, single stage, and class WH-3, two stage. It is fully illustrated and contains tables of specifications and details.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34.60	$37.60
Northern Basic	31.80	34.80
Southern Ohio No. 2	32.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	39.55
Southern No. 2 (silicon 2.25 to 2.75)	39.95	41.70
BIRMINGHAM		
No. 2 Foundry	31.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	39.15*
Virginia No. 2	35.10†	40.50†
Basic	33.90*	36.90*
Grey Forge	33.90*	36.90*
Bessemer		39.10*
CHICAGO		
No. 2 Foundry Local	31.00	34.50
No. 2 Foundry Southern	37.25	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	35.40
Basic	30.00	34.40
Bessemer	33.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	...	...	...	...	...
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For ⅜-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	3.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	4.70	6.22	6.22	6.445	5.75	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.12	6.35	5.65	6.35	6.12	6.35
*Nos. 22 and 24 black	4.55	6.07	6.07	6.295	5.60	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.02	6.245	5.50	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.37	5.645	4.95	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.27	5.545	4.85	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.17	5.445	4.75	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.57	7.695	7.15	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.27	7.395	6.85	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.12	7.245	6.70	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
3/32, 1/8, 5/32, 3/16, 1/4, 5/16, 3/8, No. 8, 7/32 and No. 10	25.50 to 33.00	3/16 by 12 in. long	14.00
1/2		1/4 by 19 in. long	12.00
No. 12		1/4 by 19 in. long	10.00
5/32, No. 14 and 1/16		5/16 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/8	33.00
		5/32	30.00
		3/16	38.00

Domestic 20c. for 1/16, 15c. for 1/4 to 1/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, 1/4, and 3/8	47%	20½%	1/4 to 1½	36%	20%
1/2	51%	36½%			
3/4 to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/4, 3/8 and 1/2	43%	25½%	3/4 to 1½	36%	21%
3/4	48%	35½%			
1 to 1½	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	29%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	18.00	20.50	23.50
Tin in 5-ton lots	72.50	72.00	85.00
Lead	5.00	5.75	7.00
Spelter	6.85	7.85	8.00
ST. LOUIS			
Lead	4.70	5.45	6.85
Spelter	6.50	7.50	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	29.00	29.00	31.50–33	30.00	32.50	32.00	36.00
Copper wire (carload lots)	28.00	28.00	32.00	32.00	28.50	28.50	34.50
Brass sheets	29.00	29.00	30.75	32.00	29.00	29.00	35.50
Brass pipe	37.00	37.00	36.50	38.00	35.50	37.00	41.50
Solder (half and half) (case lots)	41.00	41.00	62.00	44.00	47.00	39.00	48.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under: over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$22.76	$25.25
New York	26.28	26.25
Cleveland	30.00	30.00
Chicago	28.50	37.00

February 27, 1919 American Machinist Vol. 50, No. 9



Improved Methods of Hollow Forging

By S. A. Hand,
ASSOCIATE EDITOR, AMERICAN MACHINIST



While the product described in this article is an essential one and relates to war, the process of manufacture can be applied to many articles for use in times of peace. The methods described were used in France in making forgings for the famous 75-mm. shell. They have been adapted to American practice and have been found more economical than the methods formerly used in American plants.



FIG. 1. THE TORCH AND THE NICKED BAR

IN THE machining of shells there has been much waste of time and material owing to lack of concentricity in the forgings. The trouble starts in the first forging operation known as piercing, and if the hole and the exterior are not made concentric in this operation no amount of work in the succeeding forging operations will make them concentric. Working to eliminate this trouble the Worthington Pump and Machinery Corporation has adapted at its Hazleton, Penn., plant a French process for forging 75-mm. shells, the result of which is a product several pounds lighter than formerly and requiring much less work in machining.

The billets from which the forgings are made are broken from bars of shell steel $2\frac{43}{64}$ in. in diameter. All bars bearing the same heat number are kept in a separate pile, the practice at this plant being to work continuously on material bearing one heat number until it is all used. The first operation is nicking the bars so they can be broken into billets of the proper length. This is done with an oxy-acetylene torch mounted on two copper wheels so spaced that one wheel acts as a length gage for the distance between nicks. The torch and nicked bar are shown in Fig. 1 and the details of the mounting are shown in Fig. 2. The bar at the position of the nick is preheated for about two seconds by the acetylene flame, combined with a small amount of oxygen, after which the full amount of oxgen is turned on, producing a flame of intense heat that locally fuses the steel.

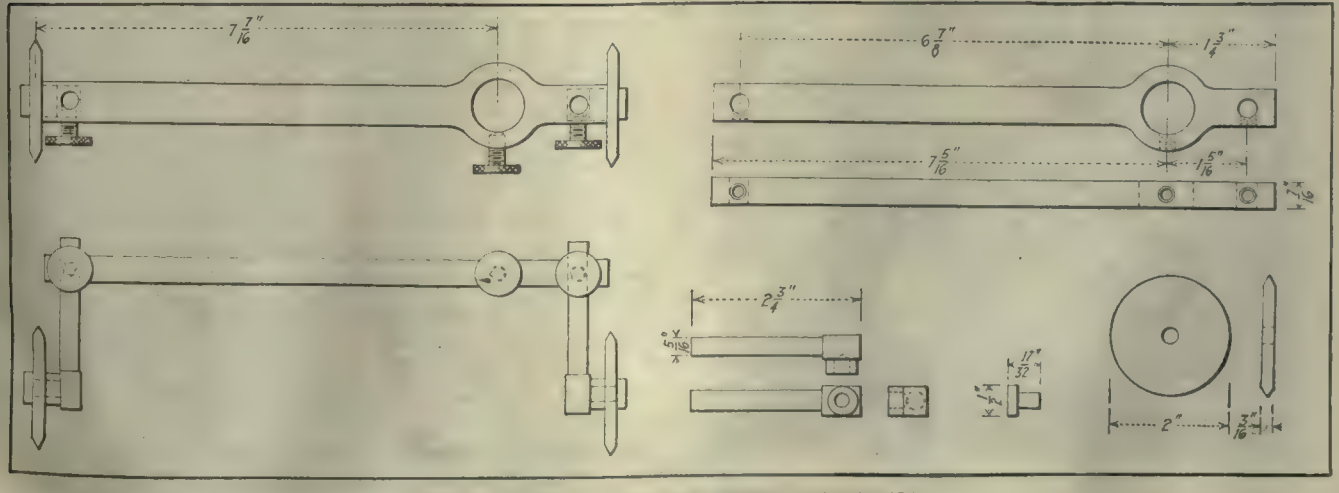


FIG. 2. DETAILS OF THE TORCH MOUNTING

During the application of the intense flame the torch is moved about $\frac{1}{2}$ in. transversely, resulting in a hollow spot about $\frac{1}{2}$ in. long and $\frac{3}{16}$ in. deep. No further marking or measuring is necessary, as placing one wheel of the torch mount in the preceding nick brings the

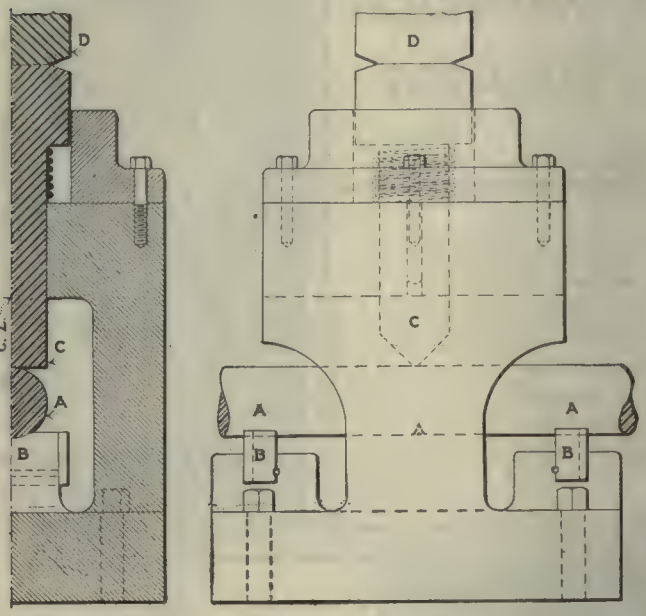


FIG. 3. THE BREAKING DIES

nozzle in the proper position to make the next one. One operator can nick about 7000 billets in eight hours.

The cost of the gases is about $1.50 per 1000 nicks.

Breaking the Bars

After nicking, the bars are passed to the first breaking press where they are broken into lengths of about five billets. The press is equipped with a subpress having two hardened supports, or anvils, on which the bar rests, and a breaking punch that is normally held away from the bar by a spring as shown in Fig. 3. *A* is the bar to be broken, *B* the anvils, *C* the breaking punch and *D* a hardened piece on the press ram. Fig. 4 shows the subpress as mounted in the press proper.

When the press ram descends it pushes the breaking punch into contact with the bar, and a continued downward motion of $\frac{1}{4}$ in. further is all that is necessary to break the bar.

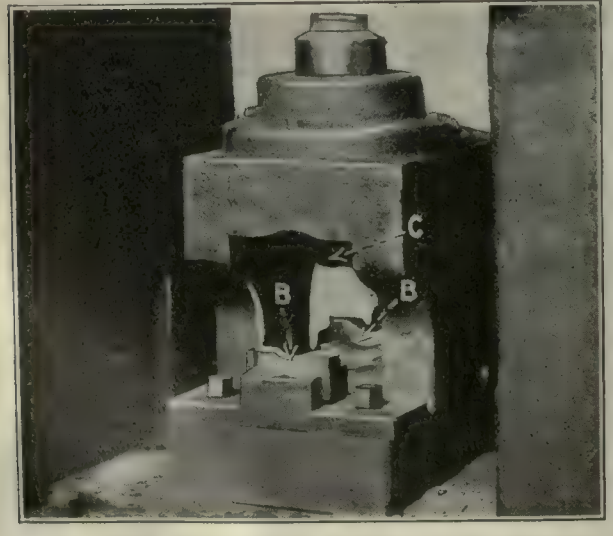


FIG. 4. THE SUBPRESS

The theory of this process is that nicking the bar by the torch flame disrupts the molecular construction of the steel and sets up unequal internal stresses at the cross-section where it is nicked so that it can be broken with comparative ease. Experiments have shown that the length, width and depth of the nick have not much to do with the breaking except in the amount of power required. This process is the subject of a French patent.

Differences in temperature alter the conditions of breaking to some extent. In hot weather there is a

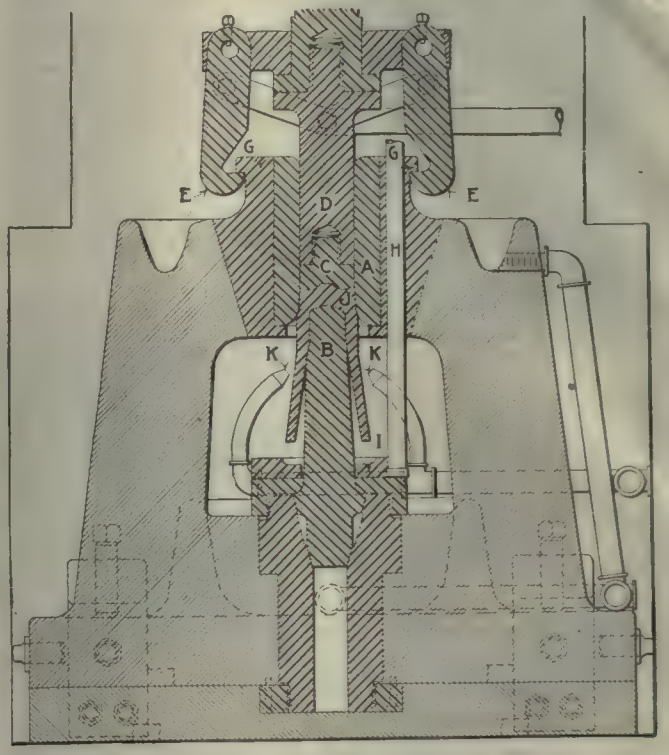


FIG. 5. SETUP OF THE PIERCING PRESS

tendency for the parts to stick together, while in cold weather they will fly apart for a considerable distance.

From the first breaking press the short bars are taken to the second breaking press where the billets are broken off singly. This press and equipment are the same as used for the first breaking.

SEQUENCE OF OPERATIONS

1. Nick with oxyacetylene torch.
2. Break into five-billet lengths.
3. Break into billet lengths.
4. Heat to 2000-2200 deg. Fahrenheit.
5. Pierce.
6. Hot-draw.
7. Anneal.
8. Pickle, wash and scrub.
9. Cold-draw.

The billets, which are $7\frac{7}{16}$ in. long and weigh from 14 lb. 11 oz. to 15 lb., are passed to gravity conveyors and are there inspected for pipes, segregations, surface defects and porosity of metal. Segregations that are hardly noticeable are apt to show up in the pierced billet as cracks ranging from $\frac{1}{4}$ in. wide to a complete split. If the segregations are small they are cut out with an air chisel.

Passing from the inspectors down the gravity conveyors, the billets are charged into oil-fired furnaces

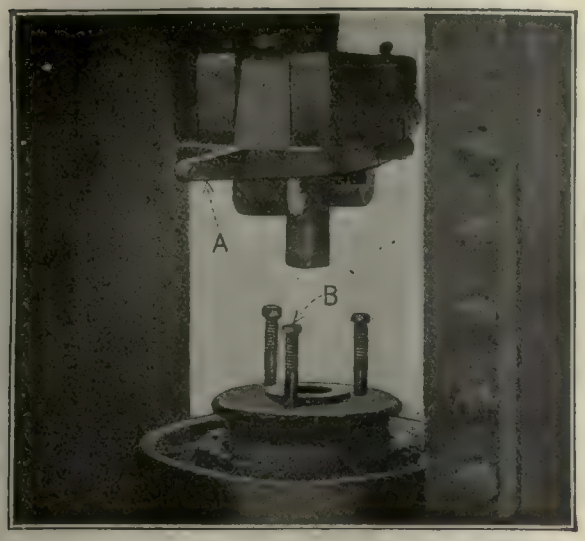


FIG. 6. THE GRAB HOOKS

fitted with iron-pipe preheating runways about 20 ft. long, through which they are gradually pushed into the main heating pit. There they are heated to from 2000 deg. to 2200 deg. Fahrenheit.

The pyrometers for controlling the furnaces automatically operate electric lights of three colors—red, signifying too high heat; white, the proper heat, and blue, too low heat. These lights can be seen from all control points of the furnace, so that the man in charge can tell the heat conditions without reading the pyrometers. Recording pyrometers keep daily records of the heat conditions by means of graphic charts.

The oil used for fuel is ordinary crude petroleum, and is fed to the burners by an air blast at a mercury pressure of from 6 in. to 9 inches.

Each furnace will hold 100 billets, and 20 min. are required to bring them to the proper temperature.

Piercing the Billets

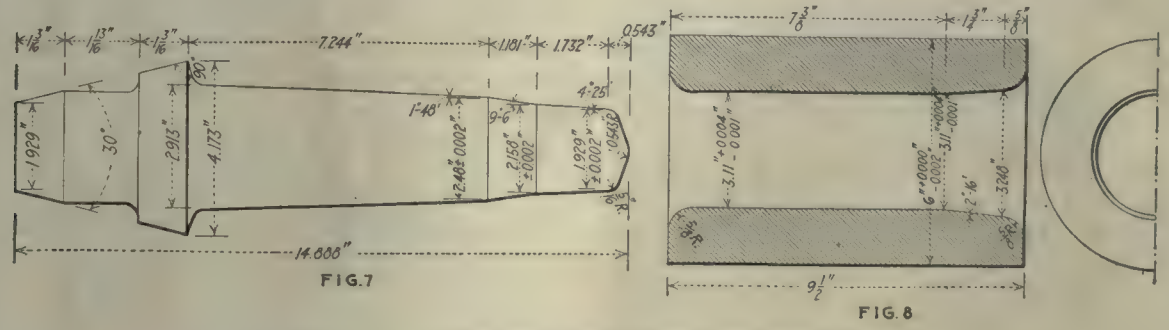
From the furnaces the billets are transferred to the piercing press. Here they are forced through a sleeve, or matrix, and down over a stationary inverted piercing punch. Fig. 5 shows the setup on the press, in which *A* is the matrix, *B* the punch, *C* the base-forming die and *D* the plunger attached to the press ram. Toward the end of the downward motion of the ram the grab hooks *E* engage in the rim of the matrix holder at *G*, so that the return stroke lifts the matrix holder from its conical seat. In rising, the upper face of the matrix holder comes in contact with the nuts on the bolts *H* which are attached to the washer *I*, carrying it up so that it strips the pierced billet *J* from the punch. Cold-water jets are provided at *K* for cooling the punch and matrix.

Before piercing the next shell it is necessary for the press to make an idle stroke to reseat the matrix holder. The grab hooks are then released by the lever *A*, shown in Fig. 6, where the three bolts that operate the stripper may be seen at *B*.

Salvaging Cracked Billets

Should the pierced billet show longitudinal surface seams it is placed on a horn, or stake, and the seam opened out by a swedge so that the sides form an included angle of about 90 deg. The subsequent procees of hot-drawing irons out the seam. If it was attempted to close the seam instead of opening it the result would be a pipe after hot-drawing.

The wear on the punches and matrices both from the work and the heat is very great and considerable experimenting has been done not only to find the best material from which to make them but the method of heat treatment that will insure the longest service. At present a chrome-vanadium steel known as La Belle hot-work steel is used for the punches. They are heated in a muffle furnace to 1550 deg. F. and quenched in oil, reheated to 1100 deg. F. and again quenched in oil.



FIGS. 7 AND 8. THE PIERCING PUNCH AND THE MATRIX

From the performance of the punches it has been determined that when made of steel that is comparatively soft and tough they work better than if made of hard steel. Experiments have been made with chilled cast-

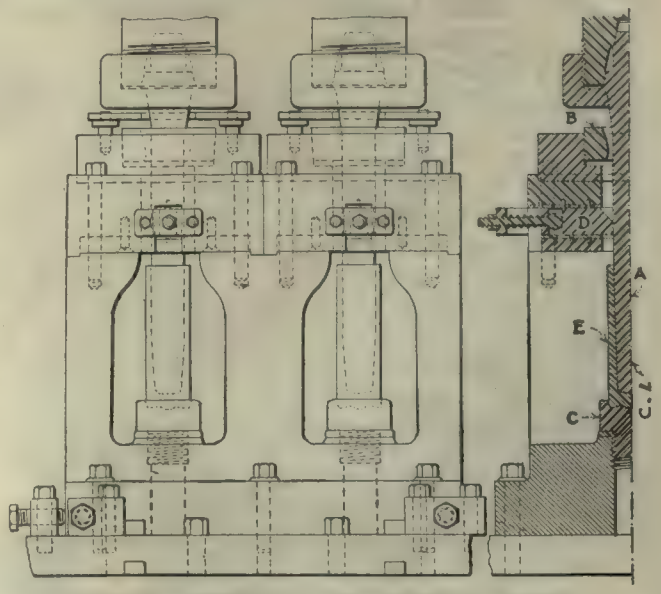
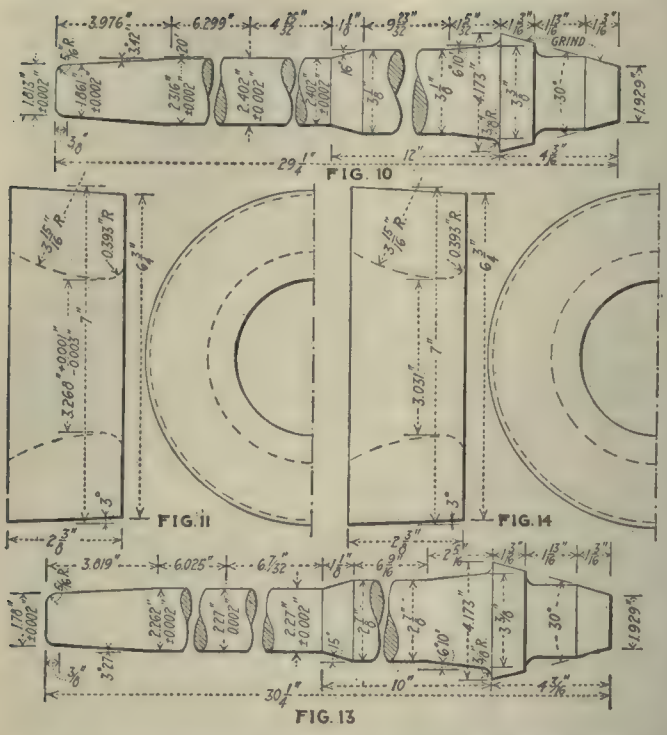


FIG. 9. SETUP OF HOT-DRAWING PRESS



FIGS. 10, 11, 13 and 14. HOT AND COLD DRAWING TOOLS
Fig. 10—Hot-Drawing Punch. Fig. 11—Hot-Drawing Die. Fig. 13—Cold-Drawing Punch. Fig. 14—Cold-Drawing Die

iron punches, but the statement above that a soft, tough material is best readily explains why a hard and brittle metal such as chilled cast iron will not stand up under the strain.

Pack-hardened machine-steel punches have also been tried, but the hardened skin was soon destroyed by the heat from the billets, and they soon commenced to upset.

Life of Punches and Matrices

Punches made of chilled cast-iron and pack-hardened machine-steel have pierced about 200 billets before breaking down.

Chrome-vanadium steel punches, heat-treated as before mentioned, have pierced as many as 1700 billets without regrinding, and their total life is from 3000 to 5000 billets. The matrices are made of an alloy of manganese and cast iron, known as Adamite, and have a life of 1000 to 1500 pierced billets.

While the punch and matrix absorb a great deal of heat from the hot billets—and they work better when heated to a certain temperature—they must not be allowed to get red hot, so water jets are used to cool them. To prevent the billets from sticking to either the matrix or the punch these parts are doped with a mixture of graphite and a special press grease.

In piercing billets certain fixed distances must be kept between the wearable parts of the piercing apparatus, and the amount or wear must be constantly checked. For instance, the end of the punch either wears away or is permanently compressed about $\frac{1}{16}$ in. for every 1000 billets pierced so that it becomes necessary to lower the position of the press ram at stated intervals to compensate for this wear. Readjustment of the ram must be done with care, for if the billet is driven down too far on the punch the walls will be too thin, and if not far enough they will be too thick. If the latter condition prevails too much power will be required in the next operation of hot drawing, besides there is always the ever-present danger of the forging being torn in two.

The crew for operating one piercing press consists of four men. One man cleans the hot billet from scale; one man picks up the billet, cools one end slightly by dripping in water and places it, hottest end down, in the matrix; one man removes the pierced billets from the press, dopes the matrix and punch, operates the cooling jets, keeps tally on the number of billets pierced and operates the grab hooks that lift the matrix holder; the fourth man operates the press.

The reason for cooling one end of the billet is to prevent the metal from flowing up and forming a flash around the base-forming die.

Details of the punch and matrix are shown in Figs. 7 and 8.

Hot-Drawing

After piercing, the billet is passed without reheating to the hot-drawing press where it is pushed base first through a die by a punch that enters the hole already made. In this operation the forging is lengthened about $1\frac{1}{4}$ in., the hole reduced about $\frac{5}{16}$ in. in diameter and the walls thinned about $\frac{1}{8}$ inch.

The end of the punch is flat instead of slightly pointed, as in the piercing operation, and the contour of the base re-forming die is such that the tit on the base is compressed in its length so as to force the metal at the bottom of the hole against the flat end of the punch.

The temperature of the pierced billet must not be over 1300 deg. F. when passed through the hot-drawing process lest the forging pull apart in the process.

The punches for hot-drawing are made of the same material and receive the same heat treatment as those for piercing. The dies are made of Adamite. The die

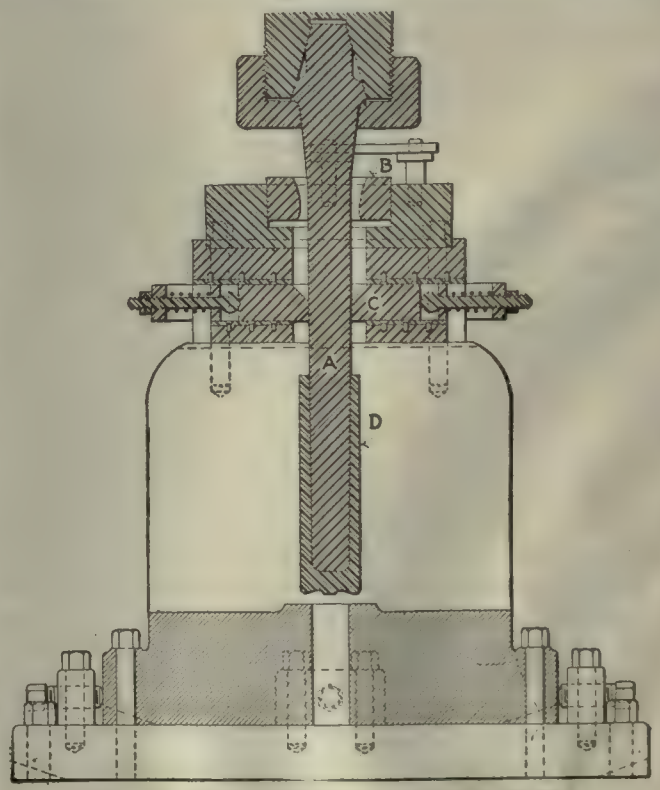
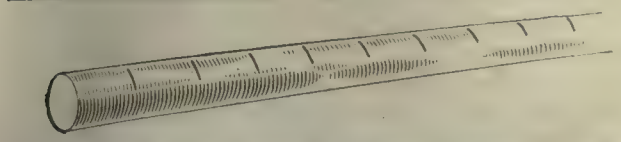


FIG. 12. SETUP OF COLD-DRAWING PRESS

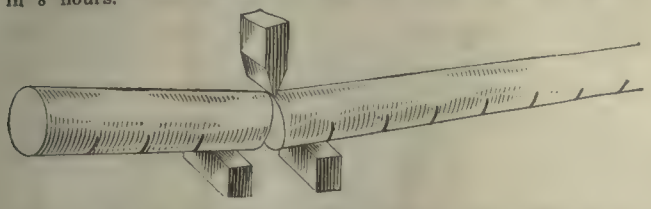
for re-forming the base is made of machinery steel and has provision for the insertion of steel stamps for marking a code representing the heat number.

The punches and dies are doped with the same lubricant as used in piercing. The life of the punches is about 1000 forgings, and of the dies from 400 to 700.

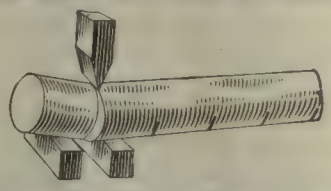
The setup of the press is shown in Fig. 9, in which it will be seen that there are two punches and dies set side by side. These are used alternately so as to allow time for cooling. Referring to the sectional view, *A* is the punch, *B* the die, *C* the base re-forming die, *D* the spring-actuated stripper and *E* the forging that has just been drawn. Details of the punch and die are shown in Figs. 10 and 11.



Transformation for Operation 1.—Nick. Tools—Oxyacetylene torch mounted on small copper wheels; one wheel arranged for spacing from nick to nick. Production—7000 nicks per operator in 8 hours.

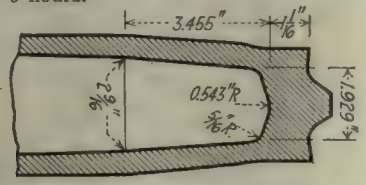


Transformation for Operation 2.—Break in five-billet lengths. Machine—No. 87 Bliss press driven by a 15-hp. motor. Tools—Subpress with breaking punch and two work supports, or anvils. Number of Operators—Three. Production—7000 per press in 8 hours. Note—Illustration shows only four pieces in billet.

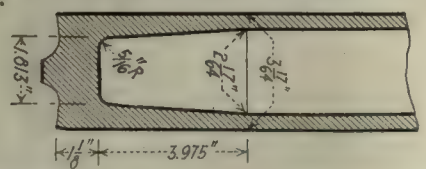


Transformation for Operation 3.—Break in single billets. Machine—No. 87 Bliss press driven by a 15-hp. motor. Tools—Same as previous operation. Production—7000 per press in 8 hours.

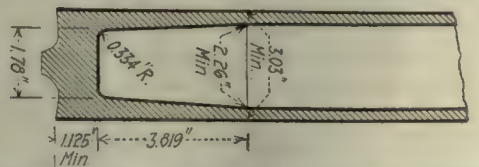
Transformation for Operation 4.—Heat. Equipment—Ten American oil-burning furnaces; pyrometers. Production—1200 per furnace in 8 hours.



Transformation for Operation 5.—Pierce. Machine—No. 78½ Bliss special press, 16-in. stroke, driven by a 30-hp. motor. Equipment—Punch, matrix and stripper; two water jets for cooling punch. Number of Operators—Four. Lubricant—Graphite mixed with a special press grease. Production—2300 per press in 8 hours.



Transformation for Operation 6.—Hot-draw. Machine—No. 78½ Bliss special press, 32-in. stroke, driven by 40-hp. motor. Number of Operators—Four. Equipment—Duplicate punches and dies used alternately; base-forming tools, with provision for insertion of steel stamps for stamping the heat number on the forging; stripper. Lubricant—Graphite mixed with special press grease. Production—2000 per press in 8 hours.



Transformation for Operation 9.—Cold-draw. Machine—No. 78½ Bliss special press, 32-in. stroke, driven by a 40-hp. motor. Equipment—Punch, die and stripper. Lubricant—Lubro. Production—3000 per press in 8 hours.

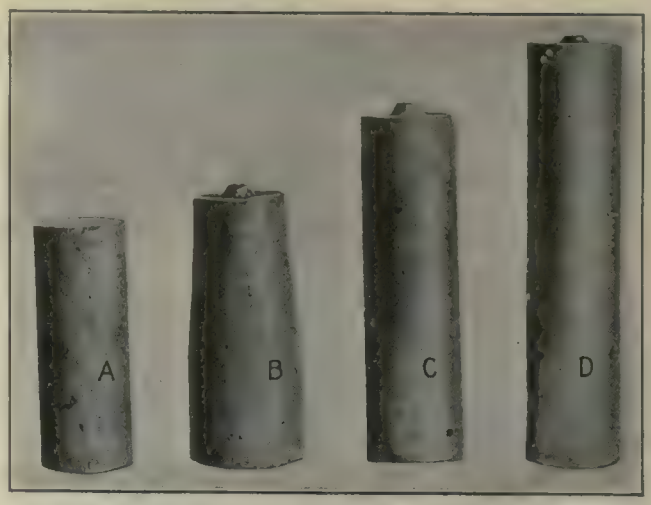


FIG. 15. THE BILLET AND THE FORGINGS

Annealing and Pickling

From the hot-drawing press the forgings are tossed to the annealing pits near by. Here they are packed with fine coke and allowed to cool slowly. When cold they are pickled to remove the scale. The pickling is done in a hot solution of Eddes compound (sodium bisulphide) and commonly called niter cake. It is a by-product from the manufacture of nitric acid. About 1 lb. of niter cake is used for each forging to be pickled. The strength of the solution, which is used at a temperature of 175 deg. F., is 1 to 12.

About 1½ hours are required for thorough pickling, after which the forgings are washed in cold water and the scale brushed off. After pickling one batch of forgings the bath can be used for another batch by adding 50 per cent. of the original amount of niter cake; a third batch can be pickled in the same way, after which the vat should be emptied and the residue cleaned.

The forgings are now ready for the final operation, which is cold-drawing, and is a repetition of the hot-

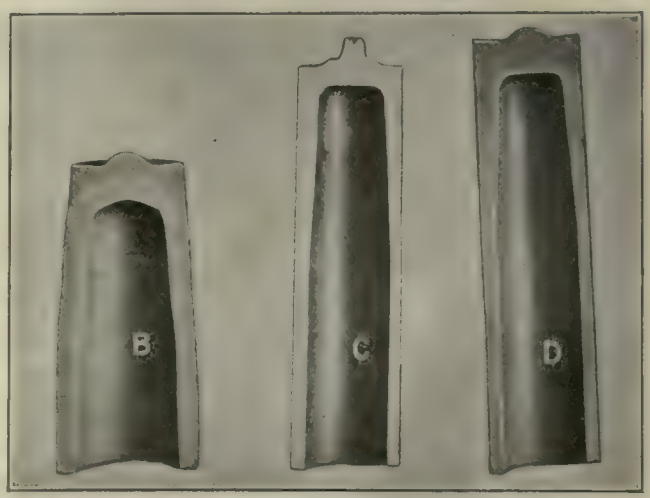


FIG. 16. THE FORGINGS CUT OPEN

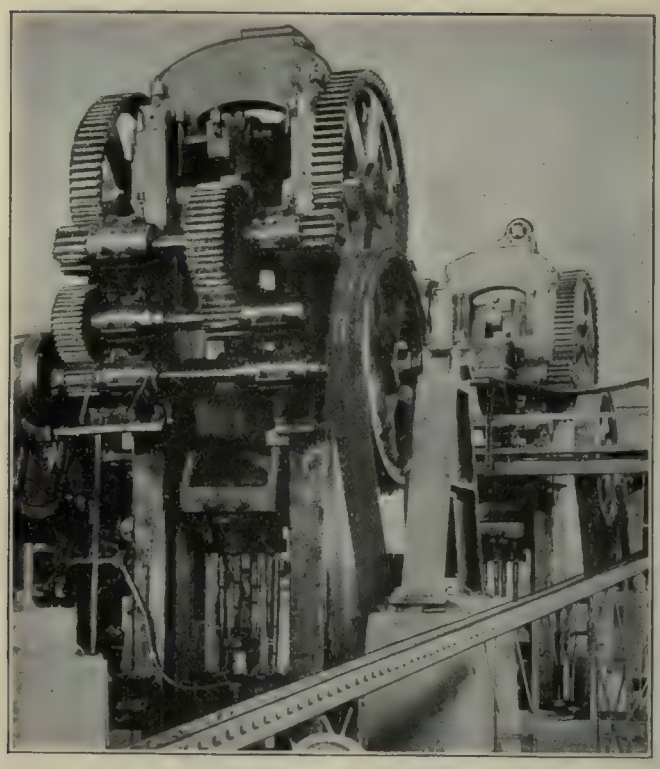


FIG. 17. PRESS FOR FINISH HOT-DRAWING

drawing process with the exception that the forgings are not heated.

This operation adds about 2 in. to the length of the forging, reduces it in diameter about $\frac{1}{4}$ in., reduces the diameter of the hole about $\frac{1}{64}$ and thins the walls 7/64 in., representing a displacement of more than 4 cu.in. of metal.

Both the punches and dies are made of Crescent steel. The punches are heated in a muffle furnace to 1450 deg. F. and quenched in brine. They are then drawn to 400 deg. F. in an oil bath and quenched in oil.

One of the secrets of successful cold-drawing is in the hardening of the dies. This is done by quenching the walls of the hole only by a stream or jet of water, leaving the rest of the die soft. A drawing die intended for hard work, if hardened all over, is apt to break at the first attempt to draw through it.

The punches have an average life of from 3000 to 7000 forgings and the dies about 2000. The dope used on the punches and dies is a compound known as Lubro.

The setup of the press for cold-drawing is shown in Fig. 12, in which *A* is the punch, *B* the die, *C* the stripper and *D* the cold-drawn forging. Details of the punches and dies are shown in Figs. 13 and 14.

Cold-drawing gives the least trouble of any of the operations, and if the forgings are supplied in sufficient quantity the press can be kept running continuously and 2000 forgings a press a day of eight hours can be cold-drawn with ease.

The forgings come from the cold-drawing press with the holes clean and to size, so that the only tooling required is deepening the holes slightly in order to remove the nonhomogeneous metal that is naturally forced to the bottom by the punches in piercing and hot-drawing. The outside of the forging, while bright, has some longitudinal scores on its surface.

Forgings made by this process weigh from 5 to 7 lb. less than those formerly bought in the open market, and require much less machine work than those made by other processes.

The billet is shown at *A*, Fig. 15, while *B* is a pierced billet, *C* is a hot forging and *D* is cold-drawn. Fig. 16 shows the forgings cut open and designated by the same reference letters used in Fig. 15.

Finish Hot-Drawing

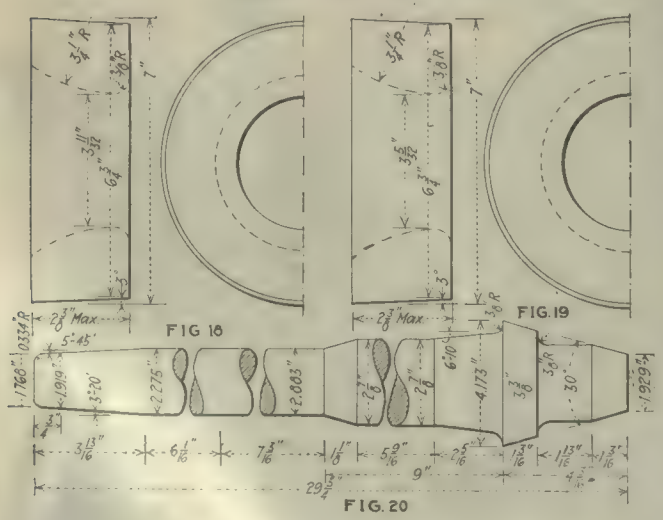
The Worthington Pump and Machinery Corporation has carried its experiments still further and has developed a hot-forging process that surpasses the cold-drawing process just described in that it cuts out the operations of annealing and pickling.

In this process the pierced billet is passed through two hot-drawing operations without reheating. There are two methods of doing this in use at the present time.

The first is by passing the pierced billet through two successive hot-drawing operations by means of a press equipped with two dies set side by side and drawing the pierced billet first through one die and then through the other. Four punches are mounted on a turntable on the press ram as shown in Fig. 17, and while two are in use alternately the other two are in dipped tanks of water at each stroke of the press. At the completion of every fifth or sixth forging the press is stopped and the turntable turned one-quarter way around, bringing the two idle punches into use and allowing the hot ones to be cooled in the tanks of water. Passing the pierced billet through the first die produces a forging about the same as in the hot-drawing previous to the cold-drawing operation, while the second die leaves it about the same as the cold-drawing die except that the surface is a blue-black of high luster like that of a bar of tool steel.

The second and improved method is to pass the pierced billet through two dies set one above the other, so that the operation is completed at one stroke of the press. By this process operations 7, 8 and 9 are eliminated.

The two dies are shown in Figs. 18 and 19 and the punch in Fig. 20.



FIGS. 18 TO 20. FINISH HOT-DRAWING TOOLS

Fig. 18—Upper Die for Finish Hot-Drawing. Fig. 19—Lower Die for Finish Hot-Drawing. Fig. 20—Punch for Finish Hot-Drawing.

WAR-TIME REPAIRS IN THE NAVY



By FRANK A. STANLEY

V. Boring and Lining Operations

This article explains the principal features of the simple and thorough system for taking care of the many jobs handled by the repair ship. Relining a set of connecting-rod brasses is also described, together with details connected with the necessary boring of the lining. The method of setting up the work on the horizontal boring machine is described and illustrated.

THE work handled for the fleet by the repair ships is taken care of by a simple system carried out in the repair officer's headquarters on board the train flagship "Vestal." Thousands of orders for work of all kinds come to this ship every month, and the necessary job orders are here issued to the different departments of the ship by the repair officer and his yeoman assistant. When the part repaired or the new part made is finished and sent back to the ship originating the work all records covering the job are put in an envelope and filed for reference in a steel cabinet with the records for each ship in a special drawer.

General Instructions

As many of the ships are away from the naval base for days or weeks at a time it is important that full instructions be given with each job to prevent serious delays in completing the work. To eliminate misunderstandings in connection with drawings, sketches, etc., the instructions, Fig. 42, are issued by the train commander.

The Original Job Orders

It is the intention that such repairs as can be attended to by a vessel's own mechanics be handled in the shops on that ship. But as the machine shops on men-of-war are limited in space and equipment there is a large share of work that can be done to best advantage by the regular repair ships, especially if the job requires the attention of mechanics of special experience or skill.

The requests for repairs from ships are made on a standard form, Fig. 43, which is sent to the train commander, and if two repair ships are present at the base he assigns the work to the ship best prepared at the moment for handling the repairs. This is usually determined by means of weekly reports from the repair ships showing the number of mechanics available, the number of days' work already on hand, and the percentage of urgent work. The repair officer determines the plan of handling the work and lays out the schedule on the loose-leaf form, Fig. 44, copies of which are sent to each shop having part of the work to look after and to the supply officer as a record of material charges. The reverse of the form is shown in Fig. 45.

TABLE I. UNITED STATES SHIP "VESTAL"

Weekly Report of Work
Week ending July July 14, 1917

Job Order and Ship	Specifications	Remarks
	Completed Jobs	
3759—Alabama	Manufacture one eccentric strap	Complete and Delivered
3674—Arizona	Manufacture six ice-making cans	Complete
3453—Arkansas	Manufacture following items: 1. Twelve diffuser cones, C. I. 2. Twelve air cones, C. I. 3. Twelve false furnace doors, C. I. 4. Twelve diffuser sleeves, C. I. 5. Two ring castings. 6. One ring casting	Complete and Delivered
3753	Repair following items: 1. Straighten one shaft, 50-ft. steamer. 2. Straighten and repair one shaft, 50-ft. steamer	Complete and Delivered
3814—	Repair one telescope, MK. XV-6 No. 25.	Complete and Delivered
3806—Bridge	Overhaul one comparing watch, No. 343	Complete

When the work is completed and sent back to the ship ordering it all the records pertaining to it are placed in a large envelope, which is placed on file in a compartment devoted to this one ship, so that by referring to a special drawer all of the records of work handled for any ship are located at once.

The repair officer turns in to the train commander a

File 23

UNITED STATES ATLANTIC FLEET
TRAIN, U. S. S. VESTAL, Flagship.
BASE TWO 18 OCTOBER 1917

FROM: Commander Train
TO: Atlantic Fleet

ON TRAIN SERVICE.

Subject: Requests for Repairs.

1. Requests for repairs have been received in which the accompanying sketches were marked **"dimension for pattern etc"** when it is evident the dimensions given were for the finished product Sketches accompanying requests often have incomplete dimensions, views and are sometimes indefinite

2. In order to avoid the necessity for further correspondence, signalling and the resulting delay caused thereby, the Train Commander requests that ships submitting sketches be guided by the following

1. Dimensions to be of the finished product
2. All surfaces to be marked "F" which are to have machine finish since all others will merely have the finish from the mold or original surface or possibly a rough file finish, etc
3. All sketches contain two or more views of the work
4. Write all necessary dimensions on sketch and do not trust to scaling a drawing
5. Material desired should **always** be stated, or broken parts furnished Similar parts have been received from different ships, made of various materials
6. Specify on the drawing the number of pieces required.
7. Make the sketch sufficiently large so that all details may be understood
8. State on drawing the name of ship and number and date of letter referring to same
9. Sample or broken parts should always be furnished when possible, whether or not sketches or drawings are furnished This expedites work

W L. RODGERS

COPIES:

Commander-in-Chief	10
Combatfor Two	90
Combatfor One	90
Comdr. Destroyer Detachment	50
Comdr. Submarine Force	40
Comdr. Mine Force	50
Comdr. Patrol Force	25
TRAIN SHIPS	30

FIG. 42. GENERAL INSTRUCTIONS

weekly report of work on hand in the shops, so that as new work comes in this report serves as a guide for the turning over of the job to one repair ship or the other according to the amount of uncompleted work already on hand and the number of men available in various shop departments.

These reports constitute an up-to-date record of the ship's force of mechanics and the amount of work still uncompleted in each shop.

The "Vestal" has a complete electrical shop in which a great variety of work is handled. To facilitate the rapid completion of jobs of this character the form

Print Form 20

Submit in triplicate.

U. S. S. NORTH CAROLINA

Base Two

25 June 1917

FROM: C. O. NORTH CAROLINA
TO: Commander Train
OR: C. O. (when only one repair ship is present)

1. I request the following {urgent} {repairs} be made coming under the cognizance of the Bureau of Construction & Repair
(In this space give a full description of the work requested.)

Item 1:- Manufacture one (1) piston and three (3) rings for the compressed air plant of the launching device; cast and prepare for installation.

This work is beyond the capacity of the ship's force.

2. The U. S. S. NORTH CAROLINA will furnish blue print (sketch) (men) and (patterns) broken parts (broken parts) to assist in this work

3. Accompanied herewith is blue print. (drawing) (sketch) (broken parts) (patterns).

4. I request this work be completed by as soon as possible.

5. This work is beyond the capacity of the ship's force.

FROM Commander Train.
TO: C. O.

Forwarded

FIG. 43. JOB ORDER FORM

shown in Fig. 46 is filled out on board the ship requiring the work, giving the essential information for the benefit of the electricians on the repair ship.

TABLE II. UNITED STATES SHIP "VESTAL"

Weekly Report of Work
[Week ending July 14, 1917]

Job Order and Ship	Specifications	Remarks
	Uncompleted Jobs	
3838—Sea Gull	1. Repair broken plank, starboard quarter.... 2. Repair leaky window frame aft, and leaky ventilator..... 3. Fit hinged band at break in mast.....	65 per Cent. Complete
3833—Solace	Repair following items: 1. Three armatures, watertight door system 2. Three field coils, watertight door system.. 3. Two solenoids, watertight door system...	60 per Cent. Complete
3776—South Carolina	Overhaul and clean one 3-in. telescope, Mk. XI-8, No. 3763.....	0 per Cent. Complete
3819—South Carolina	1. Renew shaft for extractor, laundry..... 2. Repair or renew bottom of extractor.....	75 per Cent. Complete
3429—Texas	Repair and overhaul following items: 1. Three OOD glasses, Nos. 1872, 2420, 2365..... 2. One boat clock, No. 433..... 3. One clock, No. 121.....	90 per Cent. Complete

A weekly report of work in detail is made out in the repair office, showing the jobs completed during the week, and the uncompleted jobs with percentage of

U. S. S. VESTAL

Date 6-28-17 1917
Aux J. O. 3755-D.
For CAR U.S.S. NORTH CAROLINA

SPECIFICATIONS.

Manufacture one (1) piston, and set of rings, air plant of launching device, as per sample and blue print No. A-589.

PLAN OF WORK.

Shop "P"-Pattern, piston & ring.
Shop "F"-Cast, C.I. 1 off each pattern.
Shop "S"-Weld old piston for spare.
Shop "M"-Machine - E xecute.

Material used in shop.....has been charged against the job.

.....U.S.N.
Officer in Charge

Date Commenced

Date Completed

NOTES.

NAME	RATE	TOTAL HOURS

FIGS. 44 AND 45. WORK PLAN SHEET AND MATERIAL FORM FOR SUPPLY OFFICER

work complete given in the last column. Two sheets from a typical weekly report are shown in Tables I and II.

An almost endless number of jobs are handled in the optical and watch shops, as will be seen upon examination of the monthly report in Table III. Two views of the optical shops are shown in Figs. 47 and 48. The first is the shop where large range finders, binoculars, etc., are overhauled; a 12-ft. range finder will be seen on the stands in the center of the room. The view in Fig. 48 shows a corner of the instrument shop on the deck below, where a complete machine equipment is installed.

A quarterly report is made out for the various naval bureaus, covering details of all work handled for different ships and classified by bureau of navigation, construction and repair, ordnance, steam engineering and so on. This report covers thousands of items carried

U. S. S. VESTAL,

FROM: Commanding Officer.
TO: Commanding Officer, U. S. S.
SUBJECT: Electrical Material; Request information of.
Reference: (a)

1. Please furnish answers to questions checked on list below. This information is necessary in order to properly carry out repairs on

Series, shunt or compound
Speed, constant or variable
Duty, continuous or intermittent
H. P. R. P. M. Volts
No. of poles
No. of field coils per pole
Diameter of bore (exactly)
No. of brush stems
Brush stem extends over winding { Yes / No Inches
Brushes, fixed or shift degrees
Commutator trouble
Armature trouble
Temperature in operation (Normal or excessive)
Wear of bearings: commutator or back end
Armature rest on pole pieces
What repairs attempted
Distance from coils to bearing head or frame
If stripped, send sample coil

FIG. 46. BLANK FORM FOR ELECTRICAL DATA

through the different shops on the repair ship and is nothing short of a revelation to one unaccustomed to the variety and quantity of work regularly accomplished by the ship's repair crew.

Relining Connecting-Rod Brasses

A set of four crankpin brasses from the connecting-rods of the main engines of one of the battleships was sent to the repair ship "Vestal" to have their bearing surfaces renewed by remetaling with antifriction metal.

The brasses as they appeared on the "Vestal's" deck are shown in Fig. 49. Their dimensions are given in Fig. 50, which shows the rod end with the brasses in place.

The old worn metal lining was removed by melting, as in Fig. 51. For this operation one brass at a time was suspended over a crucible by means of the chain hoist in the gallery and a kerosene torch applied as

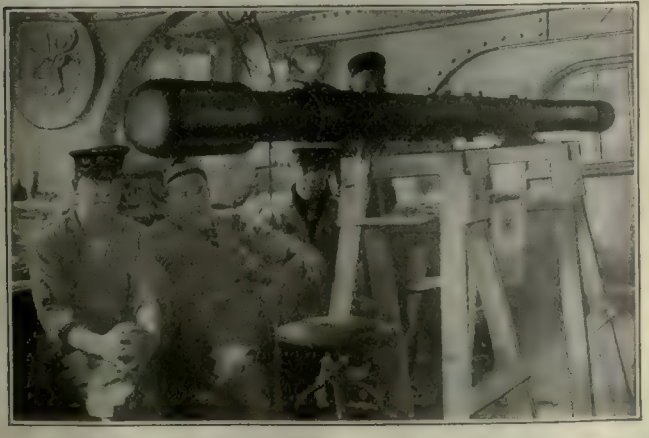


FIG. 47. RANGE FINDER IN OPTICAL SHOP

illustrated to flow the metal. The flame under air pressure is played against the old lining, and in a few moments the metal flowed out freely into the receptacle below.

Melting the metal for pouring the new surfaces is accomplished as shown in Fig. 52. A portable oil heater is used, with the melting pot suspended directly over the top of the apparatus. The heater is made up of a cylindrical shell of ½-in. boiler plate 15 in. outside diameter and mounted on a platform with four wheels at the corners so that it may be moved as readily as an



FIG. 48. GENERAL VIEW IN OPTICAL SHOP

ordinary truck. The two pipes at the bottom are for the oil and air supply. The interior of the steel shell is lined with 2 in. of fire clay, and there is a cast-iron pot, or liner, inside of this, forming the central chamber in the heater.

Crude oil is used for fuel, being supplied from a portable tank. The air pressure is regulated by the valve at the heater base.

In setting up the work for pouring no babbitting arbors are used and the sole special device required consists of a sheet of 20-gage galvanized iron. When it is considered that each brass is poured with nearly 100 lb. of babbitt and that the area of the surface poured equals something like 450 sq.in., the use of a thin sheet



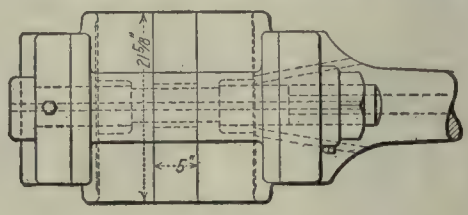
FIG. 49. THE BRASSES TO BE RELINED

of metal in place of a heavy arbor of some kind seems a rather doubtful procedure. As a matter of fact the method is a most satisfactory one and is regularly followed in navy practic

Two of the brasses are poured at once, so that two sheets for the babbitting forms are used, as shown in Fig. 53. The job is set up as indicated in the illustration. The work to be relined is shown at *A*, and the sheet-metal forms at *B*. The brasses as they stand upright are 21⅜ in., and the sheet-pouring forms are made about 2 in. higher. The forms are made to allow for a thickness of metal of 1 in. to be run into the brasses. The brasses when secured in place at the end of the connecting-rod are spaced apart by lining

blocks, so that the halves to be poured are not full half circles.

The two halves as set up for the pouring of the lining are spaced by two strips of wood, *C*, which are placed vertically between the sheet-metal forms, and the work is then clamped as shown in Fig. 54. The job rests on a 3-in. cast-iron floor plate, and the first ladle of metal poured tends to solidify at the bottom and makes it unnecessary to use fire clay or other luting material. In the case here described three men did the pouring with ladles holding say 10 lb. of metal each. As the babbitt was run into the 1-in. gap between the work and the forms a stick was pressed down into the liquid material at different points and the gases allowed



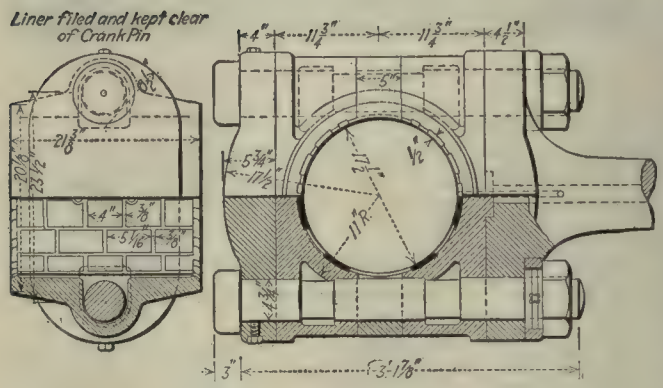


FIG. 50. DETAILS OF ROD END AND BRASSES

to escape as fast as the pouring was done. When the running of the metal was completed and the forms removed a clean, smooth surface was found with the babbitt well solidified at all points in the brass.

The formula for the metal used, which is employed by the Navy for white-metal bearings and for bearing surfaces, is: Copper, 4 per cent.; tin, 89 per cent., and antimony, 7 per cent.

Machining the Bearings

The first operation in the machine shop consists of peening in the babbitt until its entire surface has been well worked and compressed, after which the job is ready for boring and facing in the horizontal boring machine, Fig. 55.

The lower brass is placed on parallels and held by clamps at the four corners. Four spacing blocks are placed on the brass to represent the thickness of the 5-in. liners that are to be used between the brasses when secured to the connecting-rod. The upper brass is placed on the spacing blocks and clamped in place.

The two brasses must be correctly located in reference to each other and also in parallel position to the axis of the boring bar, and the table and boring bar adjusted to secure the central position for the bore through the work. The central position of the bar and work is obtainable with close degree of approximation



FIG. 51. MELTING OUT THE OLD METAL

by measuring and calipering between bar and brass; but this is a preliminary setting that is further adjusted by means of an indicator which is brought into service for the purpose of aiding in the facing-off of the superfluous babbitt metal at the ends of the brasses.

Use of the Indicator

The indicator used is a dial test instrument secured in a clamp holder by means of which it is secured to a tool shank placed in the boring head. The boring bar is then rotated by hand and the corners of the brass indicated to assure the ends of the work being square with the boring bar axis. With the work thus set it is clamped and the facing of the babbitt is then accomplished.

The tool used is a long facing tool with a thin edge ground to a keen rake. The chip taken is very light,



FIG. 52. MELTING THE WHITE METAL OVER AN OIL HEATER

but the tool extends clear across the inch or more of babbitt so that the metal is removed in the form of light shavings. This facing cut is carried down to the surface of the brass and the job is then ready for final setting for the boring of the babbitt and the finishing of the ends.

It will be understood that these old brasses are to be so machined as to go back into the rods from which

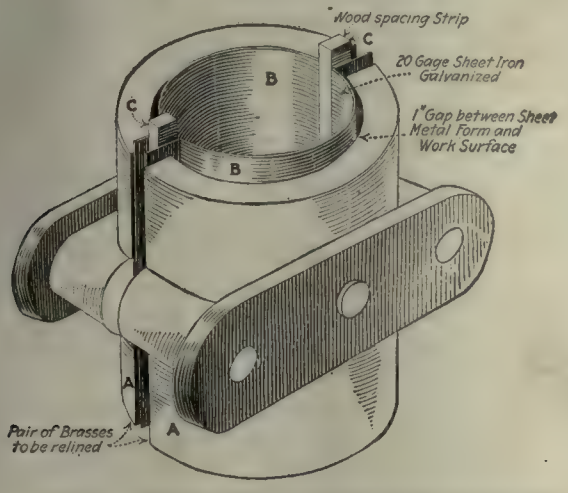


FIG. 53. THE FORM IN PLACE FOR POURING

they were removed and work properly when placed in service. The conditions are different than if they were a new piece of work and were to be fitted to a connecting-rod actually in the shop at the time. The rod is however out at sea and in operation with another set of brasses, and this means that the setting points for the work on the boring machine must be obtained from the old brasses. Hence the application of the indicator to the ends of the brasses.

TABLE III. U. S. S. "VESTAL" OPTICAL REPAIR CARD

Completed Work

Ship	Instrument	Total No.
Alabama	Telescopes	4
Alabama	Rangefinder B. & L.	1
Arkansas	Clock, fireroom	1
Arkansas	Stop watch s	7
Celtic	Stadimeter	1
Celtic	Clock	1
Connec icut	Stop watches	6
Connecticut	Clocks, deck	2
Delawaie	Stop watches	12
Delaware	Thermometer	1
Delaware	Stop watches	8
Delaware	Telescopes	4
Delaware	Telescopes	1
Delaware	Periscope	1
Despatch	Watch, comparing	1
Florida	Telescope	1
Florida	Rangefinder B. & L.	1
Florida	Stop watches	18
Illinois	Watch, comparing	1
Illinois	Stop watch	1
Illinois	Clock, fireroom	1
Illinois	Stop watches	5
Illinois	Spotting glass	1
Illinois	Telescopes	2
Illinois	Stop watches	1
Kansas	Telescopes 13½	2
Kansas	Telescopes 12½	1
Kansas	Binoculars 4½	1
Kearsarge	Clock, deck	1
Kearsarge	Watch, comparing	1
Louisiana	Rangefinder	1
McCall	Sextant	1
Michigan	Stop watches	6
Michigan	Stop watches	4
Michigan	Periscope	1
Michigan	Telescope	1
Michigan	Rangefinder	1
Michigan	Stop watches	3
Michigan	Stop watches	1
Michigan	Binoculars	1
Michigan	Stop watches	4
Michigan	Periscope	1
Minnesota	Telescope	1
Minnesota	Telescope	1
Missouri	Clock, boat	1

(Name) In charge of optical work. (Rank) 4—2553

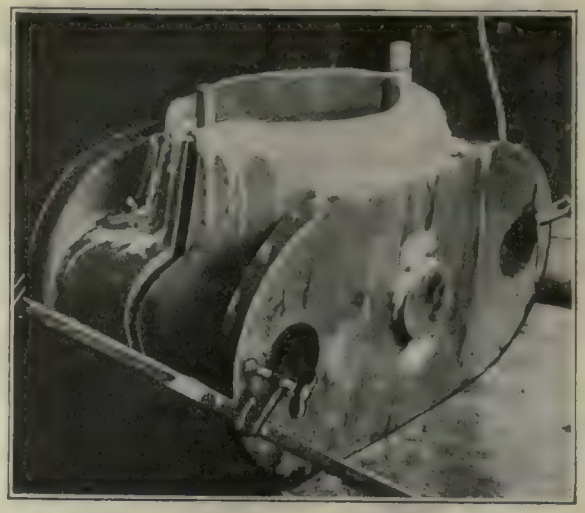


FIG. 54. A PAIR OF BRASSES AFTER RELINING

The boring is done with three cuts. There is about $\frac{3}{8}$ in. of metal all the way around to remove, and the first cut takes about $\frac{3}{16}$ in. on a side. The next cut

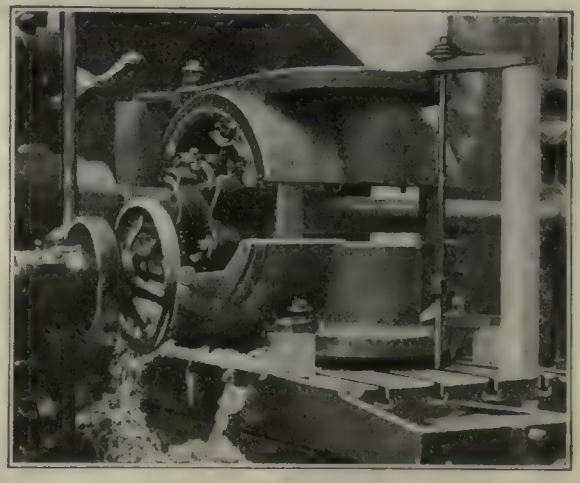


FIG. 55. FACING AND BORING THE LINING

removes $\frac{3}{16}$ in. less $\frac{1}{64}$ in., which is left for the finishing cut. The first two cuts are taken with $\frac{1}{8}$-in. feed and the finish cut with a feed of $\frac{1}{32}$ in. per revolution of tool.

What Is the Matter With the Straw Boss?

BY CLIFFORD H. DENGLER

Late one afternoon when everybody in the drafting room of one of America's largest aircraft plants was busily engaged in working out ideas or laying down plans for tools or machinery destined to win the war the door burst open and an important appearing young man with indignation in his eyes blew in and sought the desk of the chief tool designer.

The young man carried a blueprint, and soon he and the chief had their heads together over it, their conversation being generously interspersed with emphatic gestures expressive of disapproval on the part of the young man while the chief appeared to be temporizing.

After some minutes of discussion the two went over to a draftsman near the center of the room, who was evidently the center around which a storm was brewing. The blueprint was laid on his board, an accusing finger

pointed to the middle of its anatomy and a magisterial voice demanded to be informed "why in thunder," etc., etc.?

The chief makes no comment and the draftsman is plainly worried. He seeks first to justify the construction which the young man has indicated was not in accordance with their usual practice by saying that it will "work just as well that way," or "it costs less to make it" and many other stock excuses of the drafting room until he suddenly remembers, "Why, Mr. Mann ordered it that way."

Mr. Mann is the man "higher up." The displeased young man subsides, rolls up the blueprint, exits R. U. E. or any other old convenient place, while peace again broods over the department.

Presently Neighbor-on-the Right says in a stage whisper to Man-in-the-Center: "S'matter wid de guy?" "Design didn't suit him," replied Man-in-the-Center.

"Whatsee know about it?"

"Nawthin."

"Whosee any way?" inquired Neighbor-on-the-Left who was himself new to the job.

"Oh, he's just a straw boss out in the toolroom," said Man-with-a-Gray-Moustache; "he ain't got anything to say; that's why he talks so much."

"Well, he's got his nerve with him anyway," said Neighbor-on-the-Left, "comin' in here and tellin' us tool designers our business."

"Oh, his kind are allatime tryin' to put over the buck," says Man-at-the-Center. "Serves to cover their own ignorance."

"Don't blame the kid," says the chief, "he's young yet. Maybe he'll learn something when he grows up."

So it is wherever you go. No matter what line of business he may be in, the straw boss or subforeman is the goat and commands about as much respect as our story indicates.

Why is this thus? His position shows that he was picked out from among his fellows probably on account of some superior qualification, and when a vacancy occurs higher up the straw boss is the man on whose shoulders the mantle will fall, and when this happens he generally makes good in his new position. Why does everybody hate a straw boss?

Those Opulent Munition Workers

By L. L. Thwing

In the Metropolitan Museum of Art or some other place is preserved in the form of a tablet of imperishable clay the original mother-in-law joke perpetrated by some prehistoric Joe Miller about the year four-thousand-and-something-or-other B.C.

Though I have not heard definitely of its discovery I am inclined to believe that a similar tablet has recently been unearthed which translated reads something like as follows:

"Mr. Ptolemy Smith, the well-known manufacturer, whose brick yard is located in the rear of Nile St., while pricing some shirts in a leading haberdashery was astonished to learn that the shirts which he had regularly purchased at two pieces of silver had advanced to four pieces of silver.

"Though Mr. Smith is one of our wealthiest citizens he has made it a lifelong rule never to pay more than two pieces (or at most two pieces and a half) of silver for a shirt, and while he was mentally debating as to whether he should break the rule and pay the extortionate price or appear in public in his pajamas a rough-looking individual with soiled hands and clothing streaked with bronze dust snatched the garment from the hands of the sales person, inspected it, paid for it in cash and ordered it sent to the Spear Makers' Club.

"Inquiring of the sales person Mr. Smith soon discovered that the shop's best customers, who were demanding the best of everything, were the munition workers, whose wages had been increased to incredible amounts by reason of the enormous demand for labor due to the war with the Persians."

Now Being Worked to the Limit

As stated above, this tablet has been discovered and is now being worked to the limit by the hard-pressed reporters for the daily papers and the story writers on the weeklies, as witness the following:

"Mother Brown, who has run a boarding house in Bridgeport, Conn., for the past 17 years, has discovered that the 'boys' want more class to their provender and are willing to pay for it, so she has engaged the former chef of the Biltmore Hotel to take charge of the cuisine."

"It is stated that a die cutter in a local shipyard received $228 a day for four weeks;" that "the poorest-paid laborers in the yard receive more than an ensign;" that "the visible supply of stencil pianos, limousines and tan shoes is fast getting into the hands or onto the feet of the munition workers" and that "hundreds of limousines waited each night to take these toilers home." These statements were later denied in small print.

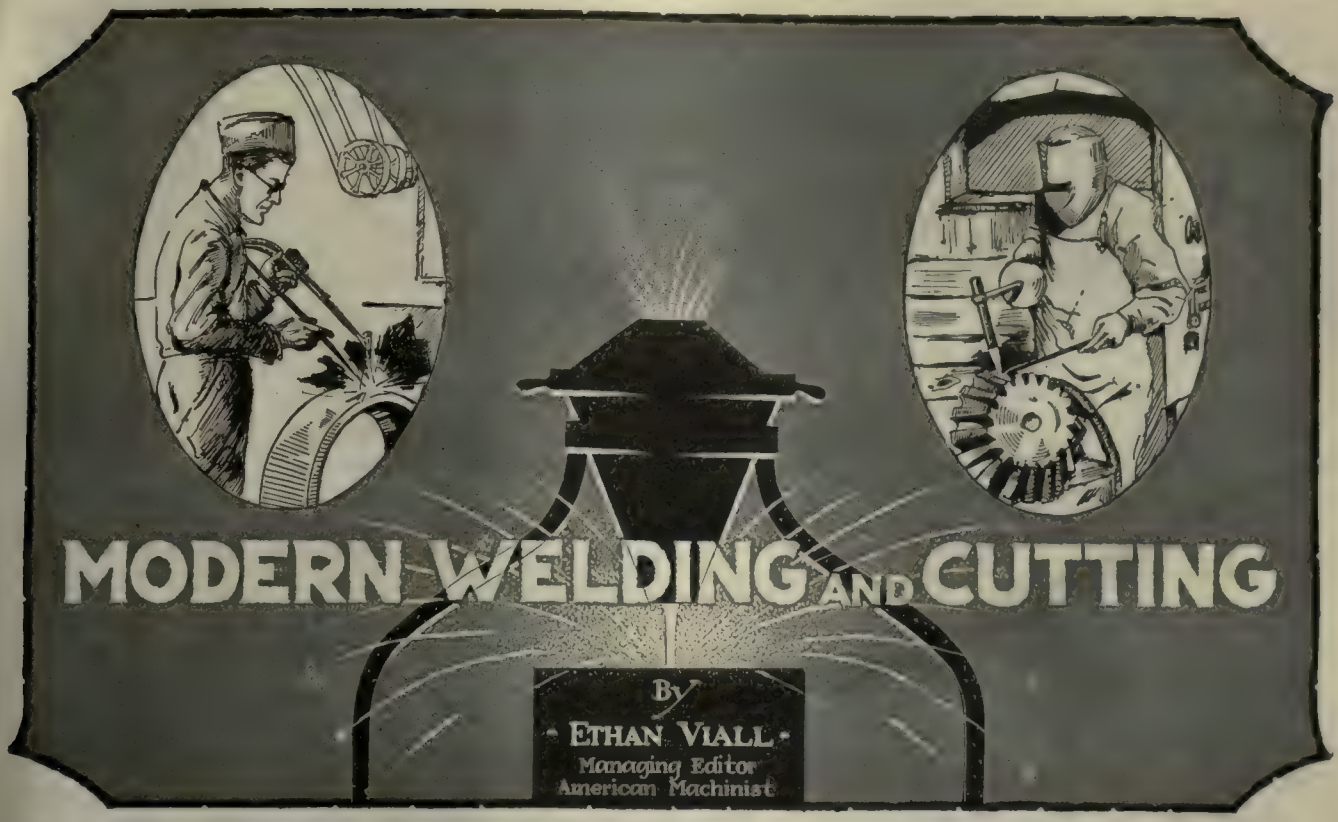
If all our industrial experts with the pen were to confine their writings to what they see themselves there would be less occasion for all of us to Hooverize on white paper.

Not in Accord with Individual Experience

My own experience in a shop employing 1000 men discloses little evidence of undue prosperity on the part of the employees who have been in the shop since before the war. One or two callow youths of tender years and slight responsibilities have broken out with second-hand Fords, and the moving-picture houses have business enough to warrant keeping open every night instead of two nights a week as formerly, but I defy expert investigators to prove that we are living like the prodigal son.

Mechanics in general being made of the same material as the rest of mankind, you may naturally expect to find some who are not looking ahead to the time when husks may be the only item of their menu, but the manner of living of the majority is not so different from before the war.

There are some, of course, who by reason of the abnormal conditions and scarcity of labor are getting more than they ordinarily would, but if any piece-worker can back up a pneumatic riveter hard enough, fast enough and long enough to earn three or four times the normal wage he is three or four times as valuable to the country, and if he happens to want a silk shirt far be it from me to say that he shall not have it.



IV. Thermit Welding—Welding New Necks on Large Steel Pinions*

The examples of steel-pinion work shown in this article are typical of welds that may be made on many other large machine sections. The illustrations presented give some examples of marine repairs and are of suggestive value to users of many classes of large machine tools.

FREQUENT breakages of heavy pinions in steel plants have resulted in the development of a very ingenious adaptation of the Thermit process for their repair. Obviously the casting on of a new neck entirely out of Thermit steel would be a very expensive operation and it would also be costly and difficult to turn up a new piece of steel and weld it on to the original section, as the weld would be a very large one to make. Experience has shown, however, that the intense heat of the reaction can be utilized for the purpose of bringing the broken surface of the pinion to a fusing temperature, at which time a supply of liquid steel can be poured in from the ladle, and this will unite with the original body of the pinion to form a new neck thoroughly amalgamated with the rest of the piece.

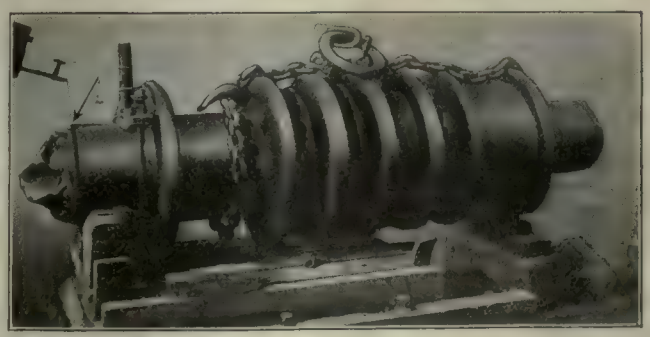


FIG. 37. SAWING OFF END OF NECK PREVIOUS TO WELDING ON A NEW ONE

Briefly the operation consists in constructing a mold around the broken section so as to permit of casting on a new neck to replace the one broken off. The original section is then preheated to red heat by means of gasoline or oil burners, after which Thermit steel from a crucible is allowed to flow over the fractured surface to a depth of 1 in. This completes the heating operation and brings the surface of the roll to the melting point. A supply of liquid steel from a ladle is then tapped into the mold and allowed to wash through and overflow into an ingot mold so as not to be wasted. The overflow gate may then be closed and the mold filled to the top with steel. Detailed instructions for these various operations follow, but it is recommended that if the process is to be used for the first time for such repairs an experienced engineer should be obtained to supervise the first welds and give personal instructions for executing this class of work. The instructions given here have been written more especially for the purpose of acting as a guide for a reference, and while we hope that these are sufficiently adequate and complete to enable anybody to make these welds, the personal supervision and instructions of an experienced engineer are much to be preferred.

We give two methods for executing these repairs. The first method which follows is undoubtedly the safest and surest method to use, but it involves considerably more trouble and expense than the second method. We can recommend it strongly, however, and believe it would be to the interests of steel plants having much of this work to do to equip themselves properly to follow out this method.

*For the author's forthcoming book, "Modern Welding and Cutting." All rights reserved.

Before undertaking a pinion repair the broken end should be cut off square, as shown in Fig. 37, so as to form a level surface when the roll stands in a vertical position. The object of this is to permit of a uniform covering of Thermit steel over the entire surface to be welded. If the break is in the pods, cut off 2 in. below the point where the pod joins the neck.

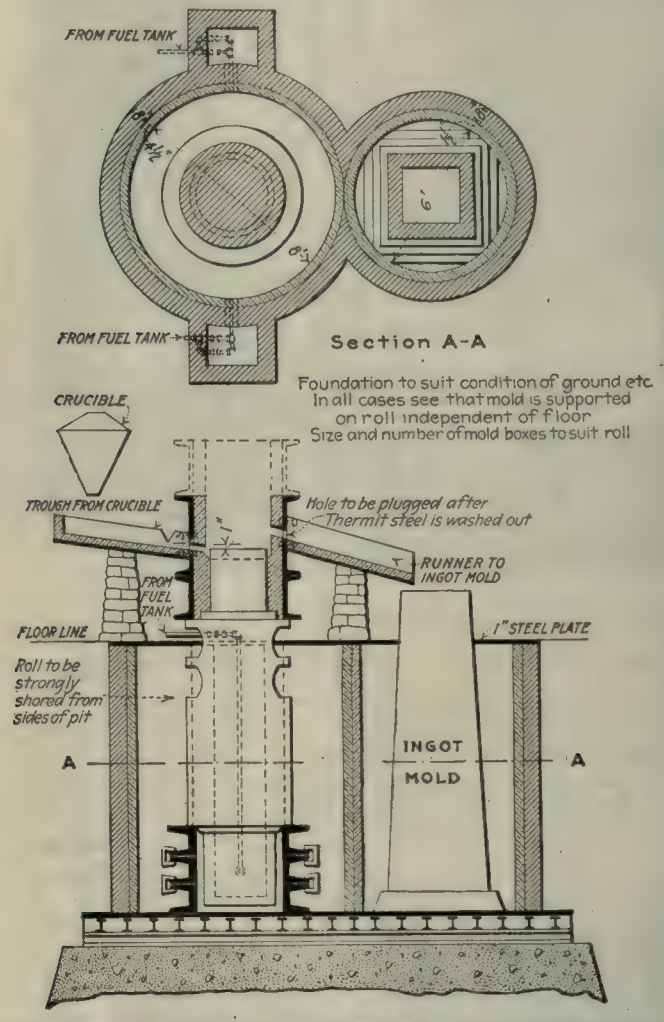


FIG. 38. A DESIGN FOR A PERMANENT PIT FOR WELDING NECKS ON LARGE ROLLS AND PINIONS. IF DESIRED A REMOVABLE FIRE-BRICK PARTITION MAY BE USED BETWEEN ROLL OR PINION PIT AND THE INGOT MOLD PIT

If when the neck is cut off it should be found to contain any pipes or cavities these should be bored out and steel plugs turned to a driving fit and driven into the cavities at least 5 in., care being taken that the plugs are driven in even with the surface on the end of the neck.

Another and better method is to dry out the inside of the cavity by heating and then fill with liquid steel. This will eliminate any danger of the Thermit metal melting the plug and running into the cavity, which might cause a violent and dangerous eruption of the steel. Clean off all dirt and grease at least 20 in. from point of weld.

A riser pattern should be provided, undercut as shown in Fig. 32-E, also a pouring gate and overflow gate pattern.

The riser pattern should be 3 in. larger in diameter than the pinion neck, and at the lower part, where it joins the neck, it should taper as shown. Where the operation requires the casting of pods a special pattern should be made having the shape of the pinion neck with these pods. This pattern, like the riser pattern mentioned before, should be larger in diameter than the pinion neck and should taper at the bottom. The pattern should, if necessary, be made in sections so as to allow of being withdrawn from the mold.

Foundation and Heating Arrangements

Heavy circular cast-steel mold flasks should be provided, the same as are used in steel-foundry practice. In the absence of these flasks suitable ones can be made of ¼-in. steel plate. The bottom flask should be divided and bolted together so that it can be removed without trouble, as it is much easier to tear down the mold after this flask is removed than before.

In undertaking repairs on these pinions it is recommended that a special pit be constructed as shown in Fig. 38. It is of the utmost importance when constructing the pit to provide a good foundation for the bottom of the pit. It has been found in many cases that steel plants are built on low and marshy ground, therefore when a pit is dug the ground is apt to be soft and many times water seeps in. For this reason the design in Fig. 39 is shown. However, unless precautions are taken to provide a good foundation heavy pinions are apt to settle before the welding

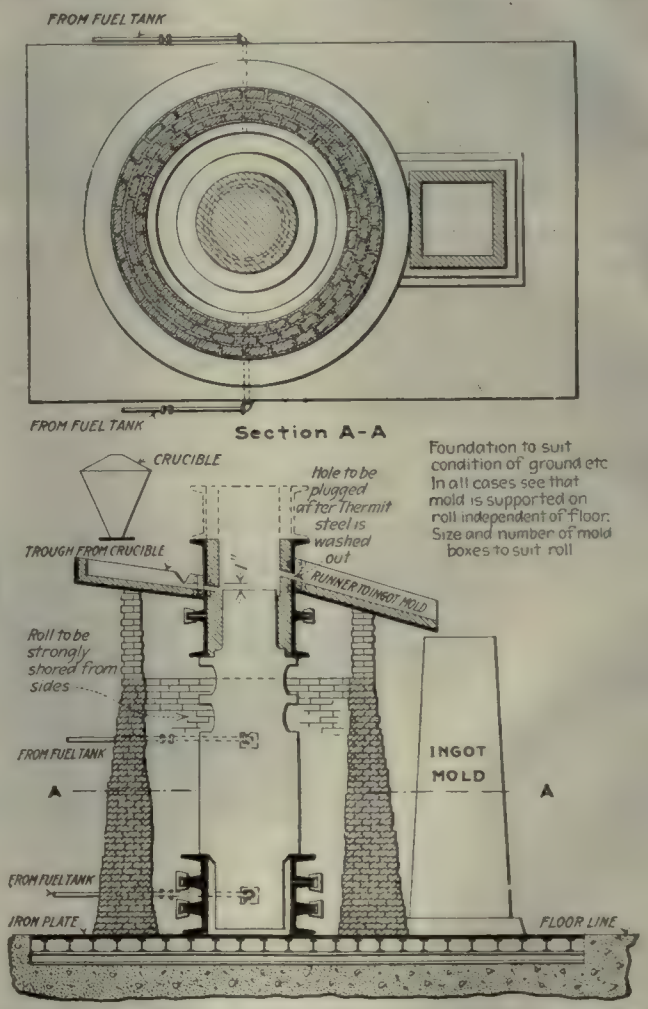


FIG. 39. METHOD OF WELDING ROLL NECKS WITHOUT DIGGING A PIT

operation is completed. This is liable to cause a loss of the repair and sometimes a serious explosion might result caused by the hot metal coming in contact with moisture. When an adequate foundation has been provided set the pinion and the ingot mold in place and brace them strongly to the sides of the pit.

Arrange the heating burners which may use gas, gasoline or kerosene. This arrangement is shown, although the complete connection to the fuel supply is not.

Constructing the Mold

Construct the mold, as shown, of sharp silica sand and fire clay. The usual proportions of the mixture are three parts of sand to one of clay, but this varies according to the sand and clay used. Coat the mold with a good

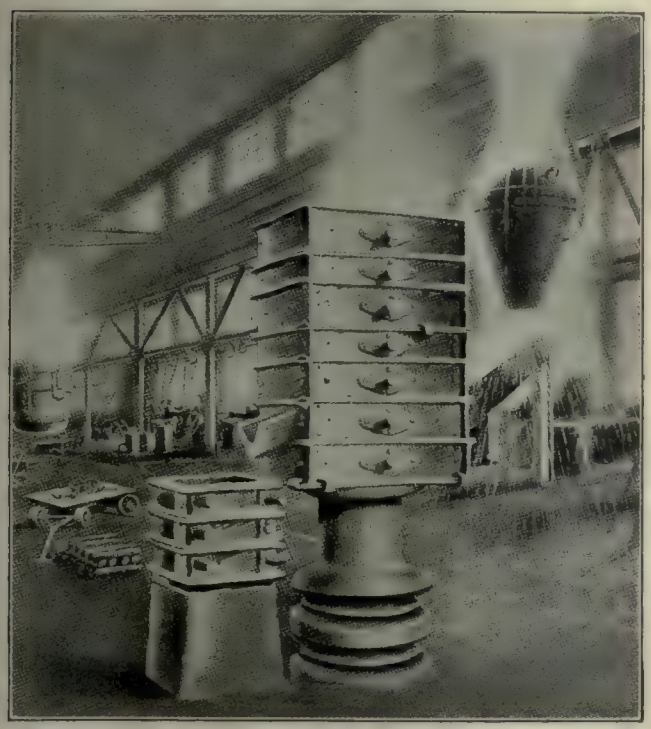


FIG. 40. WELDING A ROLL NECK. THERMIT STEEL TAPPED INTO MOLD AND LADLE OF STEEL AT LEFT READY FOR FINAL OPERATION

steel wash and drive in nails or chaplets to hold the sand in position.

Attach the runners at the proper points and ram them with the same material, being careful to arrange the runner for the Thermit exactly as shown, that is, the runner gate is so placed that when the Thermit steel has run into the mold the top surface of the neck will be covered with superheated Thermit steel to a depth of about 1 in., and the slag from the Thermit reaction will flow from the crucible and run out of the V-shaped notch in the side of the runner, thereby preventing any slag from entering the mold.

The overflow runner should have sufficient pitch so that the liquid steel will flow to the ingot mold readily without spattering. Firebricks should be laid on top of the ingot mold in order to prevent steel from spattering at that point.

When the mold is completed start the preheating of the body of the pinion. If gasoline or kerosene is used three double or five single preheaters will be required and another one should be kept filled and ready to be cut in when any one of the others has become empty. This will prevent loss of heat while a preheater tank is being refilled.

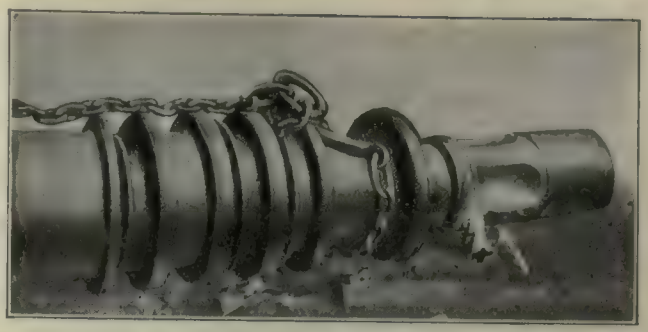


FIG. 41. ROLL NECK WELDED TO LARGE STEEL ROLL WITH PODS CAST IN

As the body of the pinion approaches a red heat start the preheating of the top of the neck as shown in Fig. 32-B. Heat this surface to a good red heat, timing the operation so as to have both neck and body of pinion red hot at the time the openhearth steel is tapped out of the furnace.

While the preheating of the neck is progressing set the automatic crucible, size 7, charging it in accordance with previous directions, so that it will be ready when needed.

Amount of Thermit Required

In calculating the amount of Thermit required for this type of repair allow 75 lb. of railroad Thermit for each square foot of surface it is desired to melt down.

Be sure that the cope has been baked while the preheating of the neck is going on (either in an oven or as shown in Fig. 32-H) and is located conveniently so that it can be brought up with the crane at the proper time. After the furnace is tapped raise the ladle of steel and try the stopper by making a couple of pours to be sure that the stopper works properly and will shut off tight.

Move the ladle to a point near the mold so that no time may be lost between pouring the Thermit steel and washing through the steel from the ladle. *Remove the preheaters to a safe distance.*

Ignite the charge of Thermit in the crucible, and

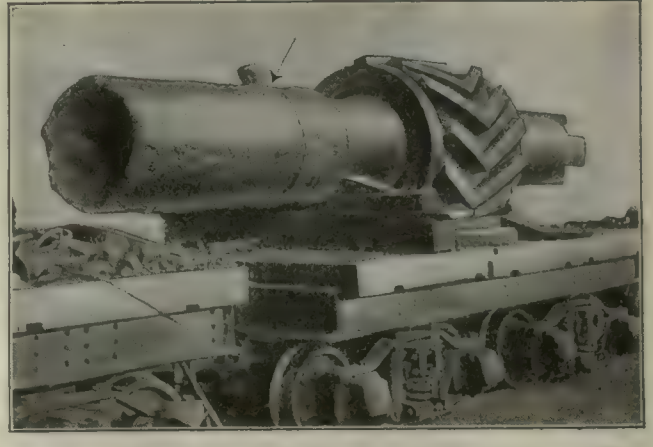


FIG. 42. NEW NECK WELDED TO LARGE STEEL PINION. IN THIS CASE THE PODS WERE MILLED AFTERWARD

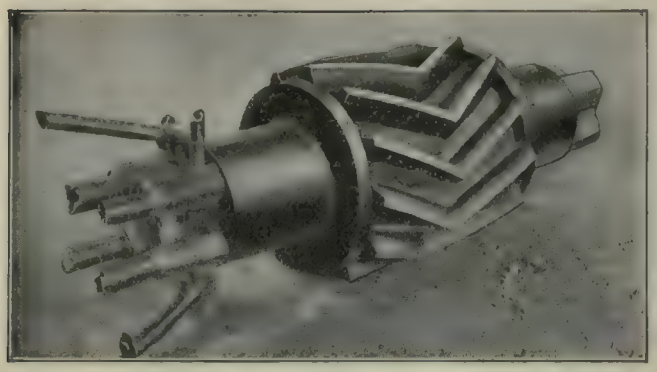


FIG. 43. WORN PODS BUILT UP WITH THERMIT STEEL. THE REPAIR CONSISTED OF FOUR WELDS MADE SIMULTANEOUSLY, USING TWO POURING GATES AND TWO CRUCIBLES

when the reaction is over (usually 35 to 50 sec.) tap the Thermit steel into the mold, as shown in Fig. 40. When all the steel from the crucible has flowed into the mold the slag will commence to run over the V-shaped notch in the pouring runner. Move the crucible out of the way and plug the pouring gate with a sand core provided for this purpose, banking up securely behind it to prevent leakage.

Lower the ladle of openhearth steel, shown at the left, to a point close to the top of the mold and tap the steel into the mold, running through about 5000 lb. into the ingot mold which has been set for the purpose, as shown.

Plug the runner gate with a core constructed as shown in Fig. 32-J and bank up well behind it so that there will be no danger of a runout. *Be careful in plugging this gate on account of its size.* After the plugging is completed and banked up, the sand should be weighted down as an extra precaution to prevent accident.

After the overflow has been securely plugged fill up the mold with steel from the ladle and cover it well with dry sand or charcoal to keep the metal hot.

Treatment When Cope Is Used

If a cope is used clean off the surface of the top of the mold and set on the cope, clamping it securely, and then fill the cope to the height desired with steel and again cover over with dry sand or powdered charcoal.



FIG. 44. BUILDING UP WORN PODS BY MEANS OF THREE THERMIT WELDS. POURING GATES WERE CONNECTED AT TOP AND BOTTOM TO INSURE EQUAL DISTRIBUTION OF METAL

If the body of the roll or pinion has cooled to any extent it would be desirable to again preheat it. After the body of the pinion is sufficiently preheated cover the pit to make it as nearly airtight as possible, so

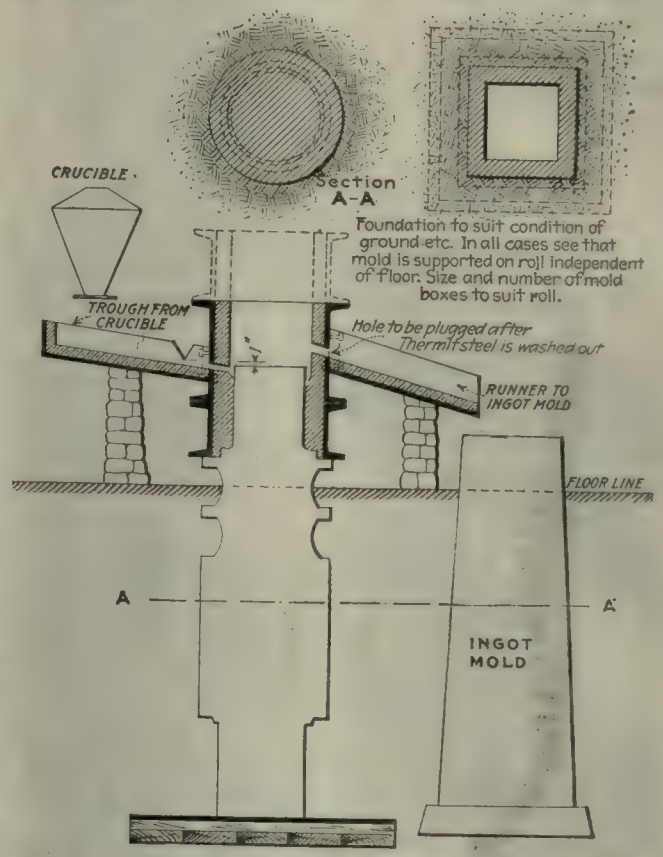


FIG. 45. ALTERNATE METHOD OF SUPPORTING ROLL OR PINION TO BE REPAIRED

as to cause the roll or pinion to cool slowly. By doing this further annealing is unnecessary.

After the pinion is sufficiently cool (usually about 48 hours or more) remove from the mold and machine to size.

In some steel plants it is considered preferable not to use a cope but to build the mold all in one piece

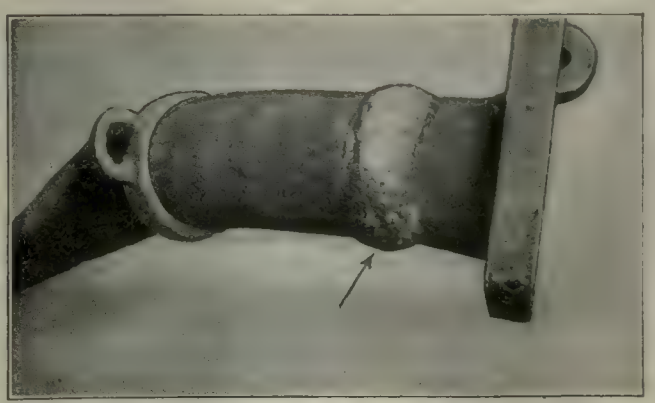


FIG. 46. FINISHED WELD ON ANCHOR DAVIT OF U. S. S. "OLYMPIA"

to the height of the new neck. This method simplifies the making of the mold and the pouring of the weld, but sometimes complicates the operation for the following reasons:

When riser patterns are withdrawn it is a little more difficult to remove loose sand from the mold.

In preheating it is not so easy for the operator to see what he is doing.

There are times when these necks will be as much as 5 ft. high, which makes it a little unhandy to work around the mold.

There are numerous arguments on both sides of the question, but we feel that either method will give good results. For short necks, however, a cope can probably be dispensed with without introducing any difficulty.

Two welding jobs just as they came from the molds are shown in Figs. 41 and 42. The first is a neck welded onto a large steel roll with the pods cast in.



FIG. 47. ANCHOR OF THE MORGAN YACHT "CORSAIR" REPAIRED WITH THERMIT

The second one shows a new neck welded to a large steel pinion. In this last case the pods were milled out afterward.

Two other welding jobs are shown in Figs. 43 and 44. These both illustrate the repair or replacing of worn pods on heavy steel mill pinions.

Alternate Method

While the preceding directions cover the welding of pinions under what might be considered ideal conditions it is not always possible to do the work in this way, and where such is the case we would recommend that the following directions be followed, as they represent a simpler method, yet one which has always resulted in satisfactory repairs:

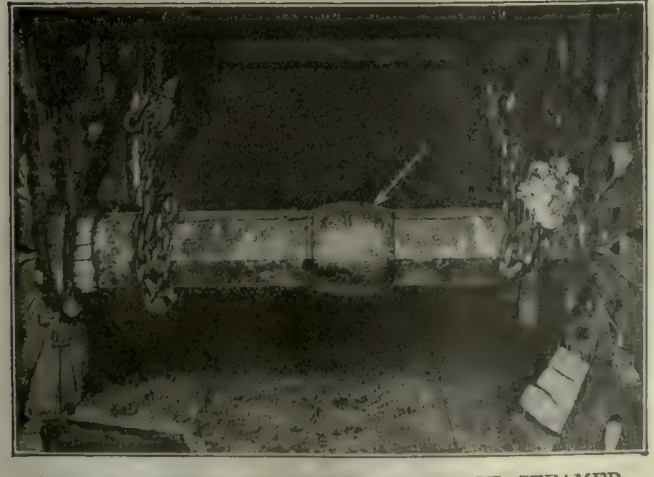


FIG. 48. WELD ON WHEEL SHAFT OF STEAMER "NASHVILLE" ON THE CUMBERLAND RIVER, MADE IN 1912



FIG. 49. WELD ON 10-IN. WHEEL SHAFT OF STEAMER "OSCEOLA," MADE AT JACKSONVILLE, FLA., IN 1915

Patterns, mold box, runners, etc., should be constructed in accordance with directions given for the previous method.

In these repairs great care should be exercised in supporting the pinion so that there is no danger of its settling under the added weight of the mold and the steel which is poured into it. If it is not desired to go to the expense of constructing a special pit as outlined in the previous method a satisfactory and economical way is to dig a hole in the ground about 8 ft. in diameter and of sufficient depth to receive at least ¾ of the entire length of the pinion. Cover the bottom of the hole by laying a double flooring of 2-in. planking, being careful that the planks in one



FIG. 50. WELD ON STERNPOST OF TUG NO. 32, MADE SEPTEMBER, 1911

layer run in opposite directions to those of the other layer.

On top of this place a steel plate in order to distribute the weight of the pinion over the entire floor area. Such a foundation has always proved adequate and is not expensive.

Set the pinion in the hole so that the surface to be welded is level and fill in all around the pinion with dirt, ramming hard to hold the pinion permanently in position.

Dig a second hole alongside of the buried pinion to

receive the ingot mold. This should be at such a distance from the pinion that a suitable runner for the overflow steel can easily be placed. The top of the ingot mold should, of course, be lower than the top of the roll or pinion neck.

If the neck is broken off close to the body of the pinion it is absolutely necessary to provide arrange-



FIG. 51. STERNPOST WELD ON THE "WILLIAM HENRY MACK," JULY, 1912

ments for preheating the body protruding above the ground in order to avoid shrinkage strains. A simple way to do this is to build up a brick furnace and heat in accordance with directions relating to casting of teeth in large pinions, and more of the pinion body should protrude above the ground than shown in Fig. 45. If, however, there is one foot or more of neck protruding from the body of the pinion, it is not absolutely necessary to preheat the rest of the pinion.

The mold box should be constructed with heavy steel flasks or a substitute made of at least ¼-in. plate



FIG. 52. ANOTHER STERNPOST WELD. S. S. "CORUNNA" OF THE CANADIAN LAKE TRANSPORTATION CO., MADE IN 1907

and should be supported entirely on the roll and independent of the ground.

With the mold box adjusted in place ram up with good molding material in accordance with the previous directions and then draw out the various wooden patterns. Nails or chaplets should be driven into the sand so as to hold it firmly in place. It is advisable to coat the mold with a good steel wash. When the mold is completed the preheating of the body of the pinion should be started if the repair is of such a nature as to require this preheating. If this heating is not necessary start preheating on top of the neck as shown in Fig. 32-B. If the body of the pinion is heated the heating of the neck should not be started until the pinion approaches a red heat.

Heat the surface on top of the neck to a good red heat, timing the operation so that it will be red hot at the time the openhearth steel is tapped out.

While the preheating of the neck is progressing set an automatic crucible, size 7, as shown in Fig. 45, and charge it so that it will be ready when needed. If possible it is best to support the crucible with a crane so that it can be quickly removed after it has been tapped. The procedure is then the same as described for the previously given method. After cooling, strip the mold and machine the parts to proper size.

It is sometimes desirable where the body of the pinion has been preheated to continue this heating after the weld is completed. This can easily be done by again igniting the burners directed into the brick furnace. After the body is sufficiently preheated remove the burners and fill in between the bricks and the pinion with dry sand so as to cause slow cooling. By doing this further annealing is unnecessary. As previously mentioned, a cope may or may not be desirable, and this is left to the judgment of the operator.

Marine Work

The general principles to be followed in making marine repairs are the same as for any other repairs of a similar size and nature, so no detailed description need be given. However, it will be of interest to know the exact nature of some of the more common repairs made on anchors, wheel shafts, sternposts or the like, so a few views of some of the actual repairs are shown. A big point in favor of the Thermit process in cases like the ones given is the short time necessary for the ship to be laid up. In many cases little or no dismantling is necessary. In a number of stern shoe welds on lake steamers the sizes of the parts at the break have been from 11 x 16 in. to 10 x 20 in. or more, and the average time required has been about 36 hours complete. On a large number of ocean-going vessels the welds made have been on sections of larger dimensions than those quoted.

In Fig. 46 is shown a weld on the anchor davit of the famous U. S. S. "Olympia." Fig. 47 shows a repair on the anchor of the Morgan yacht "Corsair." Fig. 48 is a repair on the wheel shaft of the "Nashville," a Cumberland River steamboat, made in 1912. Fig. 49 shows a repair on the wheel shaft of the river steamer "Osceola," welded at Jacksonville, Fla., in 1915. Fig. 50 shows a sternpost weld on a tug, made in 1911. Another sternpost weld is shown in Fig. 51.

Compressed Air in a Shell Plant

By R. E. C. MARTIN and S. B. KING
In *Mine and Quarry*

The convenience, adaptability and economy of air power for industrial and manufacturing purposes are well illustrated by its use in the manufacture of shells. In this field it is speeding up some operations, reducing the labor required for other jobs and performing still other processes difficult to accomplish by other ways.

THE uses of compressed air are well demonstrated at the plant of Winslow Brothers Co. at Chicago, which before the war manufactured ornamental iron and bronze for architectural purposes. This business falling off, by reason of inactivity in the building-construction line, the plant was converted to the manufacture of munitions and a new equipment especially adapted to the manufacture of 155-mm. shells was installed.

The shell blanks are delivered to the factory in the form of pressed or drawn steel forgings, cylindrical in shape, with one end closed, weighing about 180 lb. each. In many of the 47 operations performed at this plant compressed air forms a time and labor saving agent of the first importance. Air chucks of improved standard pattern are used on practically all the lathes and boring tools for holding the work and releasing it quickly. These processes include cutting off the end of the shell blank, rough and finish turning, turning the nose and base to exact dimensions, turning the bourrelet, turning the waved groove near the base on which the copper ring which engages the rifling is forced, turning the rifling grooves on the ring itself and boring out the interior of the shells. The use of air chucks, by means of which the work can be tightened or released instantly, has been one of the most important contributions to the cutting down of the time required in the turning process and also saves considerable labor. A lathe equipped with an air chuck is shown in Fig. 1.

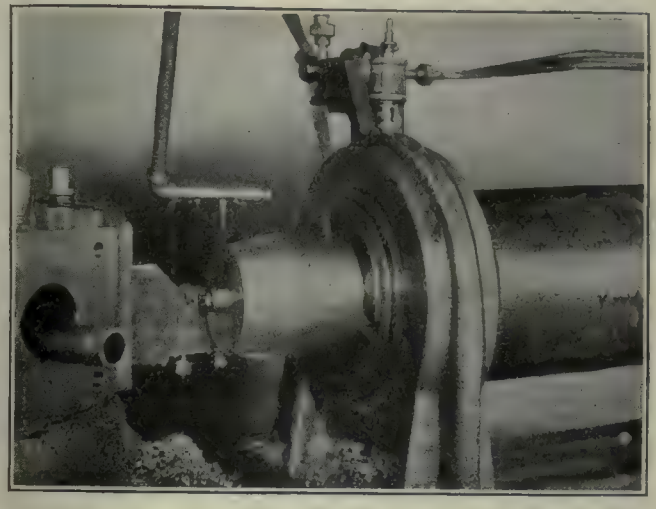


FIG. 1. A 155-MM. SHELL BLANK IN A LATHE EQUIPPED WITH AIR CHUCK

After the shells have been turned to exact dimensions, both inside and out, they are taken to the sandblasting machines, where the roughness left by the tool is carefully removed. Fig. 2 shows a battery of revolving sandblasting machines, with the shells in position. Two cuts or stages of sandblasting are performed. A preliminary blast is first given them and they are then finished on the machines shown, which put the final finish on the interior of the shell. Compressed air is also used in the machine employed for washing out the interior of the shells. The shell is placed nose down over a nozzle, through which steam, caustic-soda solution or air can be discharged as desired to wash, dry and cool the interior. This process removes excess varnish, dirt, etc.

In Fig. 3 may be seen the varnishing machines at work. It would be a difficult and tedious job to varnish the interior of these shells with the degree of care and evenness required by hand. The machine shown is the De Vilbiss type. It consists of a sprayer mounted on a hollow spindle which is connected by hose lines

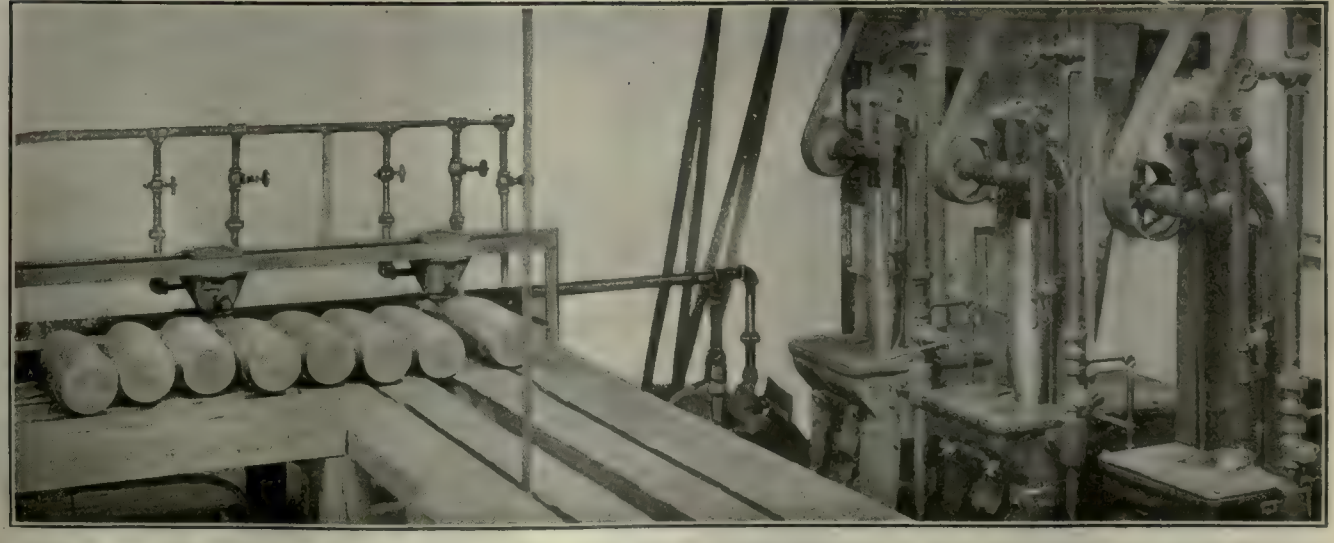


FIG. 2. SANDBLASTING MACHINES. THE SODA-WASHING DEVICE, WITH THREE-WAY COCKS FOR COMPRESSED AIR, STEAM OR CAUSTIC-SODA SOLUTION, IS SHOWN AT THE LEFT

with the air supply and with an overhead reservoir for varnish. It does the work rapidly and well. The spindle is moved forward into the shell and the varnish sprayed onto the interior surface as the spindle is withdrawn. The shell is revolved in the meantime, so that an even coating of varnish is applied.

This is one of the last processes through which the shell goes before it reaches the final inspection by the Government officials at the plant.

Compressed air is also used in the form of a jet to cool the primary windings of the shell-band-heating transformers, or ring heaters, which are employed for heating the copper bands, or rings, which are forced by powerful hydraulic presses into the machined groove near the base of the shell. On these bands the ridges for engaging the rifling are subsequently machined. The jet of compressed air is applied through the base of the winding chamber.

Compressed air for these several processes is supplied at the present time by four Sullivan angle compound belt-driven air compressors, with low-pressure cylinder 14 in. in diameter, high-pressure cylinder 8¾ in. in diameter, and a common stroke of 10 in. An interesting feature of the air installation is that instead of being grouped centrally in a power house it is distributed about the plant at convenient points where the air is most used. This saves long runs of piping and makes for efficiency, as it obviates to the greatest possible extent drop in pressure, due to friction in the transmission line, caused by elbows and turns.

The compressors are equipped with the Sullivan three-pass, counter-current intercoolers in which there are three independent sets of tubes through which the cooling water passes, and the air is forced across the tubes in the separate chambers successively, so that the temperature of the air when it finally enters the high-pressure cylinder is very little above that at which it entered the low-pressure or intake cylinder.

Receivers of ample capacity are installed close to the compressors. A 700-ft. aftercooler is also provided for the compressor that furnishes air to the sandblasting machines and varnishing sprays. It is effective in providing dry air, which is essential in sandblasting the interior of the shells.

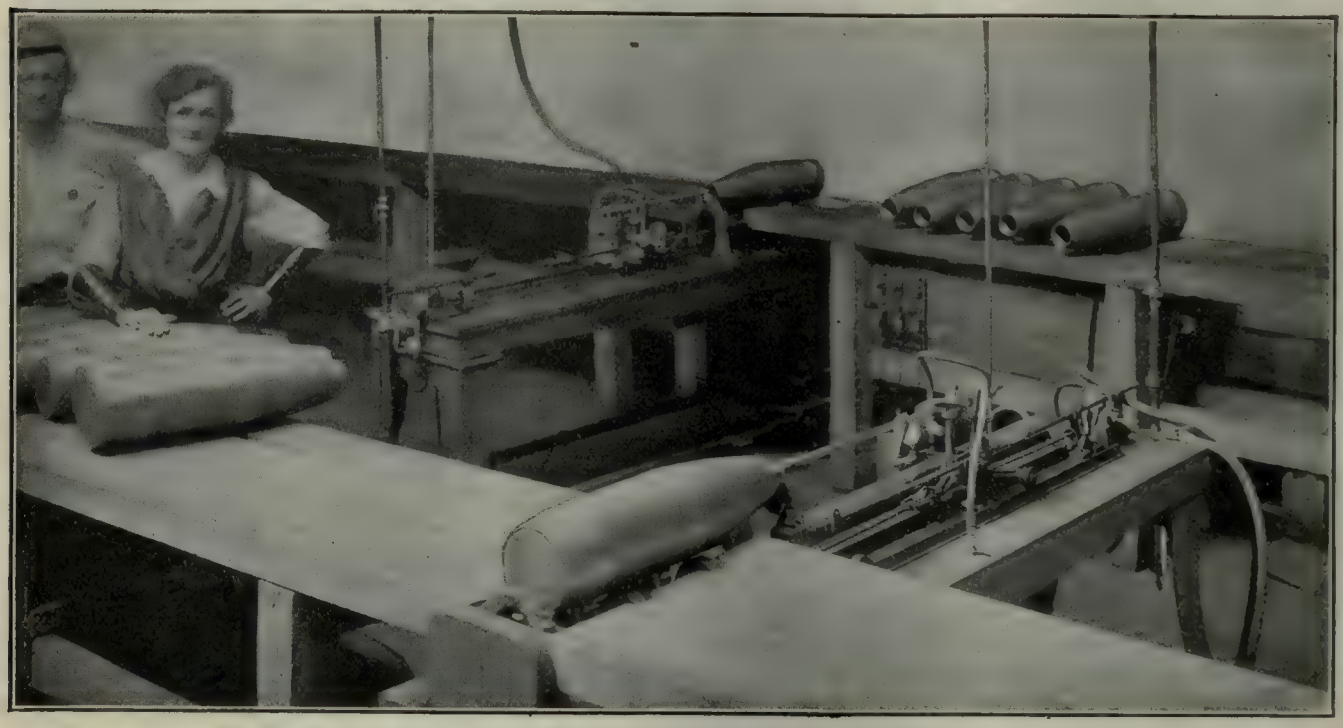
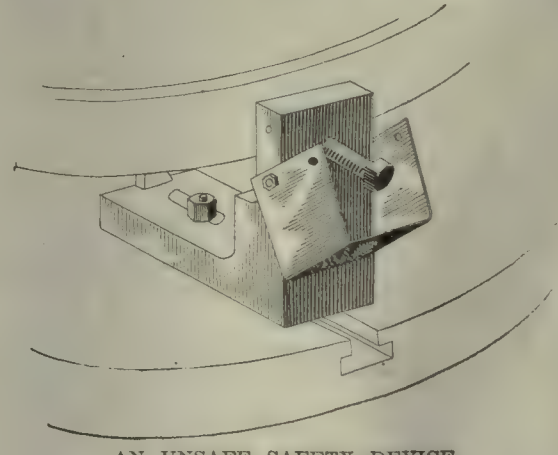


FIG. 3. SHELLS BEING VARNISHED BY COMPRESSED AIR

Operator Removes Safety Device

BY JAMES FORREST

The cut shows a safety device which has been running on a vertical boring mill in a prominent shop. This is an example of a safety device which did not meet with the approval of the operator, who would rather run the chance every minute of the day of being caught and mangled than spend the extra two seconds required to put his chuck wrench through the hole in the guard. He also furnished the energy necessary to remove tne guard and keep it removed despite the wishes of those looking after his welfare. What can a safety engineer do in the face of such cussedness?



AN UNSAFE SAFETY DEVICE



HOW the NAVY TRAINS its MACHINISTS ASHORE

BY WILLARD CONNELY, U.S.N.R.F.

In the Navy as well as in the Army a great number of machinists and machinists' mates were needed during the war, many more than could possibly be trained in the orthodox manner, therefore the training period was shortened and the method of training simplified and intensified, so that the student received a more comprehensive course in much less time. The training comprised courses in machine work, patternmaking, molding, blacksmithing, sheet-metal working, oxyacetylene welding, boat building and gasoline-engine construction and repair, with academic instruction in mathematics, drafting and electricity.

A BLUEJACKET operating a radial drilling machine in the big machine shop at Dunwoody Naval Training Schools, Minneapolis, was asked what he had been doing before he enlisted.

"I drove a truck for an oil company," he replied.

"Didn't you make more money at that job?"

"Yes, I should say a few dimes more," he answered, "but what good is a lot of extra money to a fellow if he can't save it? One of the greatest things about the Navy is that it makes you save—you don't have any ambition to spend. Besides, in war time, driving a truck around the home town is an old man's job, a job for a man too old to mix in the fight."

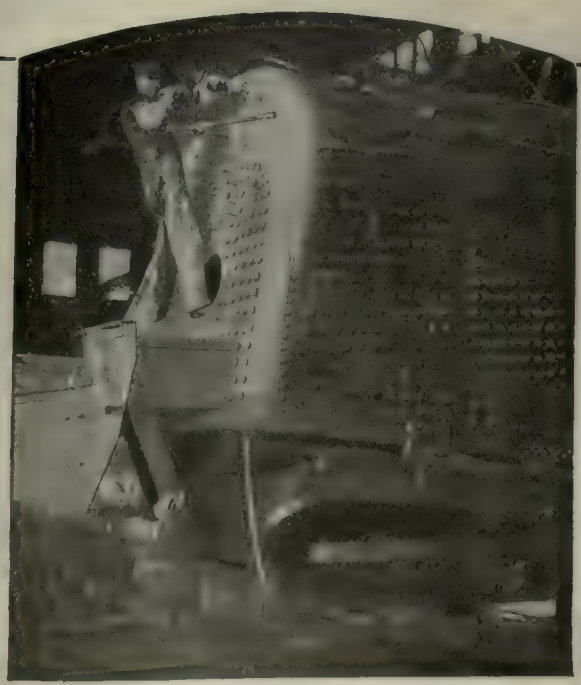


Fig. 1. Getting experience on boiler work

So he had decided to become a general machinist's mate in the Navy, and he had chosen well, for the eight months' course given at the training stations was indeed a liberal mechanical education.

Eight months seemed a long time for young men to be held in leash at a training school when they were so eager to hurry into action with the fleets. However, in peace time the sailors in the machinists' school at Charleston Navy Yard are given 16 months' training, and under the se-

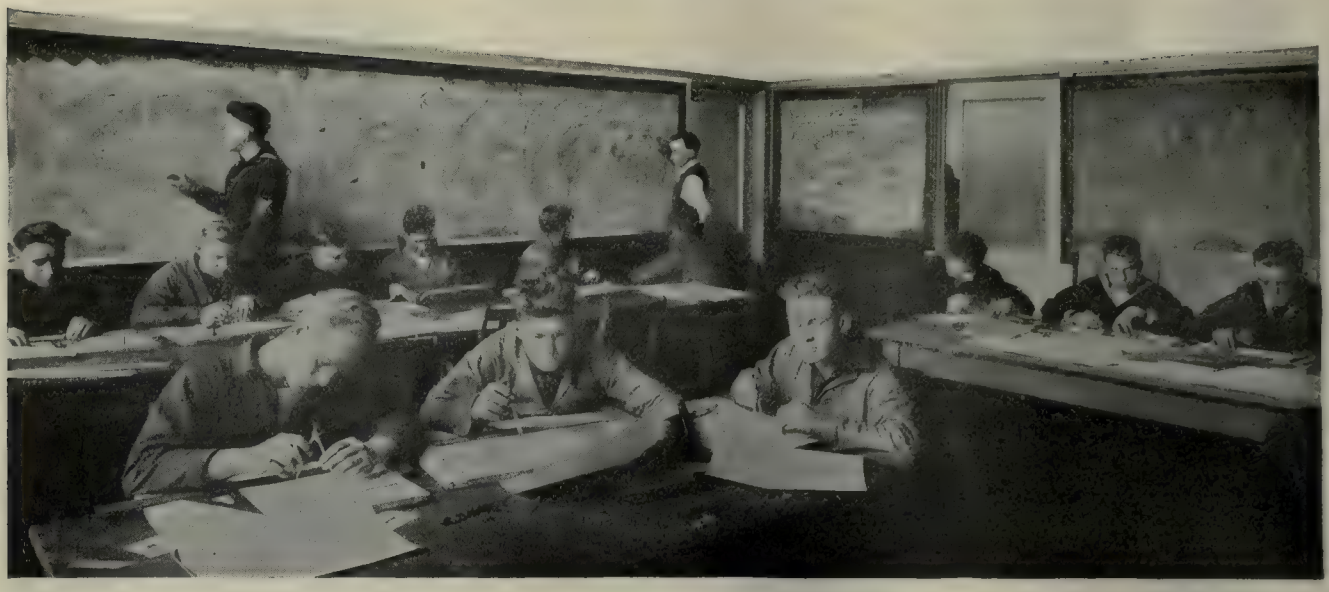


Fig. 2. Classroom instruction in drawing and mathematics

verest concentrative war-time régime efficient machinists could not be developed in less than half that period.

All students who entered the course were assured that their deferred arrival aboard ship would be well compensated for by the extraordinary scope of their instruction. Not a man but should make good, for he was reasonably sure to encounter some angle of the training in which he had a natural, though unsuspected, talent.

Not all of the schooling was given at Dunwoody Institute. The work extended as well to the engineering college of the University of Minnesota, where the apprentices learned the operation of such apparatus as boilers, condensers, marine pumps and ice machines. Va-



Fig. 4. Where instruction is given in blacksmithing and flame welding

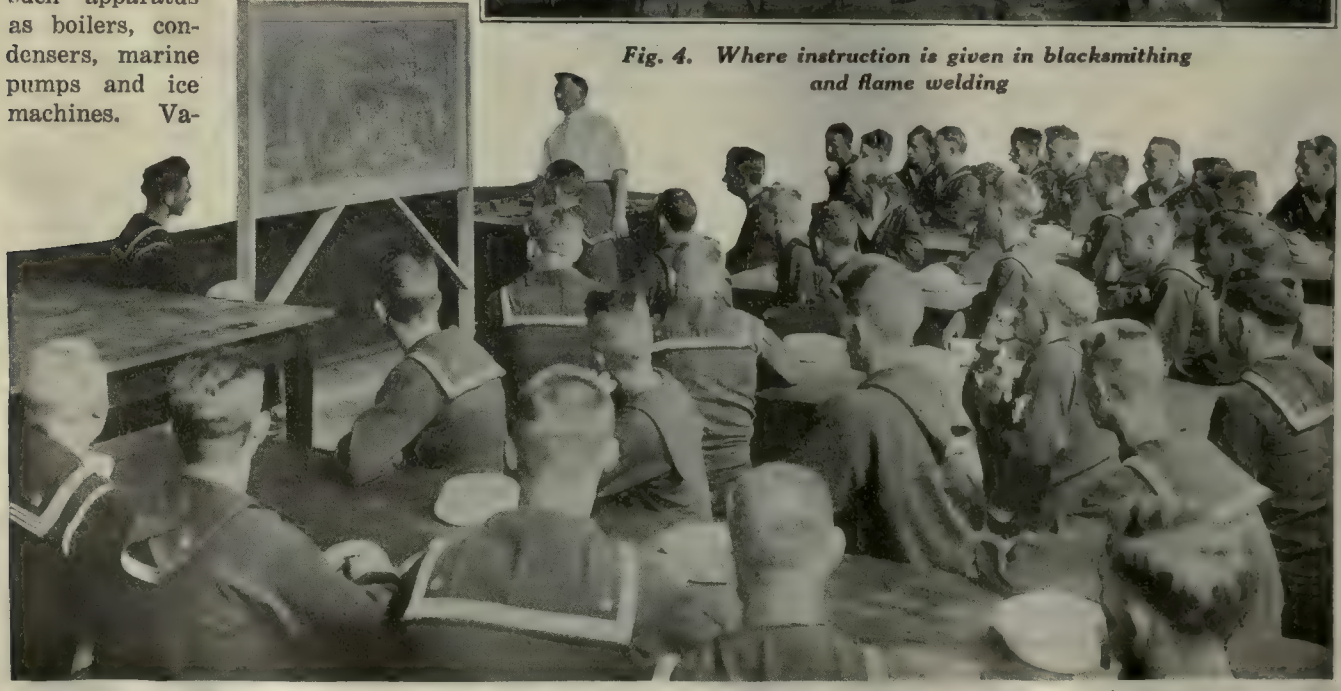


Fig. 3. The class in heat-treating and properties of metals

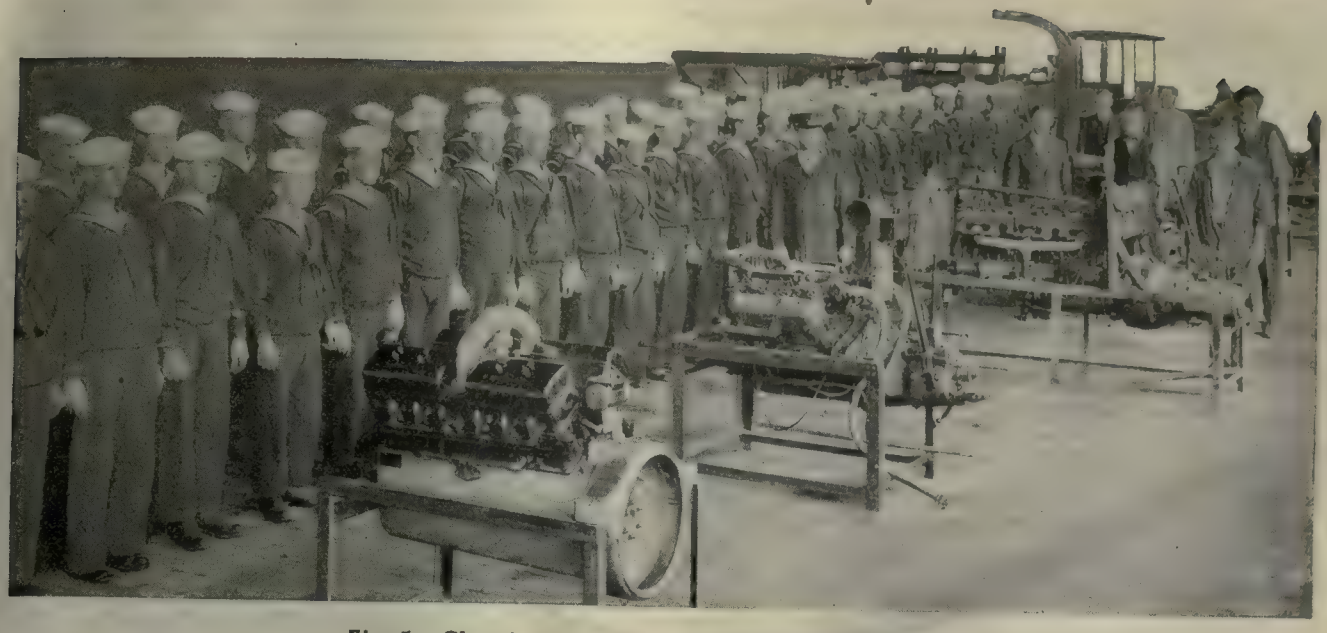


Fig. 5. Class in gas-engine work lined up for inspection

rious machine shops in the neighborhood also contributed to their training. At the railroad shops the men gained a knowledge of heavy jobs, such as work on boiler patches and locomotive frames, in order that they might be prepared at sea to tackle heavy repairs in the engine room. Fig. 1 shows a student making a repair on a large locomotive boiler.

Machine Shop Instructions

Classes were formed and the boys given instruction in bench, lathe and vise work, and on milling, shaping, planing, drilling and grinding machines. This was followed by pipe-fitting, brazing, babbitting and tinsmithing, together with machine sketching in the drafting room, mathematics and formulas in the classroom, and a series of lectures and examples in the heat treatment of metals. Figs. 2 and 3 show the classrooms.

In the carpenter shop there were about two weeks of patternmaking; then the boys took their patterns to the foundry, made and poured their molds, and returned with the castings to the machine shop to finish them. In the blacksmithing department these eager craftsmen forged ship accessories such as swivel cleats, eye pads, sister hooks, shackles, oarlocks and standard chains. In oxy-acetylene welding the men learned to repair stripped gears, shafts, cams and the like. For example, the instructor would take an old gear from a heap of scrap iron, knock several teeth off it and tell the student to weld them back with the torch. By making a special study of contraction and expansion the apprentices were taught to exercise the judgment necessary at the critical moment to make their welds hold. Fig. 4 is a view of the students at work in the blacksmith shop where instruction in welding was given.



Fig. 6. The laboratory where the boys are taught the rudiments of electricity

Before starting work in the morning each squad or class was lined up for inspection, and in Fig. 5 may be seen the class in the gas-engine laboratory where they got theory and practice in two- and four-cycle engine mechanism, including valve setting, carburetion, ignition and lubrication. Instruction was also given in steam and oil engines as well as those of the gasoline type.

Electricity was not neglected, as this is a matter of vital importance on board a battleship, and the bluejackets received therefore a rudimentary training in magnetism, electric circuits, storage batteries, current-measuring instruments, etc. (Fig. 6). In motor boats there was training in hull construction and in mounting the engines and affixing propellers.

During the period in which the men were assigned to the coppersmith shop they were taught to lay out their patterns geometrically according to the fundamental principles of sheet-metal work, so that they could turn out ventilators, funnels, bunker lamps, oil cans, hoods, flues, etc.

Carbon in Iron and Steel

SPECIAL CORRESPONDENCE

In spite of all that has been written about iron and steel there are many hazy notions in the minds of many mechanics regarding them. It is not always clear just what makes the difference between iron and steel, because we know that cast iron has more carbon than tool steel and yet it cannot be hardened to make a good cutting tool.

Cast iron has from 3 to 5 per cent. carbon, while good tool steel rarely has more than 1¼ per cent. carbon, yet one is soft and has a coarse grain, while the other has a fine grain and can be hardened by heating and dipping in water. The carbon in cast iron is what is called graphitic carbon; that is, it is in the form of graphite, which is almost pure carbon. The resemblance can be seen by noticing how cast-iron borings blacken the hands just as does graphite, while steel turnings do not have the same effect. The difference is due to the fact that the carbon in steel is not in a graphitic form and that it is present in smaller quantities. In making steel in the old way the iron-ore pig was melted and the carbon burnt out of it, the melted iron being stirred or puddled, which gives it the long grain or fibers like molasses candy which has been pulled. The iron ingot was then hammered or rolled into bars and these bars packed in layers between layers of ground charcoal and heated to a good high heat so as to open the pores of the steel for the purpose of absorbing carbon from the charcoal. This is called the blister process for making steel. If a higher carbon content was wanted the process would be repeated until the desired amount of carbon was reached.

The carbon is soaked into the steel and mixed thoroughly with the iron so that it does not segregate or form graphite as is the case in making cast iron from the pig.

A little study of malleable iron may help to understand the nature of steel and the way in which it differs from cast iron. In making malleable iron the castings are heated in a furnace to from 1700 to 2100 deg. F. and kept at this temperature from 48 to 96 hours, both the heat and the time depending on the size of the castings. This heat burns out most of the carbon, making the metal more like wrought iron. The continued heat and the slow cooling in the furnace as it cools down away from the air rob it of most of its carbon. This same thing happens to some extent with tool steels when heated for annealing. The outer skin loses its carbon and this skin must be removed before finishing and hardening if a tool with a hard surface is desired.

Malleable iron resembles wrought iron in that it is not brittle, that the castings can be bent or straightened and that it can be welded if care is used. Borax and a little sand are used for the flux. Malleable iron, however, is not to be compared with wrought iron for strength, as it is not worked by rolling or hammering as in the case of wrought iron.

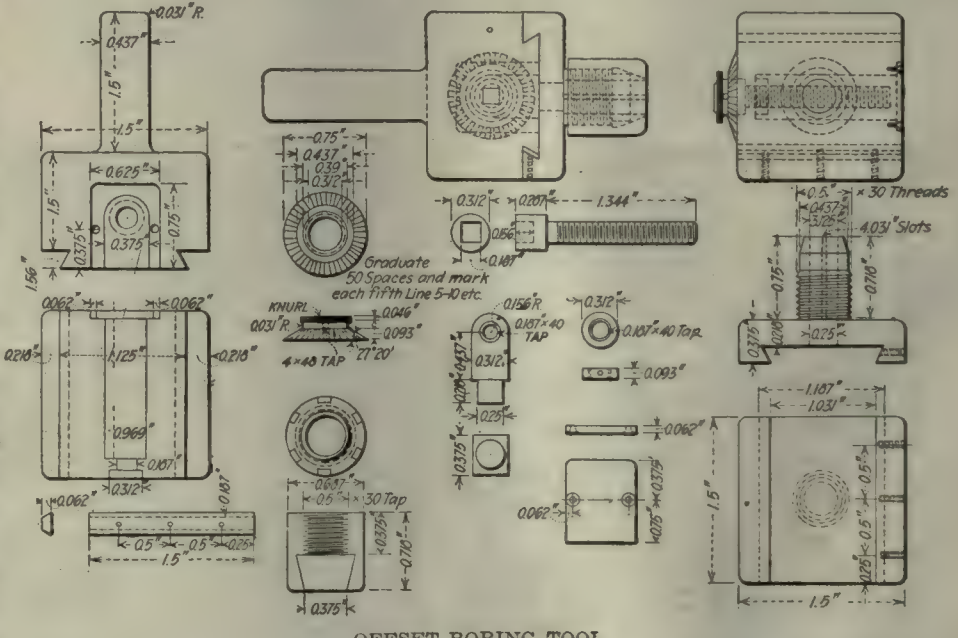
The high and continued heat leaves the metal more or less porous, but still having some of the qualities of wrought iron.

A Handy Offset Boring Head

BY ALBION SWANSON

An offset boring head small and light enough to carry in a toolmaker's kit is shown in the drawing.

The shank is made of a size suitable to be held in a draw-in collet or drill chuck, and the spring chuck that holds the boring tool is made to take ¼-in. drill rod, which is a convenient size for small tools.



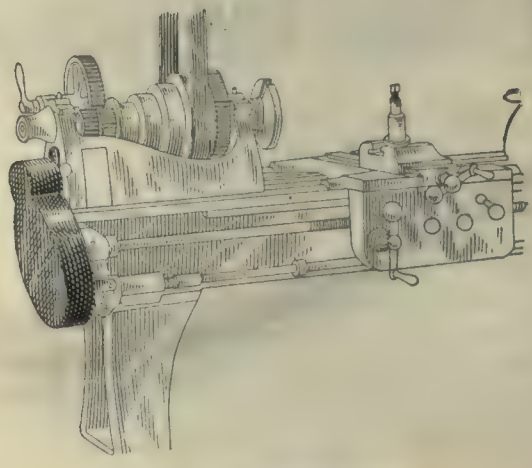
OFFSET BORING TOOL

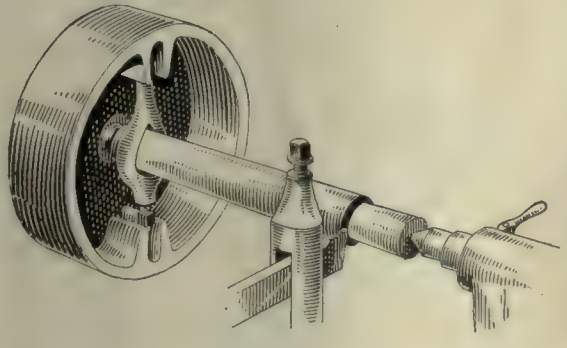
The adjustment screw carries a graduated dial for the purpose of setting the tool for a definite increase in the diameter of the hole bored.

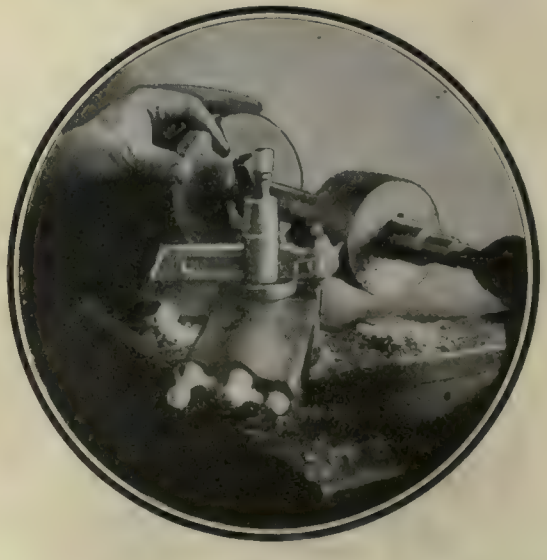
CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas

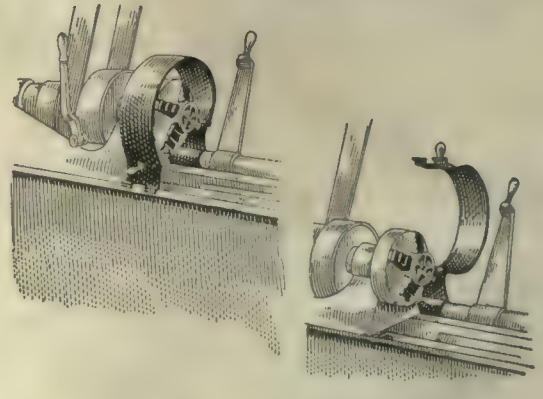










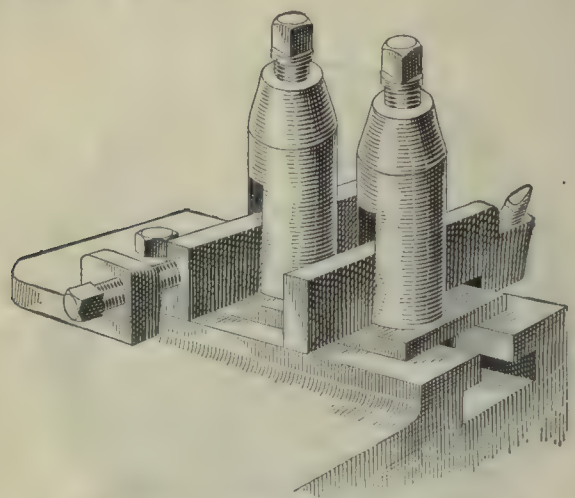




Using Two Tools at Once

By F. P. Fenaux

We have been using occasionally two tools on the same piece of work on the lathe (one tool roughing, the other finishing previous to grinding) and have had trouble in keeping the cutting edges the proper distance apart on account of the numerous sharpenings due to the hardness of the stock. We finally made the attachment shown in the sketch. It is a forging with a rib fitted to the slot of the compound rest and a projection on the end to receive a square-head adjusting screw. A bolt holds it down on the rest.



ADJUSTMENT WHEN USING TWO TOOLS

We found that it was best to adjust the finishing tool first to diameter, then bring the roughing tool up with the adjusting screw, then clamp the roughing tool solidly.

We realize that this could be improved, but in this shape it helped us a great deal.

Bending Die With Movable Anvil

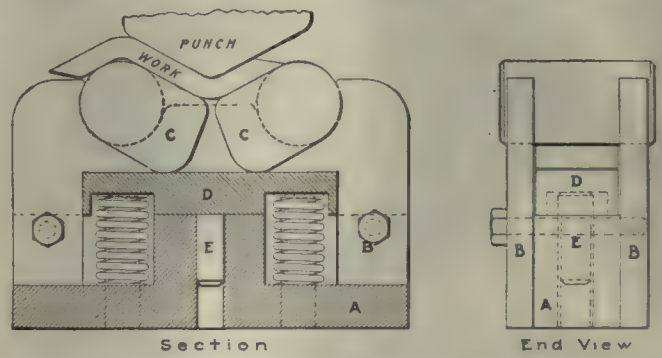
By John Chidsey

Though performing a simple operation the tools here shown and described may be of interest because of their unusual features. They are designed to form pieces of sheet copper which have already been cut to length.

Attempts to do the work with the usual forms of tools had not been successful because of the creeping and stretching of the material which would cause the bends to be out of place.

To the die bed *A* are secured the two vertical pieces *B* in which is formed the bearings for the two movable pieces *C*. The pieces *B* also serve as guides for the plunger *D*, the latter being held against side movement by the pin *E*, which is a sliding fit in the bed casting.

Heavy coil springs under this plunger hold the pieces



SHEET-METAL FORMING TOOLS

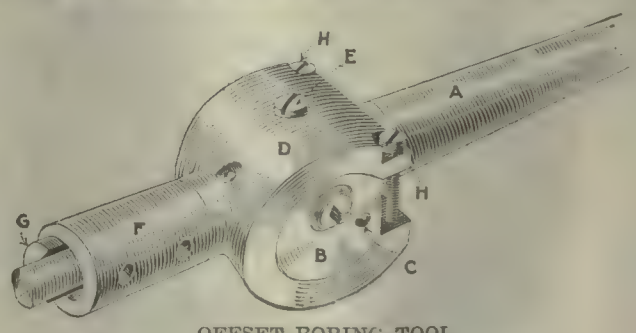
C normally in position with their upper faces in a straight horizontal line.

On this flat surface the work could be accurately located, and when the descending punch gripped the metal at exactly the right spot there was no opportunity for it to move out of place during the operation.

An Offset Boring Tool

By Leslie Eldridge

The drawing shows a tool which I have made for my own use and which I find very convenient. There are of course tools of this nature on the market, but they are more or less expensive, and many times a toolmaker prefers a tool of his own construction anyway. The tool here shown is of simple design and easy to make, but careful workmanship throughout is required if it is desired to have the adjusting screw and dial indicate accurately.



OFFSET BORING TOOL

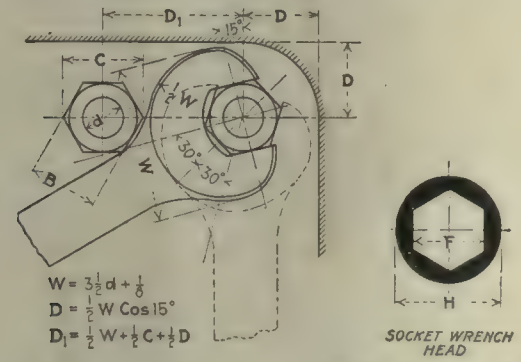
It will be noticed from the drawing that dovetails and flat sliding surfaces have been avoided as far as possible, thus making it possible to produce the tool almost entirely on the lathe, and it is for this reason that it can be made more quickly and easily than some of the others that have been shown.

The shank *A* may be made parallel or taper as desired, and the round piece *B* is bored on one side, the shouldered end of the shank fitted in and held by taper pin *C*. Part *B* has a slot milled along its upper surface to accommodate the adjusting nut which is held to part *D* by screw *E*. Parts *D* and *F* may be made one piece if desired or they may be made separately and pinned together as shown. Part *F* is bored large enough to take the half round V-block *G* in which the boring tool is seated by the two hollow-head setscrews. Screws *H* clamp the tool in position after each adjustment.

Minimum Spacing of Hexagon Nuts for Wrench Clearance

By F. H. Zeichner

The table here given enumerates the minimum spacing for wrench clearance of bolts with hexagon nuts; also the sizes for standard socket-wrench heads, diameter of spot-facing cutters, washers and other



SOCKET-WRENCH HEAD—ALL DIMENSIONS IN INCHES

Bolt Dia. U.S.S. d	D	D_1	Dia. Spot Facing Cutter	Dia. U.S.S. Washer	Over Flats B	Across Corner C	Socket Wrench F	Socket Wrench H
¼	½	1	¾	¾	½	0.578		
5/16	5/8	1 3/16	7/8	7/8	5/8	0.686		
⅜	¾	1⅜	1	1	¾	0.794		
7/16	⅞	1⅝	1¼	1¼	⅞	0.902	1⅛	1½
½	1	1⅞	1½	1½	1	1.011	1⅜	1¾
9/16	1⅛	2	1½	1½	1⅛	1.119	1½	1⅞
⅝	1¼	2 3/16	1¾	1¾	1¼	1.227	1⅝	2
¾	1½	2⅝	2	2	1½	1.444	1⅞	2⅜
⅞	1¾	3 1/16	2¼	2¼	1¾	1.660	2⅛	2¾
1	2	3⅜	2½	2½	2	1.877	2⅜	3
1⅛	2¼	3¾	2¾	2¾	2¼	2.093	2⅝	3⅜
1¼	2½	4⅛	3	3	2½	2.310	2⅞	3¾
1⅜	2¾	4 9/16	3¼	3¼	2¾	2.527	3⅛	4
1½	3	4⅞	3½	3½	3	2.743	3⅜	4⅜
1⅝	3¼	5⅜	3¾	3¾	3¼	2.960	...	...
1¾	3½	5¾	4	4	3½	3.176	...	...
1⅞	3¾	6 3/16	4¼	4¼	3¾	3.393	...	...
2	4	6⅝	4½	4½	4	3.609	...	...

Bolt Dia. U.S.S. d	D	D_1	Dia. Spot Facing Cutter	Dia. U.S.S. Washer	Over Flats B	Across Corner C
2¼	4½	7⅛	4½	4¾	3½	4.043
2½	5	7 15/16	5	5	3¾	4.476
2¾	5½	8 7/16	5½	..	4¼	4.909
3	6	9½	5¾	..	4½	5.342
3¼	6½	10⅛	6¼	..	5	5.775
3½	7	11 1/16	6½	..	5½	6.208
3¾	7½	11 13/16	7	..	5¾	6.641
4	8	12 9/16	7½	..	6¼	7.074
4¼	8½	13⅜	8	..	6½	7.508
4½	9	14 1/16	8½	..	6¾	7.941
4¾	9½	14 13/16	8¾	..	7¼	8.374
5	10	15⅝	9¼	..	7¾	8.807
5¼	10½	16⅜	9¾	..	8	9.240
5½	11	17 1/16	10¼	..	8¼	9.673
5¾	11½	17 13/16	10¾	..	8½	10.106
6	12	18 9/16	11	..	9¼	10.539
..	..	..	..	..	..	..
..	..	..	..	..	..	..

Hole in washer = diameter of bolt + 1/16 for bolts up to and including 1 inch in diameter.
Hole in washer = diameter of bolt + ⅛ inch for bolts 1⅛ to 2½ inches in diameter, inclusive.

information on bolts. The figures are especially valuable in engine design and machinery where parts must be compact but with the bolt's head easily accessible.

The information contained in this table has been very useful both to myself and to my associates and I am submitting it to you for publication in the columns of the *American Machinist* with the belief that it will prove to be equally valuable to other designers engaged in similar lines of work.

A Machine for Boring Babbitt Linings of Car-Journal Brasses

By J. V. Hunter

For the rapid boring of the babbitt lining in car-journal brasses a special machine has been built by the Wilson Avenue shops of the Northwestern Elevated Railway Systems of Chicago, and is shown in Fig. 1.

Two sizes of journal brass in use on this system are 4 in. and 4¼ in., and in order to handle both sizes the machine is made in two units connected together, thus forming the complete device. The cylinders are of two different diameters, the one at *A* being for 4¼-in. bear-

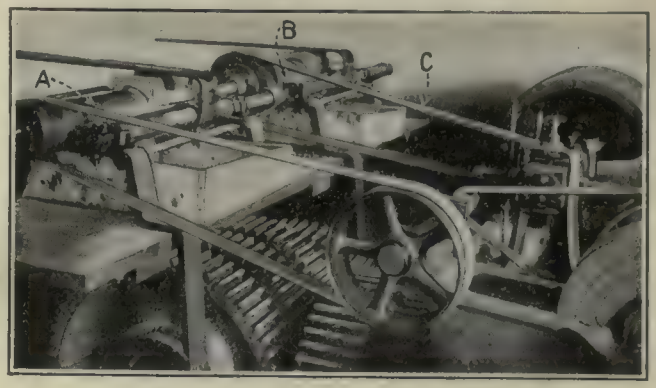


FIG. 1. MACHINE FOR REBORING CAR-JOURNAL BEARINGS

ings and that at *B* for the 4-in. bearings. Scrap pans are provided below the machine to catch the chips.

A brass, after the babbitt lining is cast in, is laid on the cylinder *A*, Fig. 2, which is driven by the belt from a motor. The arm *B* is lowered onto the brass so that the prongs *C* lock into the notches provided on the back of the brass for the locking wedge. Pressing down on the lever the operator slides the brass across the gap *D* onto the cylinder *E*, which is slightly larger than *A*. In its passage across *D* the cutting tools *F* bore out the soft metal to a diameter corresponding to that of cylinder *E*. The action of the machine is somewhat analogous to that of a jointer in which a piece of wood is planed by passing it from a lower table to a slightly higher one across a gap in which is the rapidly revolving cutter.

A uniform rate of feed is obtained by means of a screw on a continuation of the shaft to the left beyond the bearings. This screw has a lead of 3/32 in. The handle *G* has a half nut on its upper face, which fits

into this thread on the shaft, and when starting to make a cut the operator raises the handle until the half nut is in contact with the thread and is carried forward by it. The two handles are so fastened as to allow independent movement around the shaft *H*, which is free to slide longitudinally in its bearings; but the handles

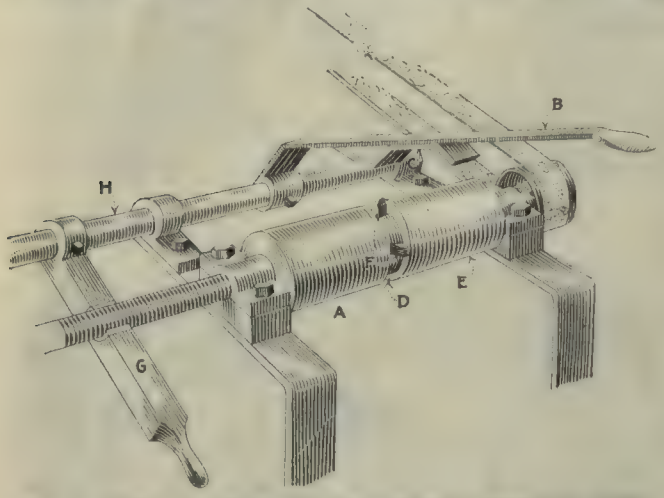


FIG. 2. DETAILS OF BORING MACHINE SHOWING FEED ARRANGEMENT

cannot move lengthwise on the shaft, therefore when lever *G* is moved forward by the thread, lever *C* carrying the brass moves with it.

The machine is always ready to operate, so when a workman takes out a journal brass and finds it badly worn at one end but still serviceable if re-dressed he takes it directly to the machine. This is so simple in its operation that almost any workman can soon learn to operate it.

The cut obtained shows noticeable toolmarks, but it is claimed that this condition is not detrimental and that a run of a few miles on the road gives the metal a chance to work down to a good bearing.

The shops state they have obtained a considerable saving in the amount of babbitt used since the installation of this device.

Boring Bar With Recessing Tool

By L. Jagow

The size and shape of the work to be done in this particular case called for the use of a boring mill, as most of the operations could be done in this machine without special tools. The best way of holding the

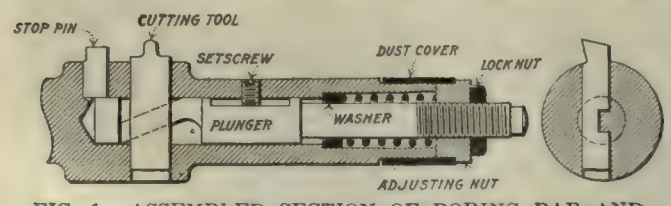
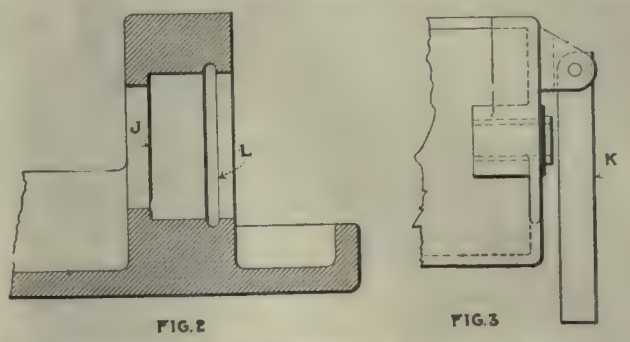


FIG. 1. ASSEMBLED SECTION OF BORING BAR AND RECESSING TOOL

casting in the fixture required that the end where the recess *L*, Fig. 2, had to be cut be away from the head of the machine. To cut this recess a special boring bar and recessing tool were made up as shown in Fig. 1.

After the bar is in position in the fixture it is set by bringing the stop pin against the shoulder *J*, Fig. 2, thus insuring accurate location of the recess.

With the bar in motion the lever *K*, Fig. 3, which is part of the fixture, is brought to bear against the end of the plunger, Fig. 1. As this is pushed in, the tongue on the inner end of it which fits in a groove in the under side of the cutting tool forces the latter



FIGS. 2 AND 3. PART SECTION OF WORK AND FIXTURE
Fig. 2—Section showing groove to be cut. Fig. 3—Fixture with operating lever

outward until the nut comes against the end of the bar. The tongue and groove are cut at a 20-deg. angle. The depth of the cut may be governed by means of the adjusting nut.

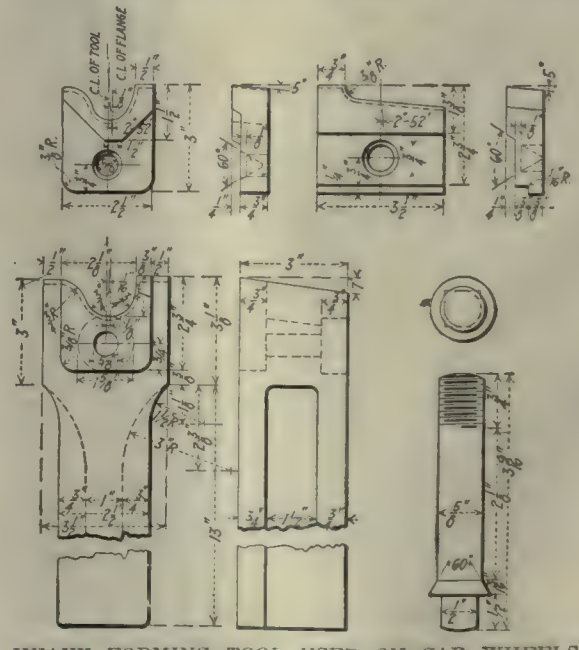
When the cut is completed and lever *K*, Fig. 3, is released the spring, Fig. 1, returns the plunger and withdraws the tool.

A Heavy Forming Tool

By J. Long

The drawing shows one of a number of forming tools used for turning the treads and flanges of wrought-steel car wheels.

The holder is made of axle steel, is channeled out on the sides to reduce the weight without sacrificing



HEAVY FORMING TOOL USED ON CAR WHEELS

strength, and is pocketed at the business end to hold the cutter, which is fastened with one or two screws according to the width of the tool.

The screws are special, with a head somewhat like a patch bolt, and serve to draw the cutter tightly against the walls of the pocket.

Re-education Vs. Disability Compensation

By DOUGLAS C. McMURTRIE

Director Red Cross Institute for Crippled and Disabled Men, 23rd St. and Fourth Ave., New York

In the past our method of dealing with men permanently disabled in the course of employment has been to pay the worker a pension in the form of compensation and forget him and his injury. But the cost of disability in the machine-tool industry has not been only in premiums paid for casualty insurance. There has been the cost involved in the training, experience and adaptation of a skilled worker who does not return to his job and the fitting of a newcomer to take his place.

THERE are three means of reducing and approaching the complete elimination of the cost of disability: First, accident prevention; second, thorough medical attention to minimize the disability resulting from the injury, and third, salvage of the remaining abilities of the worker through rehabilitation for self-support. The first of these has already received wide attention from employers and has wisely been encouraged in a financial way by casualty-insurance companies and state funds. The importance of the other two has, however, not as yet been appreciated. Their energetic application would effect a tremendous saving to industry.

Many injuries from which men would completely recover in a short time under adequate medical attention are treated for an insufficient time or by incompetent physicians, and instead of a prompt return to work the case at best drags along over an extended period and at worst becomes chronic or develops into permanent disability. Some states require the insurance carrier to provide but two weeks of compulsory free medical attention to the injured man. For the insurance company to take advantage of this limitation is a most short-sighted policy, because for every dollar saved in physicians' or hospital fees the insurance carrier later pays out ten in compensation. And what the insurance company pays comes out of the regular premiums paid by the insuring employers.

High-Grade Medical Attention

Unlimited medical attention of the highest grade should be an axiom of casualty practice and it should be insisted upon by employer and workman alike. The best outcome of any injury is to have the employee return to his job as a well man in the shortest possible time. It is well to develop a science of dealing with cripples, but the ideal is to have fewer and fewer cripples with which to deal.

The third method of attack on the cost of disability is rehabilitation for self-support—the reëducation of an injured man for an occupation he can follow or a process he can perform in spite of his handicap. The science of rehabilitation is new and the experience in it has practically all been gained in the effort to make sound and just provision for the disabled soldier or sailor. Every country among the recent belligerents is today operating a comprehensive system of reëducation for disabled soldiers, and is placing upon that system more dependence than upon the pension system.

Paying a man a small monthly or weekly stipend on which he is expected to live in idleness is not a very constructive method. With the breakdown of confidence in the pension system it was realized that the only real compensation for disablement was restoration of capacity for self-support. It was further realized that very few jobs require all the physical faculties and that with the present-day variety of industrial processes it is possible to find a job in which a man with a given type of disability can function 100 per cent. efficiently. Some jobs require standing, some sitting, and others walking about; some jobs at a bench working on small articles require but little strength, others involve great physical exertion; still others do not require the sense of hearing; in others the sense of sight is not essential. Finding the future work of the disabled man therefore requires expert and painstaking choice, but a successful selection is possible even for the seriously handicapped. The first aim is to place the man back in a different job in his own trade or in a trade closely related. In such a job his past experience will stand him in good stead. Failing this he must be retrained for a different line.

Trades Being Taught

The process of retraining the disabled is known as reëducation, and can best be accomplished in a special school for crippled men. The first school of this kind in the United States is the Red Cross Institute for Crippled and Disabled Men established in New York through the generosity of Jeremiah Milbank. At this school, open to disabled civilians and soldiers alike, six trades are already being taught—artificial-limb making, motion-picture operating, oxyacetylene welding, printing, jewelry work and mechanical drafting. More will be added as the demand develops. Graduates are already giving satisfaction in the jobs for which they have been prepared, so the enterprise has passed the experimental stage. And in the results attained with disabled soldiers abroad there is overwhelming evidence of the logic and practicality of rehabilitation.

The cost of soldier rehabilitation is being met by the United States Government and by the governments of some of our allies. It will be admitted without argument as desirable that the advantages of reëducation be made available to disabled civilians as well, but will not the cost be prohibitive? The fact is that rehabilitation effects a reduction rather than an increase in the cost of disability to industry or to the community as a whole.

A typical case will illustrate how the saving is effected. A worker in Massachusetts was injured by a fall while working inside a submarine and his hand became permanently crippled. In due course his compensation rate was determined and he was referred to the insurance carrier to be paid $10 a week for a long period, with a maximum total payment of $4000. Since

the disability was manifestly permanent the insurance company wrote the case off their books as a $4000 loss and transferred that amount to reserve to cover the weekly payments. After the compensation had been paid for nearly a year a new official of the insurance company began looking over the list of men to whom the company was paying compensation. His attention was directed to the man in question and the latter was requested to call at the office of the company. The case was, like many thousands of others, susceptible of rehabilitation for self-support, so the insurance company's official put a proposition to the man in very frank terms: "I believe that you can be trained to earn a good living. I want you to understand very clearly, however, that this proposal is to the financial advantage of the company, but I also believe it is to your advantage as well. A total income of $10 a week is not very attractive to you and you would probably rather return to work at a good wage than remain idle. If you will consent the company will send you to a school of reëducation and see if it cannot get you back on your feet in good shape."

Reëducation at Red Cross Institute

The injured man consented to the proposal and the company sent him to the Red Cross Institute in New York. It began to pay him not $10 a week as required by law, but $40 a week, $20 to him in New York and $20 to his wife at home. The company also paid liberally his traveling expenses in both directions. In the period of eight weeks he was reëducated in oxyacetylene cutting and welding and returned home. He is now making not only a satisfactory wage but twice as much as he had ever earned before.

In the whole transaction every party at interest was benefited. The man was advantaged in that his general living standard was distinctly raised and the necessity of working for his living could not be considered as a hardship. The company paid less than $500 for his rehabilitation, and this expense in conjunction with the $500 already paid in weekly compensation during the first year of idleness made a total for the case of $1000. It was thus enabled to charge $3000 of profit to the account of profit and loss. The community was infinitely the gainer in that the man, formerly an unproductive consumer, became a useful producer instead. The community further gained in the elimination of the disabled man from the category of a prospective dependent, because while compensation might have taken care of him in a very insufficient way during the period of idleness there would have come a time when compensation ceased and then he would have been in a desperate economic condition indeed—confirmed in habits of idleness, untrained for skilled work and almost invariably with no means of support.

A more intelligent handling of disability by insurance carriers will therefore reduce their expenses and cut the cost of casualty protection to the employer. There is needed also, however, some revision of the compensation laws so that there may be definite encouragement to insurance carriers to offer opportunity of rehabilitation and definite encouragement to the disabled men to take advantage of it. Practically every compensation case that has ever come to the Red Cross Institute has come on the day compensation expired. For one year, for two years or for four years the man has existed in idleness, drawing compensation and cultivating habits of indolence. When his support was cut off he then became interested in rehabilitation. Present compensation legislation tends to encourage the man to remain idle because his payments are reduced by any improvement in earning capacity. A revision of this practice will make for more constructive provision.

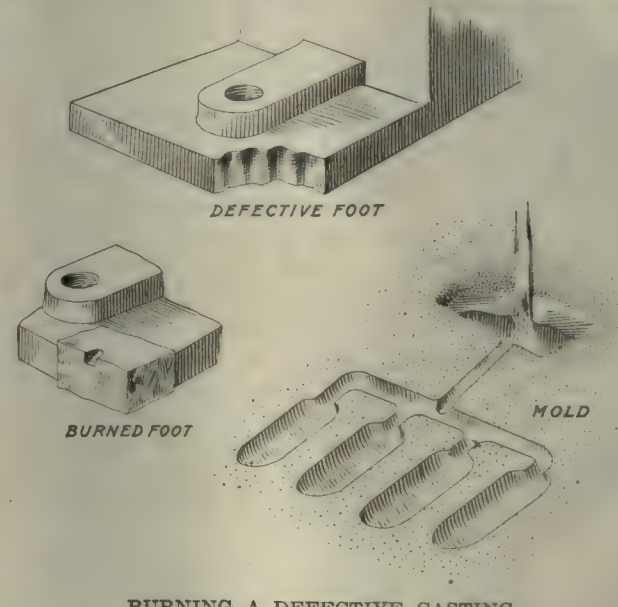
In short the first effort should be to prevent injury, the second to minimize its permanent effects, the third —when disability has ensued—to offset its economic consequences. The execution of this complete program is sound humanitarian practice and good business.

Repairing Defective Castings

By Frank Calkins

Previous to the advent of the oxyacetylene torch many an otherwise good casting was relegated to the scrap pile on account of a shrinkage crack or other defect in some vital part. Some foundries, however, resorted to the process called "burning," a method that can be profitably employed in foundries the equipment of which does not include the oxyacetylene apparatus, and thus save many castings at a fraction of the cost of remolding.

Let us take the case of a dry-sand-molded steam-cylinder casting, which because of trouble with a core was cast with a defective foot. To reclaim this cast-



BURNING A DEFECTIVE CASTING

ing the edges of the defective part were carefully cleaned and the casting placed on the foundry floor where all surfaces adjacent to the defective foot were covered with "heap" sand. A mold was then cut out a trifle larger in dimensions than the portion of the casting to be replaced and the mold provided with a runoff leading to pig molds so that no metal would be wasted.

Two 200-lb. ladles of metal were required to burn on the part. The molten metal was slowly poured against the edges of the defective part, which soon softened and fused with the metal in the mold. The repaired part did not present an appearance of which the molder could be proud, but after a little chipping the casting was made as serviceable as if no trouble had been experienced in the original cast.

ARMY ORDNANCE NEWS

A GENERAL order issued from the War Department on Feb. 13, 1919, states that "By order of the President the Distinguished Service Medal is awarded to the following named officers and civilians for exceptionally meritorious service to the Government in a duty of great responsibility: . . .

"Brig.-Gen. William S. Peirce, U. S. Army, for exceptionally meritorious and conspicuous service. While in charge of the Springfield Arsenal his exceptional ability contributed materially to increasing the output of small arms. As assistant Chief of Ordnance he has rendered conspicuous service."



William S. Peirce

Brigadier General, United States Army
Assistant Chief of Ordnance

General Peirce was born in Burlington, Vt., on May 16, 1864. His father was Albert G. Peirce. He attended the local schools and graduated from the Burlington High School in the spring of 1881. The next fall he entered the University of Vermont and completed three years of the course. In the summer of 1884 he was appointed to the United States Military Academy and left college to enter West Point in the fall. He graduated in 1888 and was appointed to the artillery.

After four years in this branch of service he was transferred to the Ordnance Department and stationed at Watervliet Arsenal. His next post was at the Sandy Hook Proving Ground, and this was followed by tours of duty at two arsenals, namely, Rock Island and Springfield.

He was for a time Inspector of Ordnance at New Haven, Conn., and later stationed at the plant of the Midvale Steel and Ordnance Co. He went on duty in the office of the Ordnance Department in Washington in May, 1909, and remained there until September, 1912, when he was given command of the Springfield Armory. He held this position at the outbreak of hostilities and retained it until January, 1918. Since that time he has been in Washington, as chief of the Administration Division, where he did splendid work in directing the handling of personnel, construction of new buildings and other administration details, and later as assistant Chief of Ordnance, a position which he still holds. In view of the fact that most of the citations have gone to the oversea forces it is pleasant to record the decoration of some of the men who did the hard work on this side of the water without having an opportunity to share in the glory and the stimulation of combat duty. Without doubt the honor is well-merited, although the men who did the work would probably be the last to admit it.

In the following pages General Peirce tells how Army ordnance met its responsibilities. Every reserve or regular ordnance officer and every manufacturer who has had anything to do with the fulfillment of ordnance contracts will be interested in reading this account written by one who has been in such close touch with the history of ordnance activities during this war and who also has a knowledge of ordnance activities in years past. General Peirce describes how tremendous obstacles were met and overcome.

ARMY ORDNANCE NEWS

How Army Ordnance Met Its Responsibilities

By BRIG.-GEN. W. S. PEIRCE
Assistant Chief of Ordnance

This is the story of the big work done by the Army Ordnance Department in the great war, written by one who believes that it is time for the American public to know the whole truth about a subject that until now has not been fairly presented to them.



TANK TAKING A REST

ARTICLES on the Ordnance Department which have been hitherto published in some papers have usually dealt with only such portions of the work as the writer's thought offered a chance for sensational criticism. They have contained so many part truths, so much false emphasis, special pleading and misrepresentation of facts that the public has been led to believe the Ordnance Department of the Army failed miserably in its task. This impression is false. The Ordnance Department did not fail; on the contrary its performance of its allotted portion of the gigantic national effort is a record of which every American can be justly proud. Every ordnance officer who, smarting under the undeserved criticism of the past year, has steadily kept at his work, believes that the American people are essentially just and need only to have the truth about ordnance presented to them to give the credit and praise that the work really deserves.

What then was the Ordnance Department's job? Briefly it was to furnish the American Army with the fighting equipment that it needed and to maintain and repair the equipment in the field.

Next, how successfully was that job accomplished? That question is convincingly answered in a letter from Lieutenant-General Liggett, commanding the First American Army in France, who said that the American troops were well and thoroughly equipped and that no military operation was prevented or delayed by lack of supplies of any sort.

Fighters Satisfied

So the Ordnance Department performed its job to the satisfaction of the fighting troops and it believes that the American people once they know that fact will accept the verdict of that jury against any other.

Where it got the needed equipment—whether it was from France, England or this country—matters little. The big outstanding fact is that it got it and delivered it as fast as the men really required it. It is true there were some close shaves and some sharp corners around which the machine skidded dangerously, but it never overturned. The work is now done; the record made, and the only reply that the department need make to those swivel-chair critics who charge it with failure in this or that particular is, "Ask the A. E. F."

It is not claimed that the department made no errors. There was a tremendous task to perform with a hastily assembled personnel working feverishly against time. Approximately half of the total appropriations for the War Department were for ordnance. It had to plan and place orders for equipment costing in round numbers $16,000,000,000. It had to arrange for the enlargement of old plants and the building of new ones costing $500,000,000. No other business in the world ever dealt in such figures. Of course, errors were made; it was inevitable they should be if action and progress were to be made. But those that were made were corrected or overcome and so did not prevent the successful completion of the job as a whole. At the beginning of the war the Ordnance Department had fewer than 100 officers and approximately 750 enlisted men. Of the fighting equipment which it had to provide there were on hand not more than 600,000 infantry rifles; less than 500 field guns, with only a small amount of ammunition; not enough infantry pack carriers for the Regular Army and National Guard; less than 2000 machine guns; no tanks; no large field guns such as had been developed and used abroad, and what was almost as bad no adequate facilities for the manufacture of these articles in the quantity required.

Equipment for 4,000,000

That greater quantities of these things were not on hand was not the fault of the Ordnance Department, but of the American people, who in spite of the appeals of the department in past years had not insisted that their Congress appropriate the money required to get them. With supplies generally inadequate for the field operations of even the small Regular Army the Ordnance Department was confronted with the task of providing equipment first for an army of a million, then of two million and finally of nearly four million men.

And bear this in mind, ordnance equipment is not kept in stock except by governments. You cannot go out and buy it at the corner store. Nor is most of the machinery and tools used in commercial work adaptable to ordnance work. The same yarn that is used in civilian clothes can be dyed khaki color and woven into uniform cloth by the same looms that only yesterday stopped their ordinary work. But a machine shop or factory cannot be turned to ordnance work without long preparation. War has become more and more a mechanical affair fought and carried on by the use of

ARMY ORDNANCE NEWS

machines. These machines are special, different from any made in peace time, are increasingly expensive and require time, time and still more time to produce. It takes nine months to make a large gun in a factory already equipped and experienced in the work. Even with rifles and the smaller articles the special equipment in the way of fixtures, tools and gages requires a surprisingly long time to provide, and until this factory equipment is procured the manufacture of the article in quantity cannot be begun. How much this time of beginning is prolonged can be imagined when the factory has first to be built and the machinery for it made. This was the job that in April, 1917, faced the little body of less than 100 regular officers that constituted the Ordnance Department at that time. It had to expand its own force while undertaking at the same time the work for which it needed the whole strength that it finally obtained. How did it meet the problems? It called to its aid from civil life the best business, professional and technical talent that it could get. It increased its number of officers from less than 100 to nearly 6000 and its enlisted personnel from about 750 to 63,000. Anyone in business can imagine to some degree what such an expansion of an organization means when accomplished in little over a year. If the department had not been able to obtain so many men of high executive ability and business experience this hasty assemblage would have resulted in confusion worse confounded instead of achieving the general efficiency that it did.



RIVETING AN ARMORED CAR

The Reserve Officers

Too much emphasis cannot be laid on the quality of Americans who responded to the call of the Ordnance Department. Men who were conducting the largest business enterprises or who were at the top of their professions, engineers, chemists, lawyers, laid down their private affairs at great personal sacrifice to assist in this work. Younger men who were experts in some needed line or who were not physically fit for field duty came also to do their part.

If such a group of men could not put over the job successfully, from what source would it have been possible to get men who could? They worked nights and Sundays, frequently under a fire of criticism and sarcastic comment more difficult to endure than that from guns. They were called "slackers" and "desk warriors," and their right to wear the uniform was questioned by many whose only visible war effort was the systematic depreciation of these loyal workers. Orders were placed abroad in factories that were ready to produce war material; new factories were started in this country; workmen were assembled and trained in the new work of producing ordnance material on a scale never before dreamed of. Delays were encountered, heart-breaking delays, due to insufficient transportation, lack of needed materials, tools and skilled labor. Expectations and promises of production repeatedly failed to materialize. But foreign deliveries bridged the gap as anticipated and production finally increased in volume here, so that when the armistice was signed it was advancing at such a rate that before it could be checked there was produced more equipment of almost every item than would equip and maintain two armies in the field for six months. The men who made success in this great work possible are now returning to civil life. They wear no medals or decorations, but remember this, if they had not done their work well and thoroughly there would have been no medals won by Americans in France. They were an honorable part of the war machine of which America is now so proud. It is only common justice that the truth about ordnance should be widely known, so that their fellow townsmen can accord these men the credit they so richly deserve.

The Army ordnance has been criticised for much and praised for nothing. It has been charged with failure because it did not get artillery and ammunition from America where the utmost efforts of manufacturers could not produce it in time, and also for getting it in France and England where it could be produced in time. It will be asked how could these countries spare any of the guns and ammunition they were making. The answer is that in the great effort they had made to equip their large armies in the shortest possible time they had developed manufacturing capacity much beyond that required to keep these armies going after they were once equipped. Every gun and carriage that could be made abroad saved tonnage space in a ship, space that was urgently needed. So placing orders abroad not only got the articles sooner but saved ocean-carrying capacity, and our troops, which the French and British so badly needed, were able to get into action in 1918 instead of waiting for the guns and shells which it was not expected America could produce until 1919.

Ordnance Department Worked in Harmony with Manufacturers

The Ordnance Department could not of itself produce these things. It had to work with the manufacturer at home and abroad. It could and did direct, encourage, assist and urge forward the industrial effort, but in the last analysis actual production depended on the energy, skill and resources of the manufacturer. In spite of all obstacles it made good; it got the stuff. That is all the people will want to know before joining with the A. E. F. in pronouncing judgment on ordnance.

ARMY ORDNANCE NEWS

Work of Aircraft Armament Section Highly Recommended

What the Aircraft Armament Section has done is well indicated in the following communication from Col. H. Dunwoody, Assistant Chief of Air Service, to the Chief Ordnance Officer of the American Expeditionary Forces:

"I desire to take this opportunity of expressing to you my appreciation of the able and efficient work of the Aircraft Armament Section, Ordnance Department. This section has been associated with the Air Service for over a year, and during that period their work at all times has been exceedingly satisfactory to myself and to the Air Service. It is felt that without the energy, loyalty and devotion to duty shown by this section it would have been impossible to put combat planes on the front.

"They have been confronted with many difficult situations and have met and overcome their difficulties in a highly commendable manner. I believe it is the general impression throughout the Air Service that the Ordnance Department has rendered us valuable and efficient service.

"From a supply standpoint there has never been a single delay in equipment of planes or mobilization of squadrons due to a lack of airplane ordnance nor to a lack of competent men to install it for us. This is also true of military operations. The experience gained by this section has been of great value to the service in general, and has provided us with a large amount of valuable information which it is felt will not be lost to the service and which is exceedingly difficult to obtain from other services. I believe that our Aircraft Armament Section has shown by far greater ability than the corresponding sections of the allied services. At any rate we have covered in an armament way in one year the ground covered by the allied forces during their whole war experience, and in many items of armament I believe that we have surpassed them in efficiency. This is due to the efforts of the Aircraft Armament Section alone, and I desire to congratulate you upon the efficiency with which this work was undertaken and carried out."

PERSONALS

Capt. H. K. Benson was professor in chemistry at the University of Washington.

* * *

Lieut.-Col. James G. Scrugham is a consulting engineer. His home is in Reno, Nevada.

* * *

Capt. B. S. Lawyer was formerly with the Ætna Explosives Co., 120 Broadway, New York.

* * *

Capt. George Zuin of Somerset, Va., who was recently discharged, had served over fourteen months.

Capt. H. E. R. Barton was formerly sales engineer of J. Edward Ogden Co., 147 Cedar St., New York.

* * *

Capt. George E. Morrissey of New York, who was formerly in the export business for himself, has been discharged.

* * *

Maj. Leon W. Chase was professor of engineering at the University of Nebraska. He entered the service in May, 1918.

* * *

Lieut.-Col. James S. Dacosta before entering the service was with the Alvey-Ferguson Co., Cincinnati, Ohio, on mechanical engineering work.

* * *

First Lieut. J. B. Renwick, Jr., was in the service over 13 months. In civil life he was employed by the Edison Storage Battery Co., Orange, N. J.

* * *

Second Lieut. Ernest F. Schimpeler, who was formerly a civil engineer employed by the Carnegie Steel Co. at Youngstown, Ohio, has been discharged.

* * *

Capt. John M. Price, whose home is in Lakeville, S. C., was with the Bethlehem Steel Corporation as special sales representative at the Chicago and St. Louis offices.

* * *

Capt. Harry W. Eisenhart, who was employed by the Frick & Lindsay Co., Pittsburgh, Penn., as a steel salesman before entering the service, was discharged on Jan. 31.

* * *

Capt. George R. Gage, who entered the service as a first lieutenant in November, 1917, was a structural-steel designer with the Electric Bond and Share Co., 71 Broadway, New York.

* * *

Second Lieut. William W. Tinsley was recently discharged. His home is in Birmingham, Ala., and before entering the service he was employed as chemical engineer by the du Pont Powder Company.

* * *

First Lieut. Harold L. Jillson entered the service in July, 1917, as an enlisted man and was twice promoted. Before enlisting he was a salesman with the Air Reduction Co., 120 Broadway, New York.

* * *

First Lieut. Charles L. Lowell, formerly of the Lowell-Moore Hardware Co., Fort Collins, Colo., has been discharged. He had been in the service over 11 months and is to return to his former business.

* * *

Lieut.-Col. Francis Le B. Robbins, Jr., who was discharged on Jan. 30, served nearly a year and a half. He was twice promoted. He is a lawyer and was a member of the firm of Winthrop & Stimson, New York.

ARMY ORDNANCE NEWS

Second Lieut. James H. Lee was formerly special agent with the Pennsylvania Railroad at Philadelphia, Penn.

* * *

Second Lieut. Raymond F. Mitten, recently discharged, was with the Rock Island Plow Company, Rock Island, Illinois.

* * *

First Lieut. Alexander W. Limont before entering the service was with E. L. Fletcher, Bridgeport, Conn., as mechanical engineer.

* * *

Second Lieut. Harold J. Smith had been in the service over a year at the time of his discharge. He is a metallurgical engineer.

* * *

Capt. Roy E. Lynd, who was formerly with Richardson & Boynton Company, Dover, N. J., as mechanical engineer, has left the service.

* * *

Second Lieut. Charles D. Wessels has left the service. He was formerly with the Wessels Company, Cleveland, Ohio, as mechanical engineer.

* * *

First Lieut. David L. Babcock, a mechanical engineer, has left the service. He was formerly with the San Francisco-Oakland Terminal Railways.

* * *

Capt. L. H. Schwarzenberg, who has served nearly fifteen months, is a structural engineer and was with Christian, Schwarzenberg & Gæde, Cleveland, Ohio.

* * *

First Lieut. William R. Snyder was with the Fulton Bag and Cotton Mills, Atlanta, Ga., as mechanical engineer before being commissioned in September, 1917.

* * *

First Lieut. John M. Quaintance entered the service Nov. 22, 1917, as Second Lieutenant. He was formerly with the Northern Ohio T. & L. Company, Akron, Ohio.

* * *

Second Lieut. Laurence A. Baldwin entered the service nineteen months ago as an enlisted man. In civil life he was employed by Smith Houser of New York City.

* * *

First Lieut. Ralph W. Kempsmith, who was discharged after thirteen months' service, was with the Bethlehem Steel Corporation at Cleveland, Ohio, and will return.

* * *

First Lieut. Clayton H. Alvord was discharged on Feb. 15. Before entering the service he was with the Bosch Magneto Company, Springfield, Mass., as mechanical engineer.

* * *

Lieut.-Col. Oliver S. Lyford entered the service as Major in November, 1917. He was previously assistant to vice president of New England Westinghouse Company, Springfield, Mass.

First Lieut. H. J. Williams has been discharged after fifteen months' service. He is a mechanical and consulting engineer, and was also on the teaching staff of Pratt Institute, Brooklyn, N. Y.

* * *

First Lieut. Myron McK. Smith, discharged after twenty-one months' service, was purchasing agent for the New England Westinghouse Company, Springfield, Mass., before being commissioned.

* * *

First Lieut. Lawrence S. Sheldrick entered the service as Second Lieutenant in January, 1918. He was formerly employed by the Timken Axle Company, Detroit, on experimental engineering work.

* * *

Capt. Aurin E. Payson of Somerville, Mass., was discharged Feb. 14. He was with J. H. & C. H. Eagle, 265 Fourth Ave., New York City, before entering the service in October, 1917, as First Lieutenant.

* * *

Capt. Carl H. Lambert entered the service in September, 1917. In civil life he is a mechanical engineer and was employed by Primza, Inc., New York City. He was once promoted, and is now back in civil life.

* * *

Second Lieut. Robert Howarth, who entered the service as an enlisted man and earned his promotion, will resume his work as treasurer of Howarth, Hawkinson Company, Utica, N. Y., miners and shippers of bituminous coal.

* * *

Lieut.-Col. Herbert W. Alden has been discharged. Before entering the service he was with the Timken Axle Company, Detroit, as mechanical engineer. He was in the service about twenty months and his original commission was as major.

* * *

Capt. Owen M. Whittenberger was discharged after over seventeen months' service during which he was once promoted. He is a mechanical engineer and his home is in Cleveland, Ohio. He was formerly employed by Seagrave & Company, Columbus, Ohio.

* * *

Capt. Thomas R. Davies has been discharged. In civil life he was with W. R. Grace & Company, 7 Hanover Square, New York City, as mechanical and construction engineer and had charge of important work in Chile. He was in the service nearly sixteen months and was promoted from First Lieutenant.

* * *

Maj. Paul Bigelow, who formerly held a commission as Senior Lieutenant in the North Carolina Naval Artillery, has been discharged from the Artillery Ammunition Section of the Engineering Division, Ordnance Department, where he was executive assistant to Lieut.-Col. Alton S. Miller at Washington, D. C. He has resumed business at 39 Cortlandt St., New York, where he has been representative of the Buckeye Engine Co. since 1901 and for the Murray Iron Works Co. for the past several years.

Bliss Flat-Edge Trimmer for Sheet Metal

SPECIAL CORRESPONDENCE

The machine here described is believed to be the only machine on the market that will trim the scrap from metal stampings and leave a smooth, flat edge suitable for soldering, welding, brazing or other operations.

IN practically all cases stampings or drawn shells produced by the ordinary power press have to be put through additional trimming operations to remove the flash, or scrap, before they can be used, and this is a process that has been more or less unsatisfactory and has caused much trouble in many cases, particularly where it is necessary to leave the edges of the finished stamping in an approximate plane.

In work where it has been necessary to join two or more of these pressed-metal parts by welding, soldering or similar operations it has been customary to follow the trimming operation by filing or grinding operations to produce the flat surfaces necessary. A fillet of any size at the point where the scrap is trimmed has of course been a decided disadvantage, and it has been the general custom to use dies with edges as sharp as possible in order to avoid this, and these have introduced difficulties in drawing. Another disadvantage has been that in working the precious metals considerable valuable material has been lost in the filing or grinding operations.

With a view to overcoming some of these disadvantages and troubles the E. W. Bliss Co., Brooklyn, N. Y., has recently developed and placed on the market the No. 702 flat-joint trimmer that is particularly adapted to trimming the flash, or scrap, from articles where the line of juncture between the scrap and the stamped or drawn body is in a single plane, so that a flat surface is produced on the edge of the stamping or shell when the stamping is trimmed. The work as delivered from the press is in condition for uniting by soldering or welding and requires no further treatment before either of these operations is performed, the flat surfaces on the edges of the material being approximately the same width as the original thickness of the sheet metal.

During the trimming operation the stamping is held in a female holding die, while the inside of the stamping up to the level of the top of the female die is filled by a filler of ordinary babbitt or some similar metal that is of the approximate shape of the inside of the stamping. After the stamping and filler are in place in the holding die the cutting die fastened to the ram descends into place inside of the stamping, and front-and-back and side-to-side motions of the holding die in the plane of its upper surface cut away the scrap with a direct shearing action, leaving the edges of the stamping in a plane and of the same approximate width as the thickness of the original material.

Figs. 1 and 2 show front and back views of the press, respectively, while Fig. 3 shows the general construction and mechanism used to operate the die in two straight lines at right angles to each other. The shell to be trimmed is supported in the lower, or holding, die *A* that is made with an opening corresponding to the shape of the stamping at the point to be trimmed. After the stamping is in place, the upper, or cutting, die *B* is brought down into operative position with its lower surface in the plane of the top of the holding die *A*. The cutting die *B* has a contour somewhat irregularly conforming to the outline of the surface to be trimmed, but is slightly smaller in size and wholly inside of the shell, so that the trimming or shearing operation shall be from the inside out. A relative movement is now produced between the holding and cutting dies that is sufficient to cause the cutting die to pass over all parts of the surface to be trimmed in a direction extending from the inside to the outside of the stamping. This relative movement is accomplished by moving the holding die to both sides and back and front, the movements being in straight lines at right angles to each other. These four movements in two perpendic-

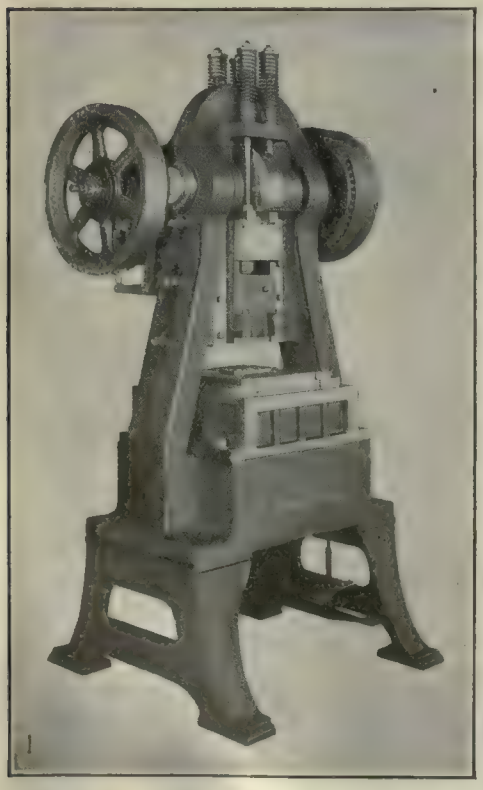


FIG. 1. FRONT OF TRIMMING PRESS

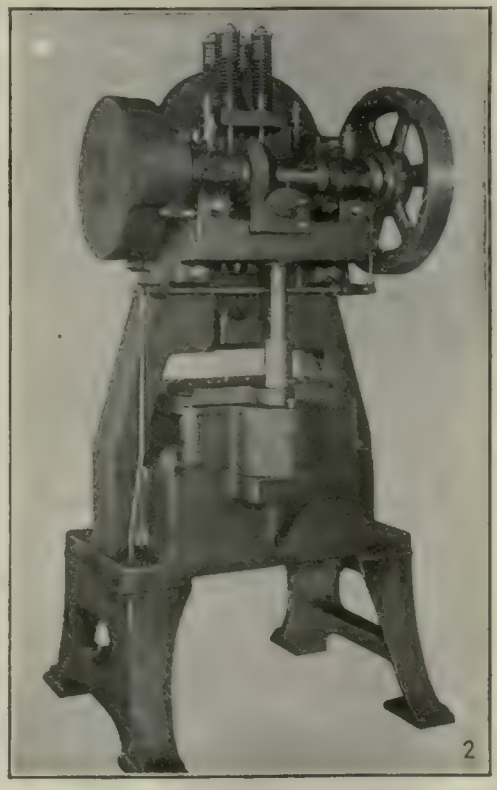
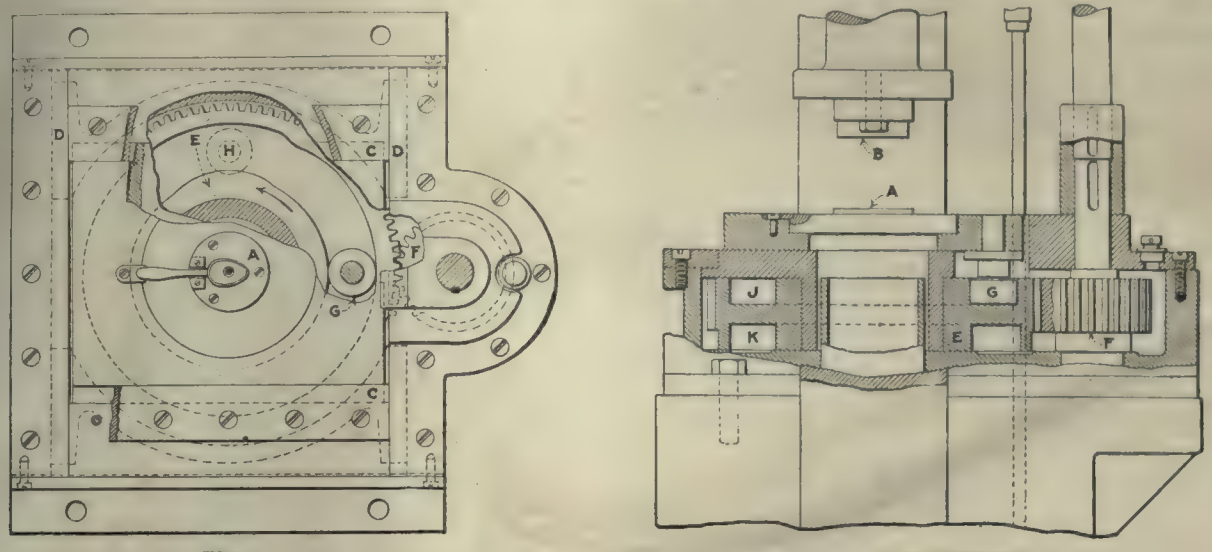


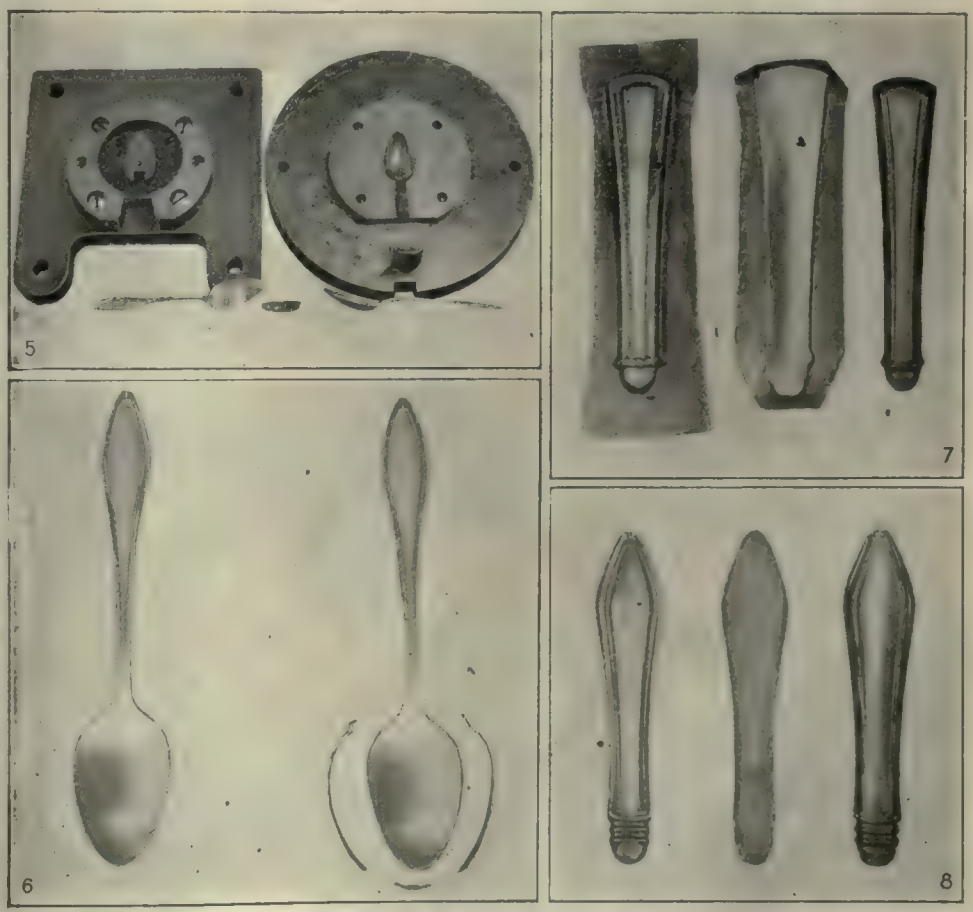
FIG. 2. REAR OF TRIMMING PRESS

ular lines are produced by a cam having two grooves, the ways *C* and *D* providing for the motion in the back-and-front and side-to-side directions respectively. The cam *E* is gear driven from the pinion *F* located on the vertical shaft receiving its motion from the main shaft of the machine, and is provided with two cam slots, one on the upper surface and the other on the lower surface. The cam roller *G*, which operates in the upper cam slot *J*, is fastened to a stud on the upper slide and imparts to this slide the forward and back motions. A second cam roller *H* moves in the slot *K* on the lower side and imparts the two crosswise motions to the holding die. It is easily seen that by changing the starting point of the geared wheel any one of the four shearing movements can be made to take place first, as best suits the outline of the shell being trimmed. In order to prevent any distortion of the stamping during the shearing operations a filler that may be made of babbitt or other such material is used. The filler may be either placed in each individual stamping by hand or it may be attached to the upper or cutting die, but in this case provision has to be made to allow it to slide on the under surface of the upper die to take care of the relative motion between the upper die and the holding die. The method of accomplishing this is shown in Fig. 4, which shows a die used for trimming a spoon. It will be noticed that two T-slots are cut in the filler at right angles to one another, allowing it to slide on the T-head bolt fastened to the upper die. It will be noticed that the T-slots open down through the under side of the filler. This is permissible because the main necessity is to hold the stamping near the edges to be sheared, the amount of bearing being determined somewhat by the thickness of the metal operated on.



Plan Front Elevation

FIG. 3. SECTION SHOWING THE METHOD AND MECHANISM USED FOR IMPARTING THE MOVEMENT TO THE HOLDING DIE



FIGS. 5 TO 8. SAMPLES OF WORK AND SOME OF THE TOOLS USED

Fig. 5—The dies for trimming a spoon. Fig. 6—A spoon before and after trimming, showing also the three pieces of scrap. Fig. 7—The stamping, scrap and finished part for half of a knife handle. Fig. 8—Another type of knife-handle half showing the back and front sides of the filler used

Fig. 5 shows a set of spoon dies which in this case is used with a filler that is placed in the spoon by hand. The die at the left is the upper, or cutting, die, while that at the right is the lower, or holding, die. It will be noticed that the portion of the upper die that does the cutting is recessed at the lower edge, this being necessary on account of the fact that the handle of the spoon must be left intact. The filler is shown in front between the two spoons. Fig. 6 shows a spoon before and after trimming, and also shows the three sections of scrap removed.

Fig. 7 shows the operations on one-half of a knife handle, the three pieces shown being the stamping as it

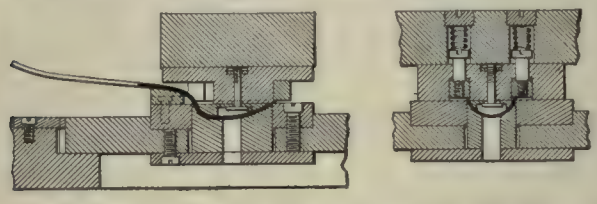


FIG. 4. METHOD OF ATTACHING THE FILLER TO THE SHEARING DIE

comes from the drawing press, the scrap removed by the trimming press and the finished piece after the trimming press has performed its operations. It will be noticed from the scrap that the dies in the forming press were made with a considerable radius on the corner of the female die and the trimming was done somewhat below in order not to encounter the rounded corner, or fillet, formed. It is claimed that this ability to form the original stamping somewhat deeper than necessary and then trim somewhat below the fillet avoids many of the troubles that were customary where it was necessary to make this fillet as small as possible on account of the former methods of trimming.

Fig. 8 shows half of a knife handle of another type after having been trimmed and also shows front and back views of the filler, which is made of babbitt metal. This filler is one of the type that is placed in the stamping by hand, a number being provided of course in order that they may be placed in the stampings while the shearing operation is being performed on the preceding piece.

Salesmanship Versus Engineering Horse Sense

By John R. Godfrey

There has been a lot of bunk written about the psychology of salesmanship; how you must look the prospective victim in the eye, size up his nose, the set of his ears and the height of his forehead and then apply rule 79 or whatever number fits his particular combination. And having argued and browbeaten him into buying something he didn't want the salesman repeats by way of inspiration the old gag to the effect that "Anyone can sell a man something he wants, but it takes a real salesman to sell him something he doesn't want."

Speaking solely from the machinery standpoint, although I haven't a doubt it applies elsewhere as well, this is the worst possible attitude for a salesman who ever expects a repeat order. It leaves a lasting antagonism and resentment in the mind of the victim, and not only the salesman but the manufacturer suffers also. And furthermore it is proof positive that the buyer didn't know his business.

Just suppose you have some automobile cylinders to machine. You know there are several ways to do it, and you will, if you are wise, consult both the reading and advertising columns of the *American Machinist* for information as to which method is best. Then you may send for circulars of those machines which seem likely and await the siege of salesmen which you know this will bring forth.

What you want is information and not salesmanship. And if salesmanship persuades you to buy the wrong machine, if Jones gets the order because he's a good fellow or you know his wife's sister, or he belongs to your lodge, you admit unknowingly that you are not on to your job. You really ought to know which machine is best and order it without bothering a salesman or having a salesman bother you.

If you need information about the different machines to decide which is best for your work, considering range of work, convenience, price, etc., the maker should be able to supply it easily. His engineers should know its various applications and give you clear and concise data on similar work to yours.

The engineers who handle such problems are being called sales engineers. But if they know when they are wise they will keep the engineering side uppermost. They should by all means give the prospective customer all the information possible as to what the machine will do and how it will handle his particular work. But when they go beyond this they are telling the customer how to run his own shop, and this is sometimes a ticklish operation.

It's one thing to make him see that your machine is best for his purpose, but it's quite a different proposition to tell him his notion of mechanics is all wrong, that he wants a vertical machine instead of a horizontal, or vice versa, when his judgment has decided on the other type. Give him good engineering advice if you will, but at least let him think he is deciding for himself.

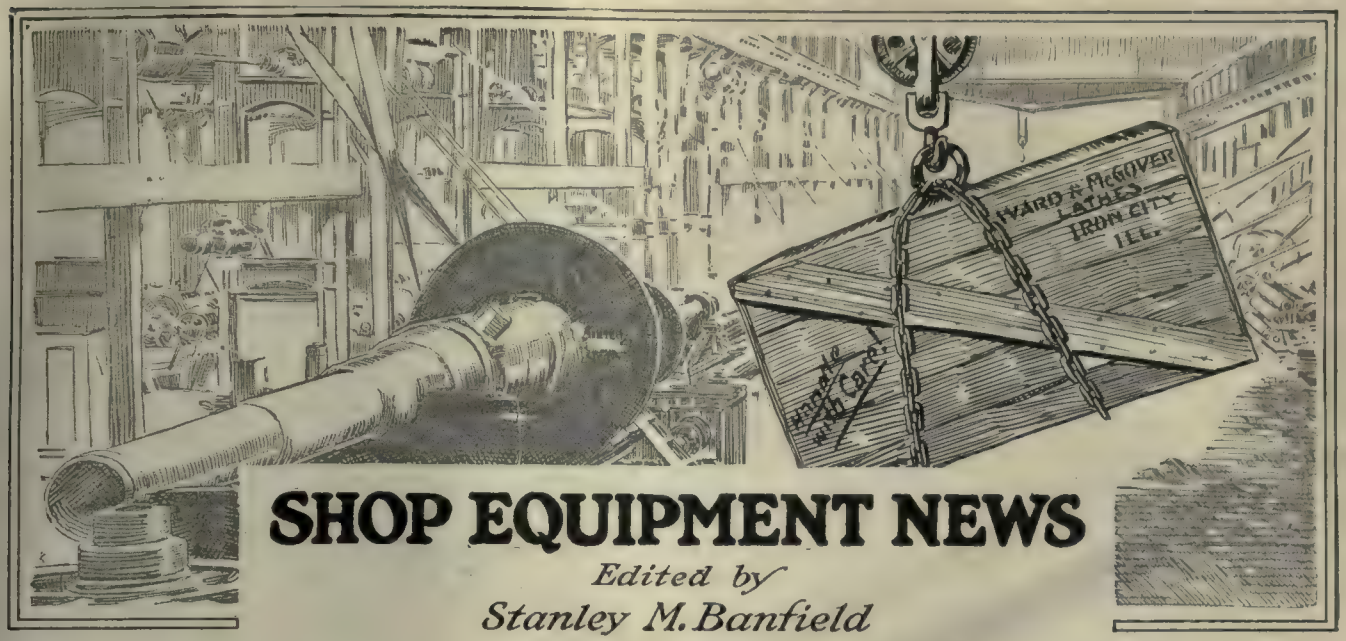
Cost per piece is what counts. If the sales engineer can guarantee a lower net cost than anyone else and back it up he ought to win. But hypnotism and any special brands of salesmanship ought not to count. Just plain horse sense coupled with sufficient information ought to do the trick. Don't ever try to sell a man something he doesn't want.

A Use for Broken and Worn-Out Drills

By Oscar Craft

Discarded drills of any size can be successfully used for end-milling and bottoming out keyways; in fact they may be used anywhere an end mill will serve. They will cut better than the regular end mills generally used. Grind the end same as a bottoming drill and relieve the spiral flutes of drill to a cutting edge.

The drills must be short and stubby. Round-shank drills I use in a taper sleeve with a straight-bored hole and slit in at least three places. An assortment of bushings cut in halves completes this equipment so that when the tapered sleeve is driven into the spindle it will grip the shank firmly.

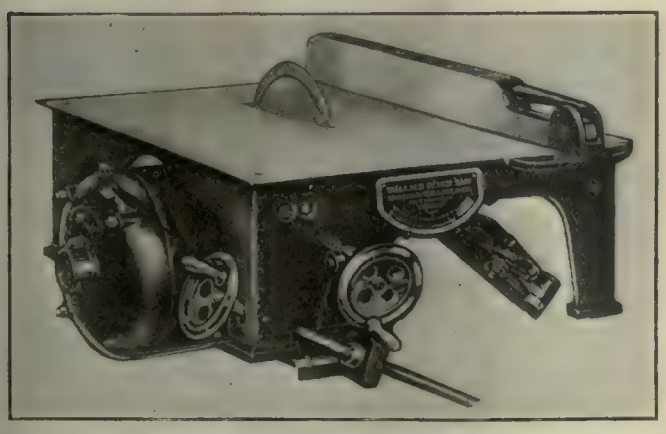


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Wallace Bench Saw

The motor-driven bench saw shown in the illustration has just been placed on the market by J. D. Wallace & Co., 1401 West Jackson Blvd., Chicago, Ill. The device is intended for light pattern, cabinet and carpenter work, and is operated by a ½-hp. electric motor that can be connected to the regular lighting circuit, the saw being portable in order that it may be moved to the most convenient position. The saw is particularly valuable where angular cuts have to be made, as it can be tilted to cut at the desired angle, which is claimed to be much more convenient than the usual

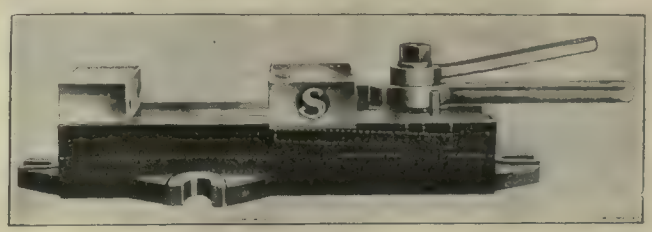


WALLACE PORTABLE BENCH SAW

method of tilting the table. The tilting mechanism is controlled by the handwheel at the left, which tilts the saw through a screw mechanism, giving an accurate adjustment to various angles as indicated on the graduated scale shown at the front of the machine. The saw is raised or lowered by means of a second handwheel which can be seen at the front. The cross-cut fence is built into the saw and is mounted on a rod located beneath the table, it being possible to swing the fence off the table when it is not needed. With the cross-cut fence set to an angle and the saw also tilted it is possible to cut at both angles in one operation, the operator working on a table, which is in a horizontal position, and the stock being guided by the rip fence. The saw is geared directly to the motor, which prevents any belt trouble or slippage, the motor swinging with the saw when this is tilted. The machine is shipped in a heavy frame standard that can be used as a saw bench after uncrating.

"Supreme" Quick-Action Vise

The Spafford Tool Works, 10 Hoadley Pl., Hartford, Conn., are now marketing the "Supreme" quick-action vise shown in the illustration. It is made for general machine-shop use on milling machines, grinding machines or for other uses where a quick-action vise is desirable, and in four sizes with jaw widths of 3, 4, 5 and 7 in. respectively. All steel parts are of drop-forgings or bar stock and are hardened and ground to size while the base is scraped to fit the slide. All



"SUPREME" QUICK-ACTION VISE

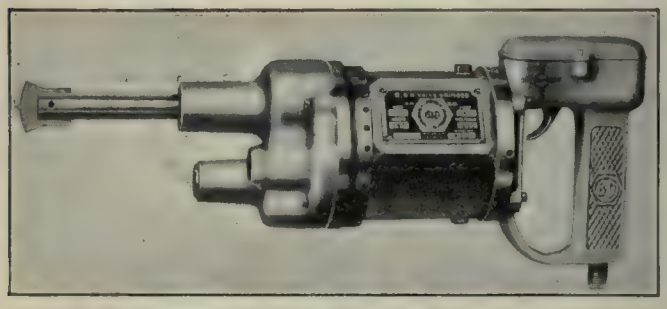
Made in four sizes, with 3, 4, 5 and 7-in. jaws and openings of 2⅝ in., 3⅜ in., 4¼ in. and 6½ in. respectively; jaw heights of ¾ in., 1¼ in., 1⅜ in. and 1½ in. and total heights of 2¼ in., 3⅛ in., 3⅝ in. and 4¼ in. respectively.

parts so far as possible are made to gages to insure interchangeability. A stationary jaw is let into a recess in the semisteel base in order to prevent it from changing position. The bolt holes for clamping the loose jaw to the stationary jaw are so located that they may be conveniently tightened without coming into contact with the bumper block. The pin which the cam lever works against in opening the vise is so located that when the vise is fully opened the lever slips past the pin, thus avoiding breaking the pin

or elongating the hole in the base. The hardened slide is smooth on the top without any serrations for dirt to get into, the levers being held in place by means of a bolt in a T-slot, the under side of which is made at an angle. The bolt head is also made at the same angle, thus giving it a wedge shape and preventing slippage in a backward direction. The sliding jaw is operated by a cam lever, which draws it tight against the work, while the eccentric lever gives the final tightening.

Black & Decker Electric Valve-Grinding Machine

The motor-driven, poppet-valve grinding machine shown in the illustration is being manufactured by the Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md. The construction is such that the spindle oscillates with a long, steady sweep similar to the movement obtained in grinding by hand, but much more rapidly, a pistol grip and trigger switch

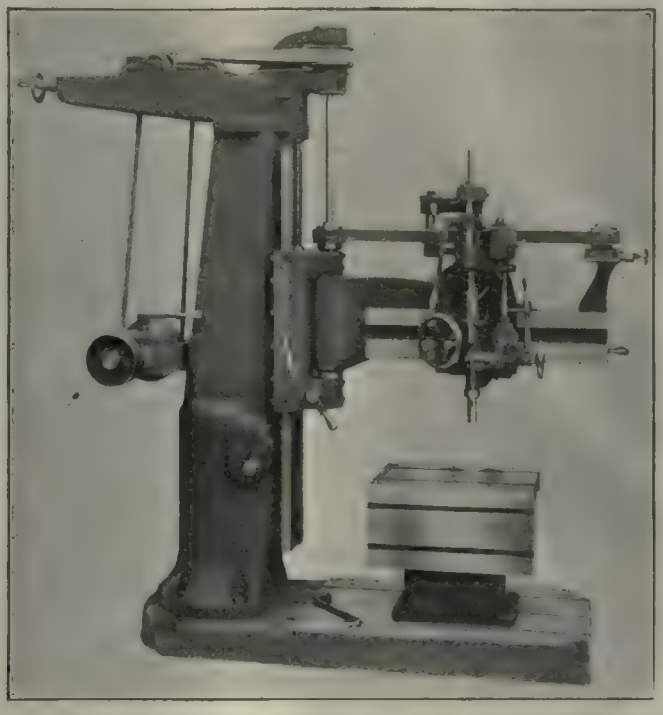


MOTOR-DRIVEN VALVE-GRINDING MACHINE

being incorporated to provide for convenience in operation and control. The motor is of ⅛ hp., air cooled, and operates on standard power circuits of 25 to 60 cycles alternating current or on direct current. It is made in voltages of 32, 110 and 220. The motor and gearing for the reciprocating motion are completely inclosed in an aluminum housing, the gearing being separated from the motor compartment and packed in grease. The grinding spindle has a ball thrust bearing, the armature shaft runs on Norma ball bearings and the gears are mounted on shafts ground to size and supported at both ends in long phosphor-bronze bushings. A number of bits are provided to make the tool adaptable to various types of valves.

"Avey" Radial Drilling Machine

The Cincinnati Pulley Machinery Co., Cincinnati, Ohio, is now marketing the "Avey" sensitive radial drilling machine shown in the illustration. The machine is ball bearing throughout and is said to incorporate a number of new and novel features that have not been previously employed in the design of sensitive radial drilling machines. It is regularly supplied with plain hand feed and tapping attachments, but power feed can be supplied if this is desired. The spindle has a vertical rack feed of 8 in., and is provided with a No. 2 Morse taper in nose, giving a drilling capacity up to $\frac{2}{3}\frac{3}{2}$ in. The machine illustrated has a 2½-ft. arm and takes 48 in. under the spindle. Six spindle speeds are obtainable, three being obtained through the open belt running on cone pulleys and three additional ones through back gears on the countershaft of the machine. On the power-feed machine four rates of feed are provided by means of a gear box located conveniently on the side of the head. The work may be held either on the table or on the base of the machine, both of which are provided with T-slots, the table also having



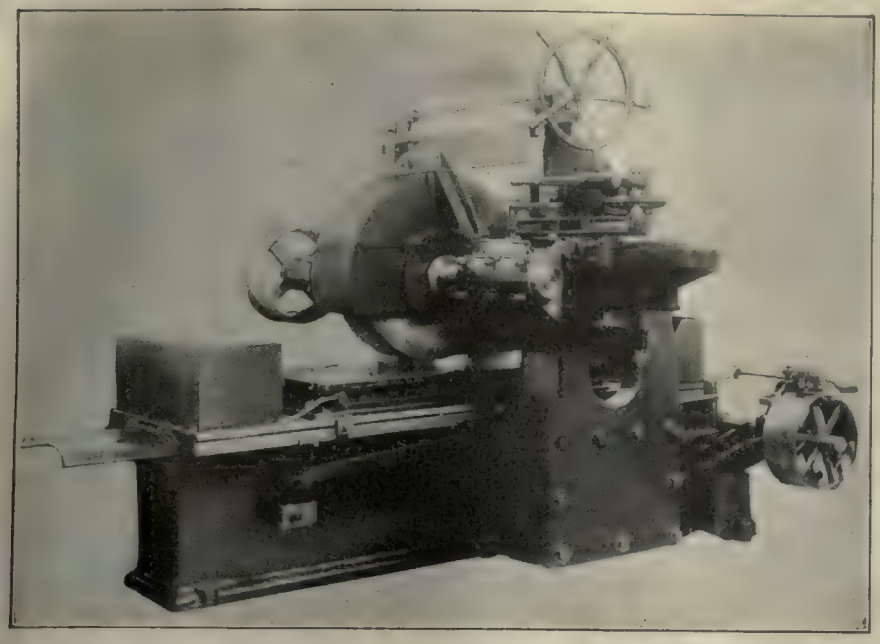
"AVEY" SENSITIVE RADIAL DRILLING MACHINE

Length of arm, 2½ ft.; distance from nose to spindle, 48 in.; spindle speeds, six, three with open belt and three with back gears on the countershaft; speeds on power feed machine, four, obtainable through gear box located on side of head; vertical feed of spindle, 8 in.; taper in spindle nose, No. 2 Morse.

a finished side supplied with T-slots. The arm is raised or lowered by means of a crank placed on the shaft projecting from the lower part of the column. A scale and adjustable stop are placed on a spindle sleeve to enable drilling to a fixed depth.

Springfield Heavy-Duty Oscillating Surface-Grinding Machine

The Springfield Manufacturing Co., Bridgeport, Conn., is now marketing the heavy-duty, oscillating, surface-grinding machine shown in the illustration. The particular machine shown is equipped with a regular sandstone for grinding steel lithographing plates, but it can be equipped with an emery wheel for other types of work if desired. The size of the wheel is 36 in. in diameter with 10-in. face, and the work is held on the machine shown by a large magnetic chuck. The machine is of substantial construction, the drive to the table being by means of bevel gears and a screw-reversing device the same as is customarily used on planing machines. The wheel and wheel spindle are carried in heavy and substantial slides fitted to the saddles on the faces of the uprights, and when the machine is in operation the wheel oscillates across the work as this passes under it. The oscillatory motion is accomplished by means of the crank and connection shown at the right side of the machine. The lever



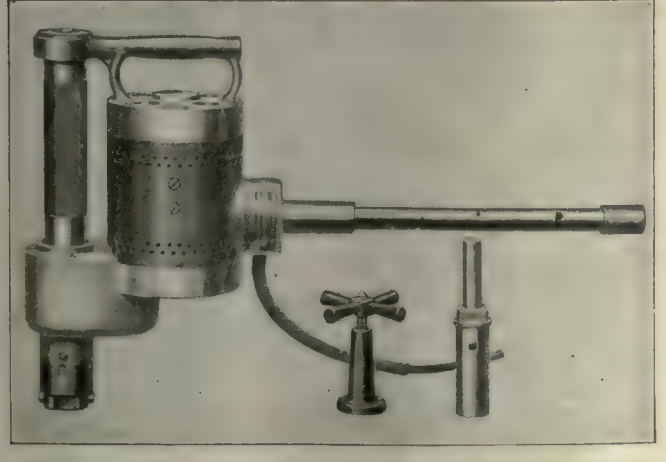
SPRINGFIELD HEAVY-DUTY SURFACE-GRINDING MACHINE

Size of wheel, 36 in. in diameter, with 10-in. face; capacity for work on table, 26 in. wide by 60 in. long; approximate weight, 13,000 pounds

just above the connecting-rod operates a clutch engaging the bevel gear which drives the oscillating motion, and this can be connected or disconnected at will, so that the wheel will travel in a straight path when doing the final finishing work. The table is inclosed with guards to take care of the splash, and will hold pieces up to 26 in. wide and 60 in. long. The weight of the complete machine is approximately 13,000 pounds.

McKay Bolt, Nut and Lag Screw Driver

The George C. McKay Co., 4247 Greenlee Ave., Cincinnati, Ohio, has just placed on the market the automatic nut, bolt and lag screw driver shown in the illustration. It is stated that the machine will drive nuts and bolts from $\frac{1}{2}$ to $\frac{7}{8}$ in. in diameter to a dead stop, meaning by this that they will be driven down as tight as they can be pulled with a 3-ft. hand wrench. The device is driven by an electric motor, the spindle running at 60 r.p.m. under full load. The total weight is 29 lb. and the motor is equipped with an automatic burn-out device that protects the motor against over-loading the machine beyond its capacity. The device is a part of the armature shaft and consists of a sliding clutch held in position by a spring. When any overload is applied to the machine, either by trying to make it do too heavy work or by any of the parts breaking, the clutch partly disengages, and in doing so strikes against a switch and shuts off the current in exactly the same manner as is done by pulling off the switch by hand. The device is wholly mechanical in action and it not dependent upon any electrical connections for its successful operation. After the device shuts off the current all that is necessary to start the machine again is to pull the switch out and then push it in. There are no fuses to be burned out. In using the device, when the nut is driven home the automatic device shuts off the current, thereby making unnecessary the judgment of the operator as to the time of shutting off the current. It is also claimed that the device is useful in tapping holes, spot facing, driving portable bars, reaming, line reaming, drilling, cutting threads and other such usages. The motor is reversed by merely turning the switch handle from left to right as required, making it possible to either drive or remove bolts and nuts.

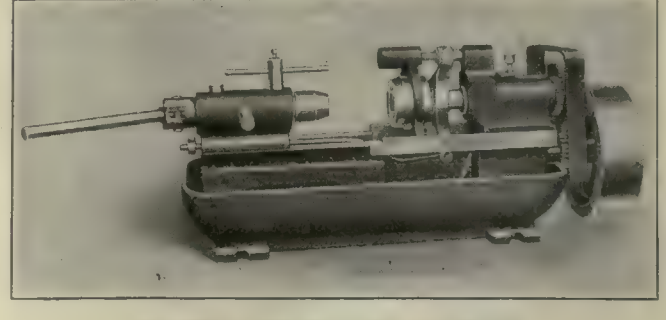


McKAY AUTOMATIC NUT, BOLT AND LAG SCREW DRIVER

Weight, 29 lb.; spindle speed under full load, 60 r.p.m.; bearings on armature and gears, S.K.F. ball type; thrust bearing on spindle, S.K.F.; spindle equipped with internal square, $1\frac{1}{4}$ in. and external square, $1\frac{13}{16}$ in.; height from tip of spindle to top of machine, 17 in.; total length to end of handle, 26 in.

Eastern Threading Machine

The threading machine shown in the illustration is being marketed by the Eastern Machine Screw Corporation, Truman and Barclay Sts., New Haven, Conn. The machine is designed for threading work which cannot readily be threaded on the automatic screw machine or such work as it is not desirable to thread on an automatic machine. It is equipped with a self-opening die head, and with a spring collet or expanding arbors for holding the work. The oil pump and countershaft are incorporated so that the machine is in reality a complete unit in itself. The work held in a collet is tightened by moving the lever on the end of the carriage. The work is then fed to the die head and when the desired length of thread has been cut the die head automatically opens and the carriage is moved

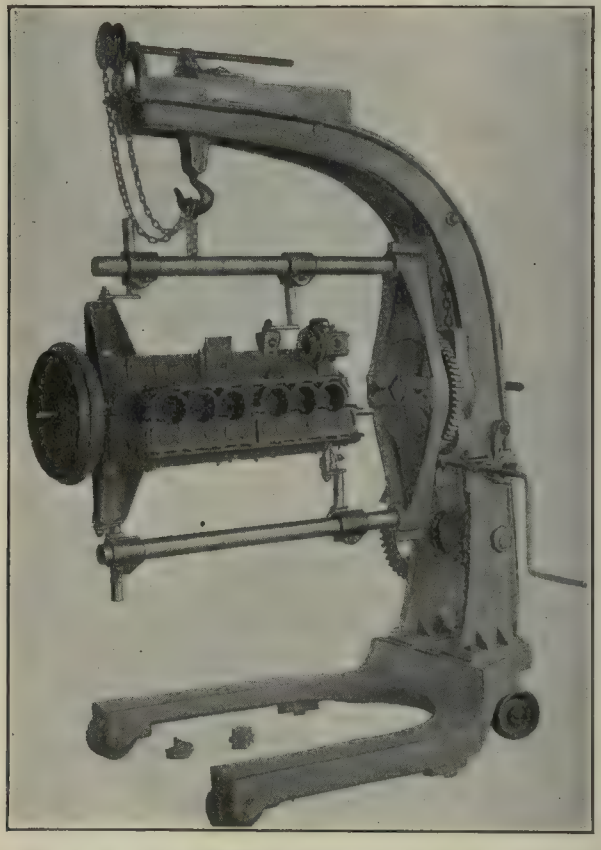


EASTERN THREADING MACHINE

back by hand. The length of thread cut is determined by the adjustable stop shown on top of the carriage. The present type is made in one size which will cut standard threads up to ¾ in. in diameter and fine threads up to 1 in. in diameter. The machine is intended to be placed on a bench and occupies very little space in comparison with other machines used for the same purpose.

Canton Floor Crane with Gasoline Engine Stand

The Canton Foundry and Machine Co., Canton, Ohio, has just placed on the market a portable floor crane and hoist shown, which is equipped with a special type of engine stand for the quick and economical handling of repair jobs on automobile engines. With this device



CANTON PORTABLE FLOOR CRANE WITH SPECIAL TYPE GASOLINE ENGINE STAND

the engine can be removed from the chassis, hooked on the motor stand and then moved to any part of the shop where the work can be most conveniently done. It is also possible to turn the motor into the best position to obtain the desired lighting. The hoist has a capacity of 2 tons with a clearance or lift of 6 ft. 2 in. The crane is equipped with Hyatt roller bearings.

International Thread-Gage Grinding Machine

The International Thread Gage Co., 100 W. 23d St., New York, has developed a simple and efficient grinding fixture for finishing thread gages. The machine is portable and can be used on a table or bench in whatever position desired. Power for driving the grinding

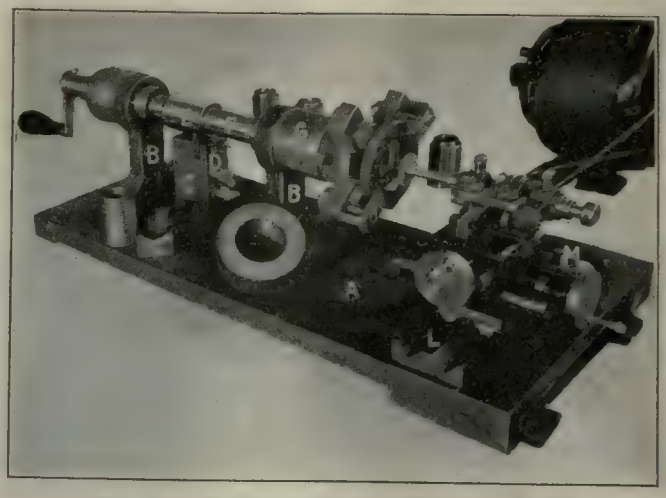


FIG. 1. GRINDING A RING THREAD GAGE

wheel is furnished by an independent motor of about ⅛ hp., which can be attached to any convenient electric lamp socket. A machine, set up for grinding an internal gage, is shown in Fig. 1, while in Fig. 2 may be seen the same machine with chuck for holding an external gage. The only thing that is changed is the chuck.

In the following description like letters will refer to like parts as far as they can be made to apply. A base casting *A* has three brackets bolted to it, the two brackets *B* carrying hardened and ground steel bushings which form the bearings for the shaft. The bracket *C* carries a vertically adjustable member *D*, in the top of which is a clamp for holding the bronze nut which engages the master, or lead, screw *E*.

The slide *D* and the clamp are provided with wing nuts so that the master nut may be adjusted to a perfect bearing against its screw. The shaft *F* is a piece of mild steel carefully ground to a fit in the steel bushings. It is provided at one end with means for attaching chucks for holding different kinds of work, while at the other end a crank is shouldered onto the shaft and held by a taper pin lightly pressed into place with the fingers.

The master screw *E* is held to the shaft by four small headless setscrews, and to change from one to another it is necessary only to loosen these screws, take out the taper pin that holds the crank, and slide the shaft partly out of the machine toward the front.

On the outer end of each bearing bushing is threaded a dust cap *G* which protects the bearings from dust and abrasive. A removable cover *H* (shown only in Fig. 2) sits over the brackets and incloses everything between them when the machine is in use.

Master screws and nuts are provided for each pitch that the machine is intended to handle. One of each

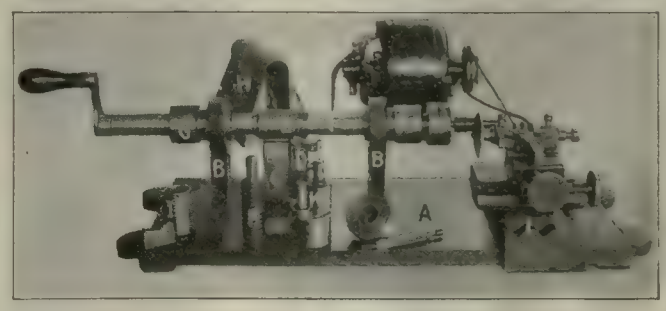


FIG. 2. GRINDING A PLUG THREAD GAGE

may be seen at *I* and *J* respectively. Samples of work are shown in each view at *K*.

At *L* a cast-iron block with a double V-groove in its upper surface is attached by screws and dowels to the bed, the axial line of the grooves being at a right angle to the center line of the shaft *F*. The wheel-carrying fixture is a standard slide rest regularly manufactured for the market by the Waltham Watch Tool Co., and is held in the grooved block by a bolt and strap *M* so that it is but the work of a second to change its position or remove it entirely. Means are provided to tilt the wheel arbor to an angle complementary to the helix angle of the thread to be ground.

For dressing the grinding wheel the slide rest is removed to the fixture shown in Fig. 3, for which the same bed and slide block are used but without the brackets. Instead a block *N* of steel, hardened and ground, is mounted on a suitable pedestal of cast iron, the whole being firmly attached to the base casting.

Two rectangular pieces of tool steel *O* are so mounted on block *N* as to swing on studs near the back end and are clamped in position by screws *P*. A $\frac{5}{16}$-in. standard plug *Q* fits in a hole at the front of the block. The exact relative position of the pivots on which the slideways *O* turn and the hole for the plug *Q* being known it is a simple matter to compute the angle from the sine which is measured with a micrometer over each slideway in turn and the central plug. The plug

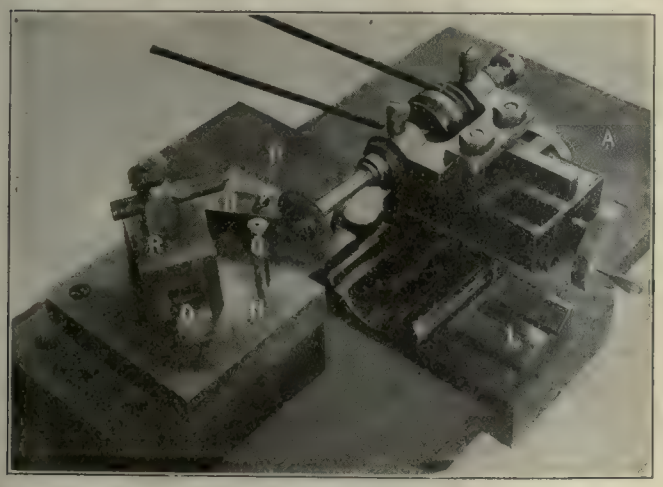


FIG. 3. DRESSING THE GRINDING WHEEL

is of course removed during the actual operation of dressing the wheel.

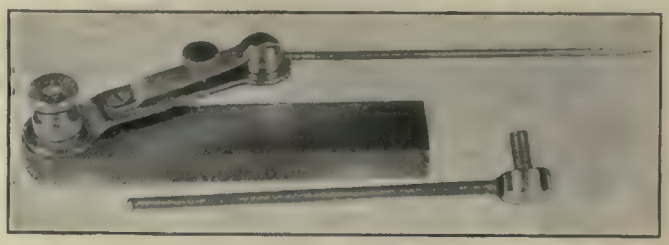
The slideways *O* are ground to parallelism and to known dimensions. The slide *R* carrying the diamond fits over the slideways *O*, and by turning it end for end it may be used on either side of the wheel without altering the set of the diamond. Adjustments of the wheel position are of course obtained by the movements of the slide rest.

Though any machine may be used for grinding any form of gage within its limits by changing its holding fixture and master screw the machines are so simple and comparatively inexpensive that it is good policy to keep one always set up to handle each kind of gage.

The machines are about 3 ft. long by 1 ft. wide and will stand 8 or 10 in. in height, not including the chuck used for holding large rings. Its weight is approximately 150 pounds.

Bush Universal Indicator

T. Daniel Bush, South Allentown, Penn., has just placed on the market the universal indicator, or wiggler, shown in the illustration. The device is adapted for use in any size of machine where work must be set



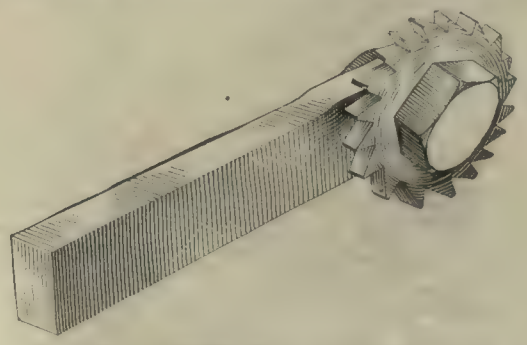
BUSH UNIVERSAL INDICATOR

up to given lines or layouts. The device consists of a base holding an arm which in turn holds the ball-headed needle. The arm is held to the base by means of spring tension adjusted by the knurled head screw at the left, while the tension on the ball head of the needle is controlled by the knurled head screw at the right of the arm; the needle being held by spring pressure will move before force enough to break it is applied. In case it is desired to use the device with a surface gage a rod is provided having a screw at its end, the entire device being substituted for the regular base. This attachment is shown in the foreground.

Milling Cutter for a Thread Tool

By A. A. Karcher

The sketch shows a toolholder in which an ordinary milling cutter is used for cutting threads. This design was prompted by having to cut an 8-pitch square thread to very close dimensions and accurate lead. Circular form tools are not practical owing to lack of side clear-



MILLING CUTTER FOR A THREAD TOOL

ance, and individual form tools are too expensive, as they have to be worked over and ground every time they are sharpened in order to maintain correct size.

This tool was first used for cutting an 8-pitch square thread for which we used a $\frac{1}{16}$-in. milling cutter. Since then it has been used to cut various sized square and acme threads. In a square thread you have only to find a milling cutter of the required thickness. In acme threads a cracked milling cutter or one with several teeth broken out can be circular ground to the required form and used.

This tool is comprised of but three parts, the holder, the screw, and the nut. After one tooth becomes dull the nut can be loosened and the next one turned up into position. In this way sharpening is avoided.



Sparks from the

The Airplane Will Become Peace-Time Utility

Engineer Loening Sees No Difficulty in Designing an Airplane That Will Travel 200 Miles an Hour

The war is hardly over and already progressively inclined minds are studying the feasibility of making the airplane a utility. Enough money and ingenuity have been spent on the war airplane during the last 10 years to make it a thoroughly reliable conveyance.

At the convention of the Society of Automobile Engineers, concluded in New York, Grover C. Loening, an aeronautical engineer of wide experience, undertook to answer the question of how airplanes can be used in peace time. He stated that during the war so much valuable experience has been accumulated that there is no reason why airplanes should not be introduced more generally. Airplanes can be made attractive to business men because they would be great time savers, especially in traveling distances exceeding about 60 miles.

Mr. Loening does not think that flying will soon become popular merely for the pleasure of flying, the comforts not being sufficiently attractive as yet. The noise of the exhaust of the engine and of the propeller are rather disagreeable, flying is not healthy for weak nerves, long trips are tedious and uncomfortable and the exhilaration expected is not realized. Exhaust, oil and cold rush of air are encountered and the seating space available is very scant.

Auto Preferred for Short Hauls

For hauls up to 60 miles the automobile will continue to have the preference because of its ability to stop at every curbstone. When it comes to greater distances the airplane has to compete with railroad train and boat. Since it is rather more expensive to use the airplane it must offer sufficient inducement in the way of speed, so as to cut down the traveling time in going from office door to office door. So long as landing fields are quite distant from office buildings an airplane trip would usually involve an automobile trip also, hence the distance from city to city should occupy little time.

In order to compete with train time Mr. Loening figures the airplane should be capable of developing a speed of 100 miles an hour, and if its speed is raised to 150 miles a complete trip will in many cases require but half as much time as when going by train. Thus, he says, a business man could leave his home in New York at 8 a.m., arriving in Washington at 10.30, leave Washington at 2 p.m. and arrive at his office at 4.30. Evidently the faster the airplane the more attractive and valuable will it be in the eyes of the man whose time is worth considerable money.

Mr. Loening says a three-seated monoplane tested at Dayton, Ohio, recently made 150 miles an hour. A European scout is reported to have made 160 miles, while a standard De Haviland four makes about 120 miles an hour.

Mr. Loening sees no great difficulties in designing a three-seated plane with a 400-hp. engine that will travel up to 200 miles an hour. He believes people will be willing to put up with considerable inconvenience just as they do in the New York subway, for example, to save time.

Why then should not the business man be willing to suffer some inconvenience in order to save an hour or more on a day's trip? Thus, it is argued that speed is the factor which will make the airplane a real utility.

* * *

The Coming Victory Loan

The Fifth, and possibly the last, of the loan drives, will begin on Apr. 6. No information as to the amount has yet been received, but it is rumored that it will be as large as any that has gone before.

America has demonstrated to the world that it can put across anything it undertakes, and when the Fifth loan drive is started it should be the passion of every real American to see it through to a successful finish.

Distributes Bonus on Salaries

The H. W. Johns-Manville Co., miner and manufacturer of asbestos and allied products, will distribute to all salaried employees, men and women, from heads of branches and departments to office boys, who have been in continuous service for the year 1918, an extra compensation of 20 per cent. on the salaries paid them during 1918. This extra compensation will cost the company approximately $1,000,000.

Aerial Service Is Planned from Australia to London

Prominent business men of Sydney, Melbourne and Adelaide, under the leadership of Reginald Lloyd or London, have formed a company with £10,000 ($48,665) paid-up capital for the purpose of developing an aerial route for mail and passenger service between Australia and London.

The purpose of the company is to explore the proposed route for landing sites, which are to be approximately 300 miles apart. The route is to be from Sydney or Melbourne direct to Port Darwin in northern Australia, from which point there will be a 300-mile sea trip across to the island of Timor in the Dutch East Indies, thence from island to island through Java and Sumatra to Singapore and Calcutta, across India to Karachi, thence to Bagdad and Port Said, from which point the choice of several developed aerial routes to London may be made.

In the near future Mr. Lloyd will lead a surveying party from Australia through the Dutch East Indies, the Malay States, India and Mesopotamia for the purpose of locating landing sites and to arrange for their lease or purchase. The organization of the present company is merely to provide for the expenses of this routeing party. After the completion of this survey it is proposed to finance a company in London to operate the aerial service to Australia which contemplates a complete journey in 150 hours between London and Sydney.

* * *

Locomotives and Cars Shipped During 1918

According to figures made public by Walker D. Hines, Director General of Railroads, there were 2622 locomotives shipped to railroads under federal control for the year ended Dec. 31, 1918. Of this number 744 were constructed under orders of the Railroad Administration, while 1410 were contracted for prior to the Government's operation of the transportation facilities.

In the total were 200 Russian decapods, constructed for the Russian government, but these were never delivered, the situation which arose in that country necessitating a change in plans.

For the calendar year 1918 there were 700 passenger cars delivered to class 1 railroads and for the same period there were 40,850 freight cars delivered. Of freight cars built during the year 15,250 were classified as standard Railroad Administration cars. Of the total number of freight cars delivered, 8663 were built in railroad shops.

World's Industrial Forge

By E.C.Porter, News Editor

Portable Shops Sent Abroad During the War

The Corps of Engineers purchased and shipped abroad three types of portable shops, each containing about 800 different tools and equipment and mounted on a 5½-ton truck. There were in all 95 of these portable shops.

The portable machine shop contains a work bench, drilling machine, portable electric drill, grinding machine, electric hammers, 14-in. lathe, power plant, switchboard and oxyacetylene-welding outfit with tools and supplies.

The portable blacksmith, plumbing and tin shop contains a work bench, forges, hoists, pipe-threading machines, shearing and punching machines, vises, welding and cutting outfit, power plant and switchboard, tools and supplies.

The portable carpenter shop contains boring machines, drilling machine, bench grinder, work bench, saw bench, double-purchase winch, power plant and switchboard, tools and supplies.

In addition there were 30 5½-ton material trucks, each containing 600 items of tools and supplies.

The complete machine shop costs about $9500, the carpenter shop $8500 and the blacksmith shop and material truck $8000 each.

* * *

Russia in Need of Agricultural Machinery and Implements

The value of foreign machinery and implements imported by Russia in 1911 was approximately 50,000,000 rubles. More than half of this amount was imported from the United States. The trade in machinery up to that year had been showing a steady rise.

At present the imports of machinery consist of reapers, binders, mowers, hayrakes, drills and plows. Russia is in need not only of these but also of all other varieties of agricultural machinery and implements. A ready market may be found among the farmers of Siberia for the following implements and machinery: Small kerosene and crude-oil tractors and engines, portable outfits of 2 to 10 hp. barn threshers of small capacity, burr-stone mills, farm wagons, cream separators, pumps, etc. Sales may be augmented through cooperative and commercial distributing channels and the coöperative farmers' associations.

What is proposed is to establish showrooms in Vladivostok for the display of American agricultural machinery and implements, where types of American machinery and implements may be displayed and demonstrated before customers, official experts, special commissions and all interested persons. The exposition and demonstration of American machinery and implements that are particularly adapted to the needs of this country would open a field of business the extent of which it is impossible even to approximate at this time. Almost daily inquiries are received from the remotest regions of this country requesting information as to where various kinds of American machinery may be inspected. So great is the interest that representatives of the farmers' coöperative association throughout Siberia visit Vladivostok with the expectation and hope of finding and having demonstrated American machinery and implements. The only thing that can be done at present is to supply catalogs, which it can be readily seen rarely answer the purpose of a purchaser.

The Russo-American Committee will coöperate in every way to assist the American manufacturers in introducing into Siberia American agricultural machinery and implements and *Russian Pacific Trade Expansion* will lend its columns for advertising.

Who Am I?

I am more powerful than the combined armies of the universe.

I have destroyed more men than all the wars of the world.

I am more deadly than bullets, and I have wrecked more homes than the mightiest of siege guns.

I spare no one, and find my victims among the rich and poor alike; the young and old; the strong and the weak. Widows and orphans know me.

I loom up to such proportions that I cast my shadow over every field of labor, from the turning of the grindstone to the moving of every train.

I massacre thousands upon thousands of wage-earners in a year.

I lurk in unseen places, and do most of my work silently.

You are warned against me, but you heed not.

I am relentless. I am everywhere; in the home, on the street, in the factory, at railroad crossings and on the sea.

I bring sickness, degradation and death, and yet few seek to avoid me.

I destroy, crush or maim. I give nothing but take all.

I am your worst enemy.

I AM CARELESSNESS!

* * *

Metal Trades Convention to Be in New York

The National Metal Trades Association will hold its 21st annual convention at the Hotel Astor, New York, on Apr. 23-24. The annual alumni dinner, the meetings of the executive committee and of the administrative council will be on Apr. 21. The gathering of the secretaries and the joint meeting of the branch presidents, secretaries and administrative councils will be held on Apr. 22.

Form Material-Handling Association

Technical Studies to Be a Leading Activity—Port and Terminal Problems to Receive Particular Attention

Following the suggestion of the Department of Commerce and the United States Shipping Board an association of manufacturers of machinery for handling materials has been formed and offices have been opened at 35 West 39th St., New York. The suggestion was made by the two Government agencies because of the need for intensive study of freight-handling methods at railroad and ocean terminals. By mobilizing the experience and ability of all manufacturers of handling devices in a single organization the Government will not only be able to reach this industry in an effective way when it needs coöperation, but the industry itself can more effectively attack the large and difficult problems presented at terminals and ports.

In general the lines of work—technical, educational, promotional, etc.—will parallel those of other trade associations, but the nature of the problems will require more extensive technical committee work than is customary in such bodies.

The active conduct of the association's work will be in the hands of Zenas W. Carter as secretary and manager. Mr. Carter was formerly commissioner of the Associated Metal Lath Manufacturers and previously field secretary of the Granite Paving Block Manufacturers' Association.

The following companies have come together in the work of forming the organization and are now constituting themselves a membership committee to complete the charter membership of the association: Watson Elevator Co., Edward F. Terry Manufacturing Co., International Conveyor Corporation, Rownson, Drew & Clydesdale, Inc., New Jersey Foundry and Machine Co., Hayward Company, Elwell-Parker Electric Co., Sprague Electric Works, Otis Elevator Co., Manning, Maxwell & Moore, Inc., Robins Conveying Belt Co., Michener Stowage Co., New York; Shepard Electric Crane and Hoist Co., Montour Falls, N. Y.; Brown Portable Conveying Machinery Co., Chicago; Karry-Lode Industrial Truck Co., Long Island City, N. Y.; Whiting Foundry Equipment Co., Harvey, Ill.; Wellman-Seaver-Morgan Co., Cleveland, Ohio; Alliance Machine Co., Alliance, Ohio; Alfred Box & Co., Inc., Philadelphia, Penn.; Meade-Morrison Manufacturing Co., East Boston, Mass.; Alvey-Ferguson Co., Cincinnati, Ohio; Heyl & Patterson, Inc., Pittsburgh, Penn.; American Hoist and Derrick Co., St. Paul, Minn.; Cleveland Crane and Engineer-

ing Co., Wickliffe, Ohio; Clyde Iron Works, Duluth, Minn.; Ohio Locomotive Crane Co., Bucyrus, Ohio; Northern Engineering Co., Detroit, Mich.; Electric Controller and Manufacturing Co., Cleveland, Ohio.

* * *

Cranes and Hoisting Engines Developed for War Work

Seven hundred cranes, mostly of the locomotive type, and 886 hoisting engines of various types and sizes were purchased for the use of the Engineer Corps at a cost of $4,996,000. About two-thirds of this equipment was sent to France and used in unloading materials at the ports of debarkation and on wrecking cars and trucks. The remainder was used in loading materials at ports of embarkation in this country. Without the use of these cranes the rapid shipment of materials and troops to France and the speedy release of vessels for the return trip could not have been accomplished.

The use of the larger cranes, which were developed for this special service and used both in this country and in France, permitted the loading and unloading of 97-ton consolidation locomotives completely assembled. thus avoiding the delay in putting them in service which would have resulted from shipping the separate parts and having them assembled on the other side.

* * *

New Opportunities for Men Disabled by War Service

The gates of hope are open for young men who seem to be hopelessly handicapped by the loss of limbs or other disabilities. Veterans of this war will not be social cripples and dependent pensioners, but rehabilitated, self-reliant and self-respecting men. That was the purpose of the framers of the vocational rehabilitation act passed by Congress last June and carried into effect by a Government agency, the Federal Board for Vocational education at Washington.

Every man discharged from the Army or the Navy should know of the opportunities offered him. Friends should point out to him that if he is entitled to compensation from the Bureau of War Risk Insurance, he is entitled also to the services of the Federal Board for Vocational Education. The board will assist him in finding suitable employment.

While he is in training his family continues to receive the usual allotment, his tuition and other expenses incident to his training are paid and he is given at least $65 a month for subsistence. If his last month's pay was more than that amount he may receive an amount equal to it. When he has finished his training course a job is ready and waiting for him probably, due to his newly acquired skill, at higher wages than he ever before earned. His compensation from the War Risk Insurance Bureau is in no way affected by what he may or may not earn.

American Gasoline Saved the Allies in Crisis

Deliveries at the Front Alone Prevented Change in Campaign, Official Documents Show

How deliveries of American gasoline in quantities on the western front alone prevented alterations in the plan of campaign which forced the Central Powers to an armistice is revealed in official documents made public by the United States Fuel Administration.

Less than 60 days before the armistice was signed, it was disclosed, the



situation hung in the balance—just when the American people were accustoming themselves to their voluntary relinquishment of Sunday automobile rides, and the observation of "gasolineless Sundays."

But for this and other sacrifices and the stimulation and direction of production what might have happened was indicated in a blunt cablegram from Marshal Foch saying simply:

"If you don't keep up your petroleum system we shall lose the war."

A still more serious cable was received Oct. 1. It said in part:

"Senator Berenger writes: 'Highest command informs him that position has become so serious that change in military operations will have to be contemplated unless increased deliveries gasoline at front are made possible.'"

United States Furnished 80 Per Cent.

Eighty per cent. of the allied requirements of petroleum products, the Earl of Curzon pointed out in a statement made Nov. 21, was furnished by the United States, and Walter H. Long, British Secretary of State for the Colonies, sent special thanks for the work of the fuel administration in providing oil and for the activities of the American oil industry.

Of this fuel, of which the American people supplied four-fifths, Senator Berenger declared: "Petroleum will have played as great a part in the victory as blood itself, and will have proved the life blood of victory," and Sir John Cadman, British petroleum executive, used identical words, writing: "Oil fuel was the life blood of the navy."

Appreciations of America's splendid and successful efforts to provide this "lifeblood" on land and sea also were received from E. D. Hewan, oil executive of the British Ministry of Shipping; Camillo Ceruti, of the Italian military mission, and other high officials among the allies.

The shipment of gasoline and other petroleum products so promptly and in such large quantities was made possible only by the patriotic efforts of the petroleum industry working through the National Petroleum War Service Committee in harmonious coöperation with the Fuel Administration.

* * *

Civilians Wanted to Teach Trades to Disabled Soldiers

The employment of additional civilians to teach trades and manual arts in the reconstruction wards and shops of Army hospitals at $50 a month, with quarters and subsistence provided, or $62.50 a month additional in lieu of quarters and subsistence is authorized by Surg.-Gen. M. W. Ireland.

Considerable difficulty has been met with in obtaining a sufficient number of instructors for the hospitals, and the Surgeon General has directed that every effort be made to find officers or enlisted men qualified to teach. These may either be transferred to the Medical Department and remain in the service, or, without transfer, be assigned to such duty.

Teachers of the following subjects are needed: Ordinary school subjects; agriculture, market gardening; carpentering; cabinet-making; motor mechanics; patternmaking; gas engineering; shorthand; typewriting; stenotyping; drafting; telegraphy; printing; shoe repairing; mechanical engineering; machine work; electrical work; leather work; sign painting; and physical education. Experienced vocational advisers are also required.

* * *

German Writer Praises American Machine Tools

In his analysis of the machine-tool industry in Germany Walter Waldschmidt writing in the Berlin *Börsen-Courier* pays tribute to the quality of American tools and expresses some anxiety concerning the ability of Germany to successfully compete in this field after the war. Throughout his discussion Mr. Waldschmidt speaks of machine tools when he often means not only the tools but also the special machines necessary for their manufacture.

According to him, when in 1890 the rapid industrial development of Germany had caused a heavy demand for tool-making machinery, it was apparent that the United States manufactured the best machines and the best machine tools. In fact, said he, "American superiority was then so great that I doubted whether Germany could complete with any success. Machine tools are one of the best, if not the best, of America's products."

Personals

CHARLES D. ELLIS, who has been with the Hart-Parr Co., Charles City, Iowa, for the past 15 years, has been elected president to succeed A. E. Ellis, deceased.

H. H. HENRY, president of the Dart Truck and Tractor Corporation, Waterloo, Iowa, has become vice president and general manager of the Maxim Munitions Corporation, New York.

THEODORE R. HERMANSON, formerly with the Harrison Works of the Worthington Machinery Corporation, has become works manager of the Epping-Carpenter Pump Co., Pittsburgh, Penn.

EDWARD W. DODGE, for many years connected with the Norton Co., Worcester, Mass., as sales manager, has been made general sales and works manager of the Star Corundum Wheel Co., Detroit, Mich.

GUSTAVE HUETTE, Sheboygan, Wis., founder and for many years president of the Falls Machine Co., now the Falls Motors Corporation, Sheboygan Falls, Wis., has disposed of his final holdings in the company and will retire.

W. H. RAISBECK of H. Boker & Co., Inc., New York, has opened a sales office at 447 Book Building, Detroit, Mich., and expects to open a new warehouse in that city, carrying a complete stock of tool steels and specialties.

LESTER E. ARMSTRONG has accepted a position as advisory engineer with the Powdered Coal Engineering and Equipment Co., Chicago. Prior to his service in the air branch of the Army Mr. Armstrong was associated with the Babcock & Wilcox Company.

A. C. OLFS, formerly Eastern representative of the Titanium Bronze Co., has been appointed Michigan representative for the Stewart Manufacturing Corporation, Chicago, maker of die castings. A sales office has been opened at 1509 Kresge Building, Detroit.

A. H. WILLEY, Reliance Steel and Tool Co., New York, plans to sail on Feb. 19 for a few months' trip to Great Britain, France, Spain, Italy, Holland, Belgium and Scandinavia. He is planning to establish reciprocal trade relations, involving thus both import and export business.

B. F. GEYER, formerly general sales manager of the Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has been elected vice president and general manager of that company. E. J. GALLMEYER, formerly manager of the Memphis district, assumes the duties of general sales manager.

EDWARD A. MILLER has been made assistant superintendent of the Jersey City plant of the Metal and Thermit Corporation, New York. Some of Mr. Miller's former connections have been with the Essex Foundry, Newark; Pioneer Iron Works, Brooklyn; Standard Aniline Products, Inc., Wappingers Falls, N. Y., and the National Conduit and Cable Co., Inc., Hastings-on-Hudson, N. Y.

ALFRED H. BARTSCH, for more than seven years advertising manager of the Bosch Magneto Co., and more recently representing several firms in the automotive industries in Philadelphia as merchandising and advertising counsel, has joined the staff of the American Bosch Magneto Corporation as general sales and advertising manager.

W. F. ROBERTS, general manager of the Sparrows Point, Md., plant of the Bethlehem Steel Co., and HOLDEN A. EVANS, president of the Baltimore Dry Docks and Shipbuilding Co., Baltimore, are among the members of the board of directors of the Export and Import Board of Trade recently formed for the purpose of increasing foreign trade at Baltimore.

Obituary

GEORGE K. GARVIN, president of the Garvin Machine Co., Spring and Varick Sts., New York, died at his home in Garden City, Long Island, on Thursday, Feb. 20. Mr. Garvin was 60 years old. Further particulars of his death will appear in next week's issue.

ALBERT M. CRANE, well known in the iron and steel industry, died recently of pneumonia. He had been ill only three days. For years he was general sales manager of the Illinois Steel Co., later becoming chairman of the executive committee of the American Steel and Wire Co.

New Publications

Steam Engines. By E. M. Shealy. Two hundred and ninety 6 x 9-in. pages; 173 illustrations; bound in green cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price, $2.50.

This book on steam engines was written to be used as a textbook for correspondence students in the University of Wisconsin Extension Division. It is the third of a series of three textbooks designed for students who are pursuing a general course in steam engineering, the other two books being "Steam Boilers" and "Heat." In this course the aim is to teach the fundamental principles underlying the operation of the steam engine and to do this in as simple and nonmathematical a manner as possible. This is particularly true of those parts which deal with thermodynamic principles. Enough of the practical features of steam-engine operation is given to illustrate the principles, and operating engineers who may take this course will be able to supplement from their own experience other applications of the principles presented. The part of the book dealing with valve gears has been made more complete than other sections because the experience of the author shows that operating engineers as a rule do not understand the valve-gear mechanism of their engines as well as they do other parts.

The different chapter headings are: Principles of the Steam Engine; Corliss and other Engines; Parts of the Steam Engine; Heat, Work and Pressure; Properties of Steam; Indicators; Indicated and Brake Horsepower; Action of Steam in the Cylinder; Steam Engine Testing; The Slide Valve; The Valve Diagram; Valve Setting; Shifting Eccentric and Meyer Valve; Reversing Mechanisms; Corliss Valve Gears; Governing; Compound Engines; Condensing Apparatus; Lubrication; Steam Turbines.

Business Items

The Merchant Calculating Machine Co., San Francisco, has moved its Eastern sales office from Philadelphia to Chicago, Ill.

The Carrie Gyroscopic Corporation, formerly of 216 William St., New York, has moved to larger quarters at 62 West 14th St., New York.

At the annual meeting of the stockholders of the Peck & Young Manufacturing Co., New Britain, Conn., held recently in Forestville the old board of directors was reëlected as follows: A. W. Bowman, J. M. Carney and S. M. Stone of Hartford; W. E. Fogg, of Bristol; I. D. Russell and W. L. Humason of New Britain, and L. C. Humason of Farmington.

The directors of the Traut & Hine Manufacturing Co., New Britain, at the annual meeting of the stockholders recently elected the following officers: President and treasurer, George W. Traut; vice president, Frank L. Traut; secretary, Henry E. Hine; general superintendent, Ernest N. Humphrey. Henry S. Walter is also a member of the board of directors reëlected.

Edward R. Ladew Co., manufacturer of Ladew leather belting, with factory and general offices at Glen Cove, N. Y., announces important changes in its Southern organization made with a view to more active efforts in the South. O. S. Horton has been appointed manager of the Southern branch with headquarters at Charlotte, N. C., and territory covering all states south of Maryland, West Virginia, Kentucky and Arkansas west to Texas. Walter Carr, formerly of the New York office, is assistant branch manager. Several new salesmen have been added to the organization, and a large stock of Ladew belting will be carried at the Charlotte office and disposed of through distributers located in this territory.

Several important changes were made at the annual meeting of the directors of the Stanley Works, New Britain, Conn., which succeeded the annual meeting of the stockholders of the concern held recently. These changes embrace the naming of Walter H. Hart as second vice president, Ernest W. Christ as secretary, and Patrick F. King as assistant secretary. The stockholders elected the following directors: William H. Hart, L. Hoyt Pease, George P. Hart, E. N. Stanley, E. A. Moore, F. G. Platt, C. F. Bennett, F. S. Chamberlain and A. W. Stanley. The directors at a subsequent meeting recently elected the following officers: Chairman of the board of directors, George P. Hart; president, E. Allen Moore; first vice president, C. F. Bennett; second vice president, Walter H. Hart; treasurer, L. Hoyt Pease; secretary, Ernest W. Christ; assistant treasurer, L. W. Young; assistant secretary, P. F. King.

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34.60	$37.60
Northern Basic	31.80	34.80
Southern Ohio No. 2	32.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	39.55
Southern No. 2 (silicon 2.25 to 2.75)	39.95	41.70
BIRMINGHAM		
No. 2 Foundry	31.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	39.15*
Virginia No. 2	35.10†	40.50†
Basic	33.90*	36.90*
Grey Forge	33.90*	36.90*
Bessemer	.....	39.10*
CHICAGO		
No. 2 Foundry Local	31.00	34.50
No. 2 Foundry Southern	37.25	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	35.40
Basic	30.00	34.40
Bessemer	33.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For ⅝-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	3.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.22	6.445	5.75	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.12	6.35	5.65	6.35	6.12	6.35
*Nos. 22 and 24 black	4.55	6.07	6.07	6.295	5.60	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.02	6.245	5.50	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.37	5.645	4.95	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.27	5.545	4.85	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.17	5.445	4.75	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.57	7.695	7.15	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.27	7.395	6.85	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.12	7.245	6.70	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
3/32, 11/32, 3/16, 1/4, 7/32, 5/16 No. 8, 3/32 and No. 10 1/8 No. 12 5/32, No. 14 and 1/16 No. 18 No. 20	25.50 to 33.00	3/16 by 12 in. long	14.00
		1/4 by 19 in. long	12.00
		5/16 by 19 in. long	10.00
		1/2 by 21 in. long	10.00
		Special Welding Wire, Coated	
		1/8	33.00
		5/32	30.00
		1/16	38.00

Domestic 20c. for 1/16, 15c. for 1/8 to 5/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
1/8, 1/4, and 3/8	47%	20½%	3/4 to 1¼	36%	20%
1/2	51%	36½%			
3/4 to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	43%	25½%	3/4 to 1¼	36%	21%
1/2	48%	35½%			
3/4 to 1½	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
3/4 to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	23%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	17.00	20.50	23.50
Tin in 5-ton lots	72.50	72.00	85.00
Lead	5.10	5.75	7.00
Spelter	6.85	7.85	8.00
ST. LOUIS			
Lead	4.80	5.45	6.85
Spelter	6.50	7.50	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	24.50–27	29.00	31.50–33	30.00	32.50	32.00	36.00
Copper wire (carload lots)	25.00–28	28.00	32.00	32.00	28.50	28.50	34.50
Brass sheets	23.75–28	29.00	30.75	32.00	29.00	29.00	35.50
Brass pipe	34.00–37	37.00	36.50	36.00	35.50	37.00	41.50
Solder (half and half) (case lots)	38.00–41	41.00	62.00	41.50	47.00	39.00	48.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$20.50	$25.25
New York	21.50	26.25
Cleveland	27.00	30.00
Chicago	28.50	37.00

March 6, 1919 American Machinist Vol. 50, No. 10

Electric Welding of High-Speed Steel and Stellite in Tool Manufacture

By P. T. VAN BIBBER
Sales Engineer Thomson Electric Welding Co., Lynn, Mass.

Every user or buyer of cutting tools will be interested in this article, which shows a practical way to save an enormous amount of high-speed or other steel which is wasted annually. It also shows how new tools may be produced so as to use the high-priced steel only for the vital parts.

THE cost of solid high-speed cutting tools at the present time is very high. At the same time their remarkable cutting qualities make them a necessity in up-to-date shop practice. The electric process of butt-welding has made it possible to obtain all the advantages of a solid high-speed cutting tool and yet at a cost that is not a great deal higher than the ordinary tool-steel product. Stellite, which has recently become more widely known, has been rather limited in its use owing to the fact that it cannot be machined, and it has been thought by many that it could not be successfully joined to any other metal for holding it. This has limited its use to special forms of toolholders, which are often very clumsy in getting into difficult corners on special shapes. The electric process of butt-welding has made it possible to join Stellite bits of any common size and shape to a shank of ordinary steel, giving all the advantages of a solid cutting tool and yet employing only a small amount of the Stellite metal just where it is needed for cutting.

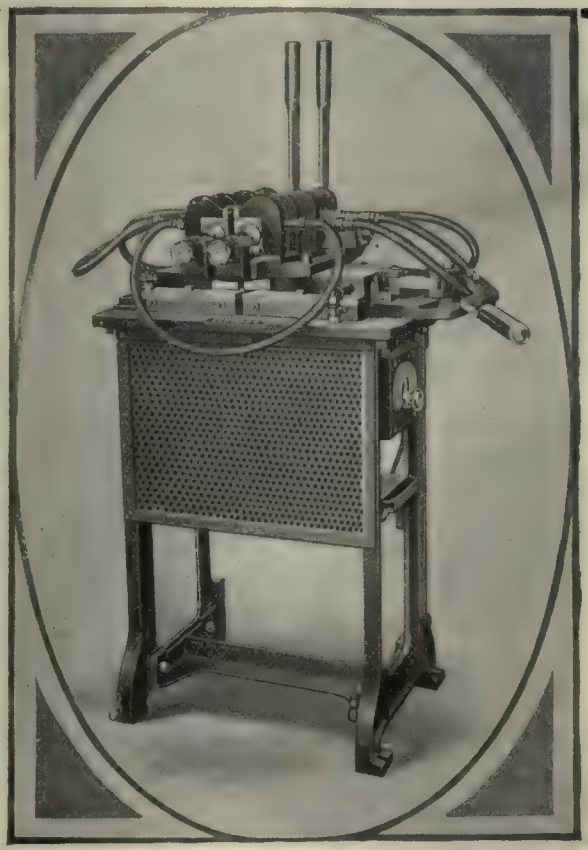


FIG. 1. THOMSON 10-A6 BUTT-WELDING MACHINE

The Thomson welding process consists of passing a large volume of electric current at a low pressure through the joint made by butting two pieces of metal together. The electrical resistance of the metals at the contacting surface is so great that they soon become heated to a welding temperature. Pressure is then applied mechanically and the current turned off, thereby producing a weld. The metal is in full view of the operator at all times instead of being hidden by the coal of a forge or by flame in an oil furnace. No smoked glasses or goggles are required any more than would be if welding by the forge method. Due to the way the metal is forced together there is no oxidation such as there would be in an open fire and therefore no welding compound is ordinarily required. It is this feature alone which makes it possible to weld high-speed steel and Stellite, the former being very difficult to weld by the forge method and the latter practically impossible. With this process of electric welding the heat is first developed in the interior of the metal. Consequently, it is welded there as perfectly as at the surface. When welding with other methods, however, the outer surface is heated first and very often the interior part does not reach welding heat, the result being an imperfect weld. There is no blistering or burning of the stock when welding electrically, whereas it certainly requires a very expert welder indeed to secure the proper heat on high-speed steel in a forge fire without burning at some point. The process is the most economical known, due to the fact that no energy in the form of heat is being wasted in heating more of the material than is required to make a weld and as soon as it has been completed the current is turned off so that the machine then is not using up any energy whatever. The operator has complete control of the current at all times so that he can obtain any color desired on the metals, which are always visible, and waste by accidental burning of metal is reduced to a minimum.

The only preparation of stock necessary for welding by this process is that when very rusty or greasy it should be thoroughly cleaned, as the presence of either rust or heavy grease affords poor contact with the copper clamping jaws, retarding the flow of electricity and seriously reducing the heating effect.

It is often asked if the electric current has any effect on the welded metal. This question arises from the fear

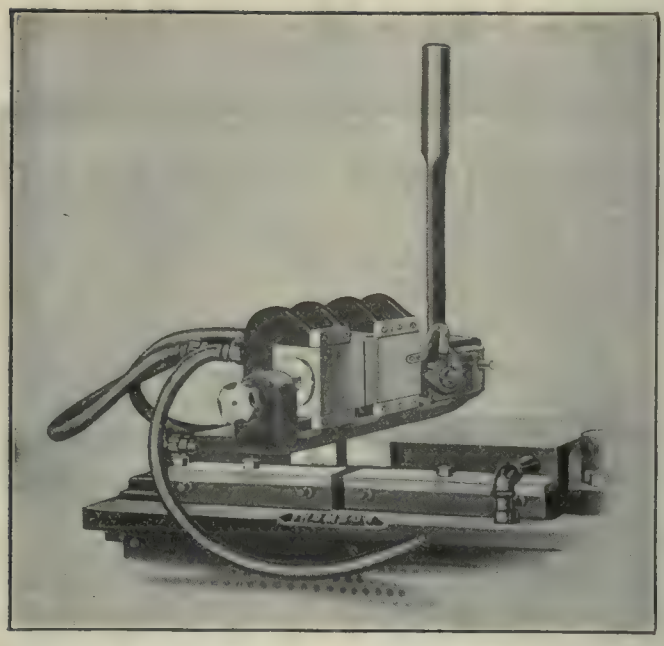


FIG. 2. CLOSEUP VIEW OF LEFT-HAND CLAMP

that there may be some mysterious condition connected with electricity that will change the characteristics of the metal, particularly of high-speed steel or Stellite. The answer is, of course, in the negative, as the only effect of the electric current is to heat the metals being welded.

The rapidity of work will depend largely on the operator, the size and shape of the pieces to be welded and the size of machine being used, as there is a wide range in welding time between heavy pieces requiring careful alignment in the clamping jaws and light pieces which can be rapidly and easily handled. The machines made by the Thomson Electric Welding Co. are designed to get the maximum output at the minimum cost for labor and current. In other words they are high-efficiency machines.

Welding High-Speed to Low-Carbon Steel

In tool welding there are various kinds of welds to be made, which require different designs of holding jaws and often two distinct types of welding machine.

Three butt-welding machines shown in Figs. 1, 3, and 4 are especially suitable for welding drills, reamers or other tools that can be made up of a combination of high-speed and low-carbon steel. The machine shown in Fig. 1, known as the 10-A6 machine, will weld iron or steel rods from $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter, or an equivalent cross-section in squares, rectangles or flats. An operator can make from 50 to 200 welds per hour, according to the size and nature of the work being handled. The clamps are of the horizontal operating type, adjustable for different sizes of stock as well as for horizontal alignment of the work. A close-up view of the left-hand clamping mechanism is shown in Fig. 2. The jaw blocks are water cooled and have a maximum movement of $1\frac{1}{2}$ in. by means of the hand-operated clamping levers. There is also a possible $\frac{3}{4}$-in. adjustment of both front and rear jaw blocks. Stops are provided for backing up the work. There are four copper jaws to a set, two being used on each clamp. These jaws are $2\frac{1}{2}$ in. square by $1\frac{7}{16}$ in. thick. The pressure device for forcing the heated ends of the work together is a hand-lever-operated toggle movement, which enables the operator to "feel" his work. This toggle device gives a movement of 1 in. to the right-hand jaw. The maximum space possible between the jaws is $3\frac{1}{4}$ in. There is an automatic current cutoff mounted on the

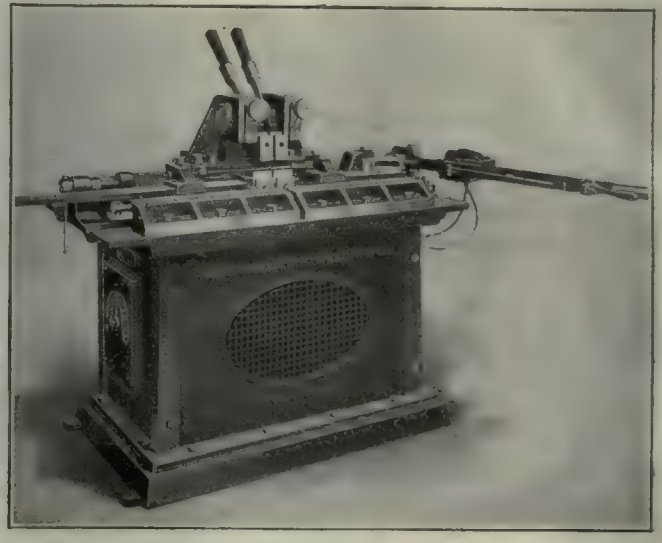


FIG. 4. SPECIAL 5-D MACHINE

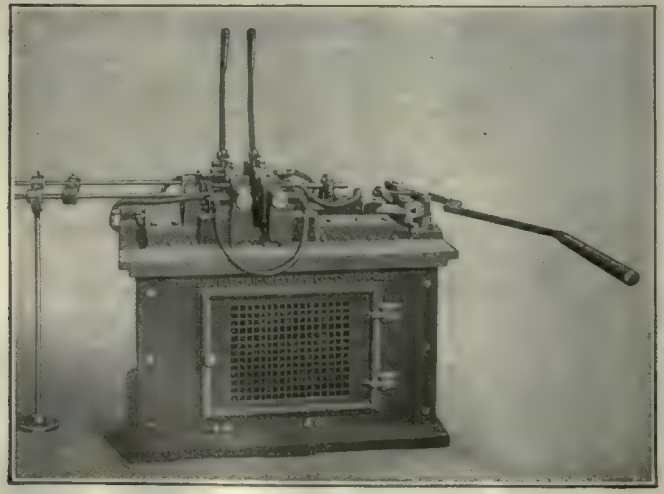


FIG. 3. NO. 6 BUTT-WELDING MACHINE

machine. The standard windings are for 220, 440 and 550 volt, 60-cycle alternating current. The current variation for different sized stock is effected through a five-point switch mounted on the machine. Standard ratings are 15 kw., or 25 k.v.a., with 60 per cent. power factor. This size of machine covers a floor space 43 x 57 in., is 65 in. high and weighs about 1100 pounds.

The machine shown in Fig. 3, or the No. 6 machine, is for heavier work, its capacity being from $\frac{1}{4}$ to 1 in. in diameter on iron or steel rods, or the equivalent in other shapes. Its production is from 50 to 125 welds per hour. The maximum jaw opening is 3 in.; the four jaws are of hard-drawn copper, $2\frac{1}{8}$ x $2\frac{5}{8}$ in. and $1\frac{1}{4}$ in. thick; toggle-lever movement $1\frac{1}{2}$ in.; maximum space between jaws, 4 in.; current standards are the same as for the previous machine. There are 10 points of current variation for different sized stock, effected through double-control switches mounted on the machine. Standard ratings are 30 kw. or 45 k.v.a., with 60 per cent. power factor. The jaws are air cooled, but the copper

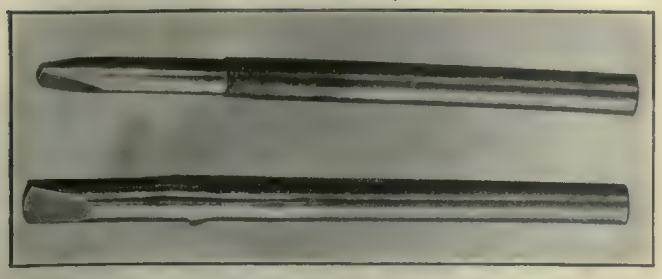


FIG. 5. STELLITE-TIPPED ROUGHING DRILLS

slides to which the jaws are bolted, as well as the secondary copper casting of the transformer, are water cooled. It occupies a floor space 22 x 44 in. and the height to center line of the jaws is 37½ in. The weight is 3100 lb. Its operation is practically the same as the first machine described.

Another machine of very similar characteristics is shown in Fig. 4. This is known as the Special 5-D machine and is intended for the use of makers of small taps and twist drills up to ⅝ in. in diameter. It has very accurate adjustments on the clamps and special jaws with steel inserts to prevent wear. To use these, however, requires that the pieces to be welded must be

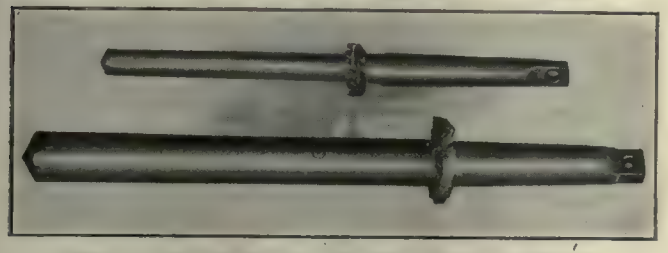


FIG. 6. TWIST-DRILL BLANKS JUST WELDED

finished to uniform size so as to accurately fit the jaws in order to conduct the current properly.

The machines shown in Figs. 1 and 3 are not only good for welding the steels mentioned, but also for Stellite work, samples of which are shown in Fig. 5, since the commonly used bits of this metal are within their range. The hand-lever toggle action is quicker and is better suited to this work than the hydraulic-pressure device used on some of the larger machines.

In welding twist drill or reamer blanks, such as shown in Fig. 6, not over ¾ in. in diameter, it has been found practical to use a pair of jaws on each side that will handle all work from the smallest up to the ¾-in. size. These jaws are made as shown in Fig. 7. The two rear, or movable, jaws on each side of the machine are flat faced, while the front, or stationary, jaws, have a V-groove cut in them just deep enough to give clearance for the smallest size of stock to be handled in contact with the face of the opposite jaw. The work is held in the jaws with a three-point contact, which has been found to be sufficient for stock of this size, although it is not to be recommended for larger work, since not enough current could be carried into the pieces without applying pressure sufficient to squeeze the work into the surface of the copper jaws. This would soon spoil all accuracy of alignment of the V-grooves.

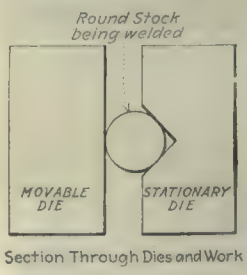


FIG. 7. COPPER JAWS FOR VARIOUS SIZES

In this connection it may be well to mention that a welding machine is not a micrometer and the welding

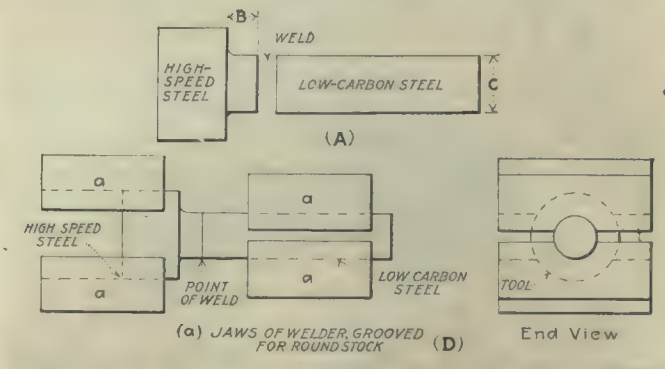


FIG. 8. COPPER JAWS FOR HOLDING LARGE HEADS AND SMALL SHANKS

of finished pieces is not recommended in commercial production, although such welding is done right along for special jobs. By "special jobs" is meant the putting on of an extention to a drill, tap or small reamer and the like.

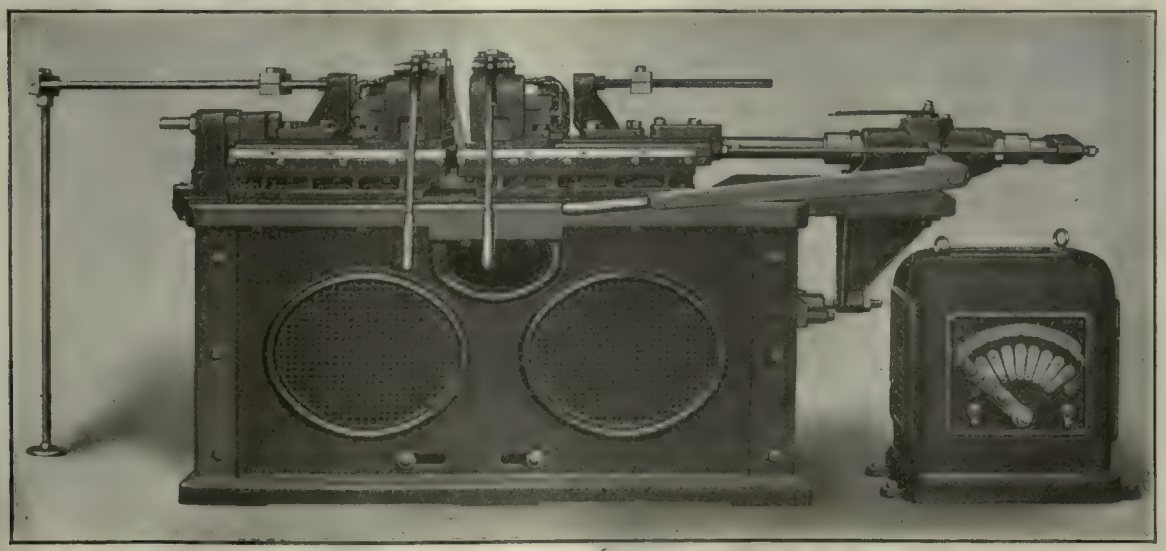


FIG. 9. No. 9 BUTT-WELDING MACHINE

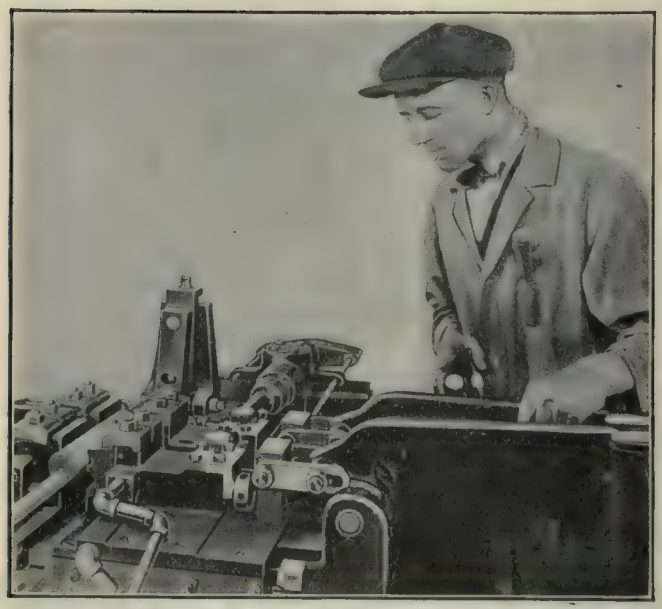


FIG. 10. CLOSEUP OF MACHINE WITH WORK IN JAWS

In welding high-speed to low-carbon steel the low-carbon steel should project approximately twice as far out from the jaws as the high-speed steel does in order to equalize as much as possible the heating of the two pieces.

Where a tool is to be made with a head larger than the shank, as shown at *A*, Fig. 8, holding copper jaws should be made as shown at *D*. In work of this kind the dimension *B* should always be about one-half of the diameter of *C*. The same rule holds good with this type of tool blank when placing it in the jaws as with steel of the same relative size; that is, the low-carbon steel should project about twice as far from the jaws as the high-speed steel since the high-speed steel has the higher resistance and has a tendency to become plastic sooner. To still further reduce its tendency to heat up quickly, the resistance should be reduced as much as possible by having the jaws as good a fit for the high-speed piece as it is possible to make them. Where different sizes are to be welded it is advisable to have special holding jaws for each separate size of high-speed steel head, although the low-carbon steel

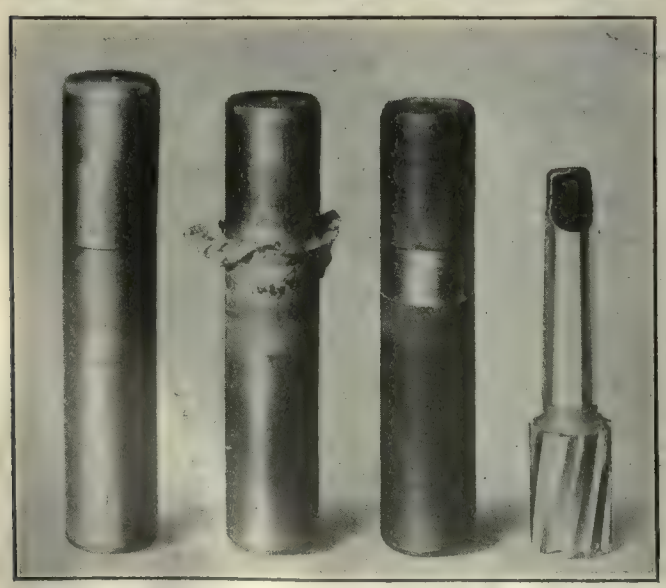


FIG. 11. STEPS IN THE MAKING OF A LARGE REAMER

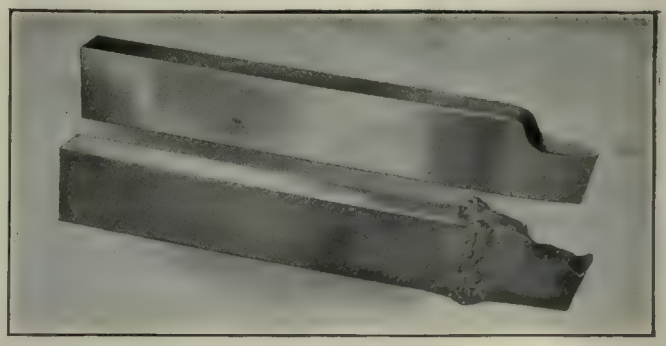


FIG. 12. A WELDED AND A FINISHED LATHE TOOL

pieces may be held in V-grooved jaws made up to hold several sizes. This is the practice of some of the largest makers of reamers and large drills.

The actual use of the machines shown for the work outlined is simplicity itself. The work is placed in the respective jaws and securely locked in place by pulling forward the two levers shown projecting upward on each machine. In addition to the grip of the jaws the work is kept from any possible slip by means of

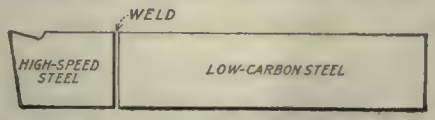


FIG. 13. HOW THE PARTS ARE ARRANGED FOR WELDING

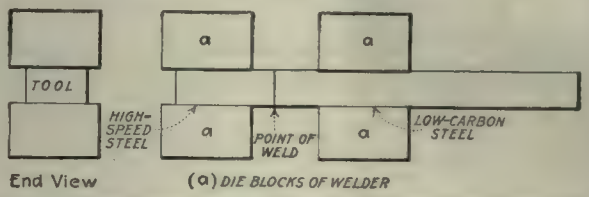


FIG. 14. HOW THE PARTS ARE CLAMPED IN THE JAWS



FIG. 15. METHOD OF PREPARING FOR AN INSERT WELD

stops against which the outer ends of the work are butted. With the work solidly in place the operator pulls on the pressure lever at the right of the machine until the ends of the work are in firm contact. He then turns on the current by means of a push button con-

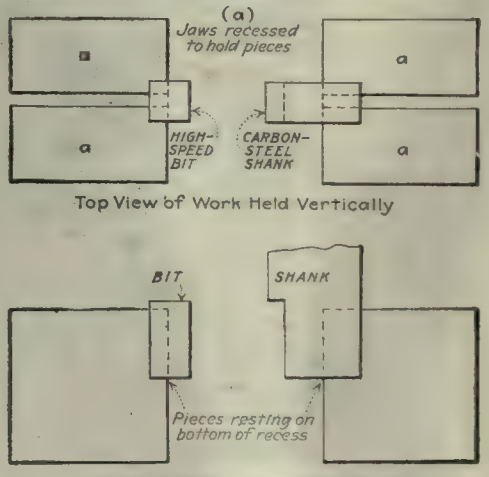


FIG. 16. JAWS USED FOR HOLDING WORK IN INSERT WELDING

veniently located in the pressure lever, and when the proper heat is reached, which is judged by the color, the push button is released. This shuts off the current and the operator then applies full pressure and the weld is made.

The maximum capacity of the largest of the three machines described is 1 in. round or its equivalent in other shapes. For larger work a machine similar to the one shown in Fig. 9 is used. This is known as a No. 9 butt-welding machine, and its capacity is from ½ to 1¼ in.; the output is from 50 to 100 welds per hour; the maximum jaw opening is 1⅞ in.; the four

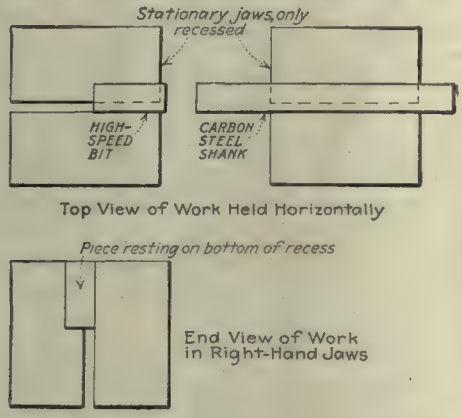


FIG. 17. JAWS USED FOR STELLITE BUTT WELDING

hard-drawn copper jaws are 3 in. high, 3¼ in wide and 1½ in thick; the pressure device is a 5-ton hand-operated hydraulic oil jack; maximum movement with jack, 2 in.; maximum movement with one stroke of jack, ¼ in.; maximum opening between jaws, 4 in.; standard windings the same as for the previous machines; standard ratings, 40 kw. or 55 k.v.a., with 60 per cent. power

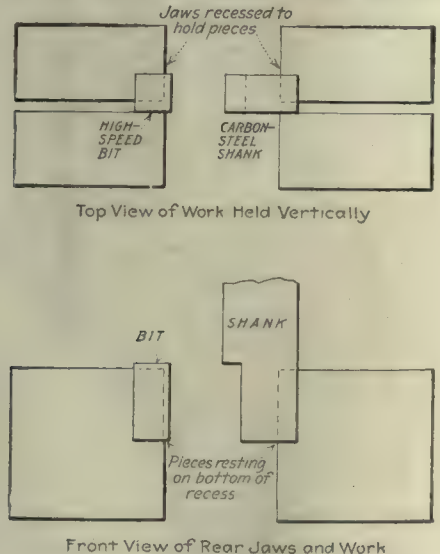


FIG. 18. JAWS USED FOR STELLITE INSERT WELDING

factor; width of machine, 27 in.; length, 60 in.; height, 46 in.; weight, 3900 pounds.

A closeup of this machine, with a large reamer blank in the jaws, is shown in Fig. 10, and progressive steps in the making of the reamer are shown in Fig. 11. The high-speed steel piece is 3 in. long by 1⅝ in. diameter, and the machine-steel piece is 6 in. long.

Two other machines (10-B and 40-A2 models) of this type suitable for heavy tool welding may be mentioned.



FIG. 19. VERTICAL TYPE OF WELDING MACHINE

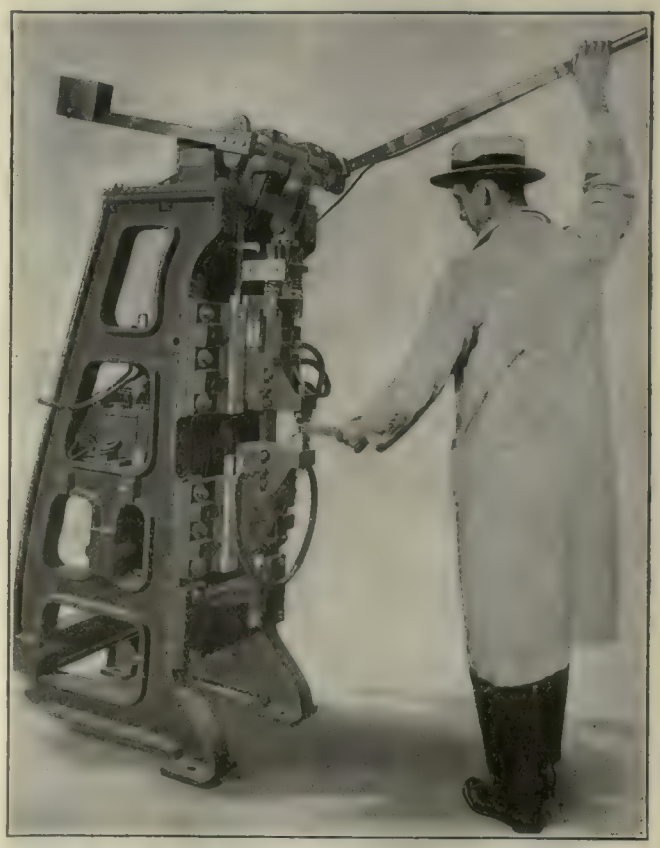


FIG. 20. MAKING A "MASH" INSERT WELD IN A 20-AV MACHINE

They are made with a capacity of from ½ to 1½ and from 1 to 2 in. The first of these has a hand-operated pressure device capable of exerting a pressure of 12 tons and it weighs 7800 lb. The second has a pressure device which receives its initial pressure from an external accumulator, which gives an effective pressure of 23 tons; it weighs 8000 lb. and is 64 x 105 x 48 in. high.

The Welding of Other Than Round Tools

The welding of tools similar to the ones shown in Fig. 12, intended for lathe or planing-machine tools, may be done in any of the foregoing machines. The cutting parts may be of either Stellite or high-speed steel. This kind of welding is usually employed by manufacturing concerns in their own toolrooms in order to

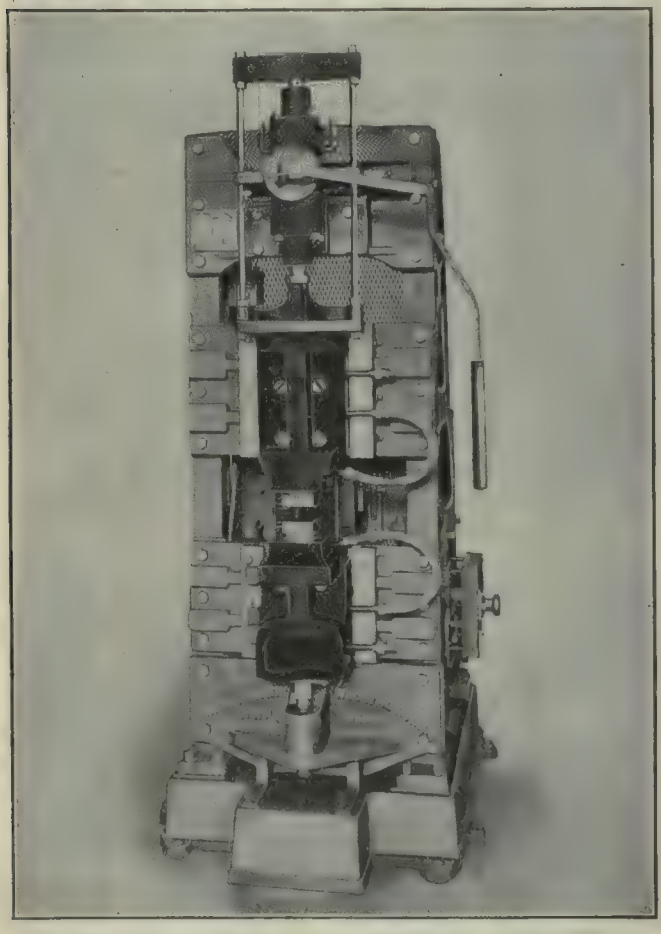


FIG. 21. LARGE 40-AV VERTICAL MACHINE

use up odd bits of high-priced steel or Stellite. The pieces are prepared about as shown in Fig. 13. Jaws for holding work of this kind are outlined in Fig. 14.

Another way to make tools for lathe or planing-machine work is outlined in Fig. 15. This method may often be employed when the one just given could not. As can be seen, in order to properly support the high-speed steel piece, the low-carbon steel shank is milled away to form a recess for the reception of the high-speed steel bit. The welding can be done on any of the machines shown provided the parts are not of too great cross-section. The method of recessing the copper clamping jaws is clearly shown in Fig. 16.

The perfect success of a welded high-speed tool depends not only on the correct welding but also upon the correct treatment after the welding itself has been accomplished. It is easily seen that if a piece of high-speed steel is welded to a piece of ordinary carbon steel and the joint allowed to cool fairly quickly in the air strains will be set up at the joint for the reason that the high-speed steel in cooling so quickly, both metals become hardened more or less but to a different degree.

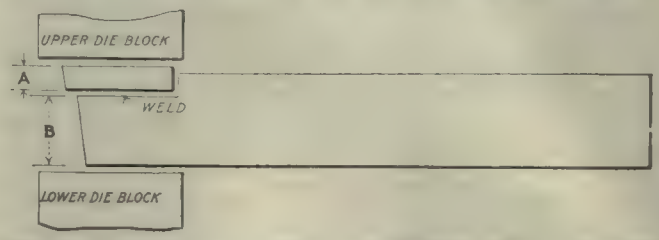


FIG. 22. JAWS AND WORK ARRANGED FOR A "MASH" WELD

Hence if the weld is subjected to any great strain under these conditions it will break either at the joint or close by, due to the strain. *It is therefore very evident that immediately after welding a piece of high-speed steel to carbon steel the work should be immediately put into some sort of furnace to be annealed.* The amount of time that the tools should be left in the furnace for thoroughly heating through and the amount of time required to allow the pieces to cool down to room temperature depend entirely upon the size and character of tool being made. However, the annealing of any piece of any size requires that the work be left in the furnace heated to at least a dull cherry red for a few hours and allowed to cool very slowly in the furnace.

If a welded tool is not properly annealed before machining much difficulty is often experienced from hard spots being encountered in the machining of the pieces, which of course is more or less disastrous to the cutting edges of the tools being used in the machining process.

The best method of hardening high-speed steel tools after the welding and machining depends also greatly upon the shape and size.

Although the welding of the various grades of Stellite is not difficult there is a certain knack in the welding

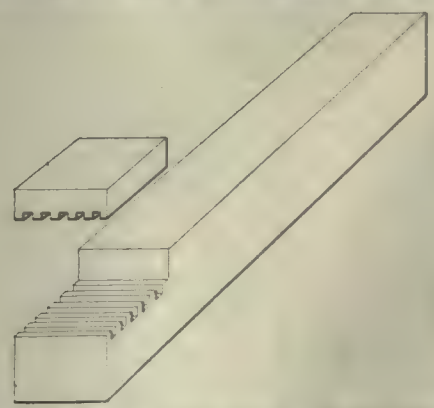


FIG. 23. PIECES GROOVED TO MAKE BETTER WELDS WITH LESS CURRENT

and also in the clamping of the stock which must be fully acquired to produce satisfactory results.

The welding should be done in a horizontal butt-welding machine with a quick-acting hand-lever pressure device. In butt welding round drill stock or rectangular tool stock the pieces should be held as shown in Fig. 17. It will be noticed that the projection of the Stellite beyond the copper jaws is very short indeed while the projec-

tion of the carbon-steel piece is comparatively long. This is because Stellite has a very high resistance compared with the carbon steel. Since in this work the heating effect varies directly with the resistance of two metals the heating in the Stellite should be retarded as much as possible by surrounding it almost completely with the copper jaws. The correct amount of projection of the carbon steel will have to be determined by experiment in each case after observing with each setting of two pieces which has the tendency to heat the fastest.

In welding in cutting bits of Stellite by the insert-weld method the pieces should be held as shown in Fig. 18.

It will be seen from this cut that the copper jaws holding the small bit nearly surround it and at the same time back up the piece to take the pressure of the squeezing up of the stock. The opposite jaws holding the carbon-steel shank do not have to grip very much of the metal but they serve to back it up to receive the force of the pressure.

In the welding itself the current is applied intermittently, as the Stellite usually has a tendency to heat very rapidly until the carbon steel is fast approaching the plastic state. The current is then held on steadily and the instant the Stellite metal "runs," the pressure lever is given a quick jerk as the current is turned off. It will be found that with a good weld there is scarcely any push up of the stock and very little of the metal flows out at the joint, requiring little grinding, if any, to finish the tool.

Unlike high-speed steel Stellite requires no further heat treatment or attention of any kind if it is welded correctly. When it is taken out of the welding machine the tool is ready for use at once after grinding off the resulting bur.

Where large numbers of tools of the lathe and planing-machine types are to be made, such as shown in Fig. 15, the highest production can be obtained by using a vertical type of welding machine built on the lines of the one shown in Fig. 19.

This machine (10-AV model) has a capacity of two pieces with contact areas between 0.40 and 0.30 sq.in. for pieces with a total thickness of ½ to 1¼ in. The production is 35 to 85 tools per hour, depending on the size; the upper and lower jaws are of hard-drawn copper 1¾ x 2¼ in. and 1⅞ in. thick; the jaw blocks are water cooled; the machine has a current variation through a five-point switch for different sizes of stock; standard windings are for alternating current 220, 440 and 550 volt, 60 cycles; standard ratings, 15 kw. or 25 k.v.a. with power factor of 60 per cent.; the pressure device is hand operated, giving a movement of 2¾ in.; maximum space between jaws, 3¼ in.; floor space occupied, 21 x 53 in.; height, 75 in.; weight, 1200 pounds.

A larger machine (20-AV model) of the same type in operation is shown in Fig. 20. This machine gives a maximum area of contact ranging from 1¼ to 1 sq.in. on pieces with a total thickness from 1 up to 2 in.; production is from 50 to 75 welds per hour; there is a throat clearance of 10 in.; the copper jaws are 2 x 3 in. and 1½ in. thick; pressure is by hand-toggle lever and spring cushion; current control, as in the other machines, is by push button in the lever operating through a magnetic wall switch; the jaw blocks are water cooled; standard ratings are 30 kw. or 50 k.v.a. with 60 per cent. power factor; weight, 2200 pounds.

Another still larger machine (40-AV model) is shown in Fig. 21. Except for its size it is but little different from the two just described, the main difference being the hydraulic-pressure device, which gives an effective pressure of 5 tons. This machine has a maximum contact area of 3 sq.in. and will weld pieces from 1½ to 3 in. total thickness; production, 15 to 50 welds; throat depth, 6¼ in.; jaws, 2 x 4 x 1½ in. thick; maximum movement of upper jaw block, 2 in.; movement with one stroke of lever, ⅝ in.; space possible between jaws, 3 in.; standard ratings, 60 kw. or 86 k.v.a. with 70 per cent. power factor; size, 34 x 60 in. by 79 in. high; weight, 3600 pounds.

For welding tools on these machines the relative

TABLE I. CURRENT CONSUMPTION FOR WELDING VARIOUS SIZES

Diameter of rod, inches		Dia. of rod, millimeters	Area of section, sq. in.	Current consumption per 1000 welds	Cost per 1000 welds at 1 cent per K.W.H.*	Diameter of rod, inches		Dia. of rod, millimeters	Area of section, sq. in.	Current consumption per 1000 welds	Cost per 1000 welds at 1 cent per K.W.H.*
Decimal	Fraction					Decimal	Fraction				
.25	¼		.04909	10	$0.10	1.2598		32	1 245	270	$2 70
.2755		7	.0596	11	.11	1.3385		34	1.407	320	3 20
.3125	5/16		.0767	12	.12	1.375	1 3/8		1 4849	340	3 40
.3149		8	.0779	12	.12	1.4173		36	1 576	360	3 60
.3543		9	.0987	14	.14	1.496		38	1 757	425	4 25
.375	3/8		.11045	15	.15	1.5	1½		1.7671	430	4 30
.3937		10	1217	16	.16	1.5748		40	1 946	470	4 70
.4724		12	.1753	19	.19	1.625	1 5/8		2 0739	530	5 30
.5	½		.19635	20	.20	1.6535		42	2 146	540	5 40
.5612		14	.2472	26	.26	1.7322		44	2,356	600	6 00
.625	5/8		.3068	30	.30	1.75	1¾		2.4053	640	6 40
.6299		16	.3115	34	.34	1.811		46	2 576	700	7 00
.7087		18	.3946	45	.45	1.875	1 7/8		2.7612	780	7 80
.75	¾		.44179	52	52	1.8897		48	2 802	810	8 10
.7874		20	.487	60	60	1.9685		50	3 089	870	8 70
.8661		22	.585	80	.80	2.	2		3 1416	930	9 30
.875	7/8		60132	85	.85	2.0472		52	3 286	1000	10 00
.94488		24	.701	105	1 05	2.125	2 1/8		3 5466	1100	11 00
1.	1		.7854	130	1.30	2.1259		54	3 55	1130	11 30
1.0236		26	.822	135	1 35	2.2047		56	3 82	1200	12.00
1.1023		28	.944	180	1.80	2.25	2¼		3.9761	1280	12 80
1.125	1 1/8		.994	190	1.90	2 2834		58	4 095	1350	13 50
1.1811		30	1 094	230	2.30	2.3622		60	4 387	1460	14 60
1.25	1¼		1.2272	265	2 65						

* Multiply these values by the rate you are paying per K.W Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

thickness of the two parts should be about that shown in Fig. 22. Under ordinary conditions the dimension *A* should be about one-third of *B* in order to have the point of the weld nearest the jaw in contact with the high-speed steel, so that the heating effect will be lessened and its fusion point retarded until the low-carbon steel has a chance to heat up properly.

In order to obtain the best results tools wider than 1 in. and with a recess longer than 1½ in. should be grooved as shown in Fig. 23. This reduces the section in actual contact, thereby requiring less current, is easier and quicker to heat and assures a better weld over the entire area of contact.

In order to assist those who have tool or other butt welding to do some useful data are given in Table I.

In Table II is given the proper size of copper wire to use to connect up the various machines mentioned for tool welding.

TABLE II. SIZES OF COPPER WIRE FOR CONNECTING UP DIFFERENT SIZES OF WELDING MACHINES

Type Machine	K.V.A. Demand	220-Volt Circuit		440-Volt Circuit		550-Volt Circuit	
		Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses
10-A6 10-AV	25	No. 4 B. & S.	100 Amp.	No 10 B. & S.	50 Amp.	No. 10 B & S.	50 Amp.
No. 6	45	No. 1 B. & S.	200 Amp.	No. 6 B. & S.	100 Amp	No 6 B. & S.	100 Amp.
20-A10 20-AV	50	No. 1 B. & S.	200 Amp.	No. 6 B. & S.	100 Amp.	No. 6 B. & S.	100 Amp.
No. 9	55	No. 00 B. & S.	350 Amp.	No. 3 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
10-B	75	No. 000 B. & S.	400 Amp.	No. 2 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
40-A2	86	No. 000 B. & S.	400 Amp.	No. 2 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
*40-A2	107	No. 0000 B. & S.	600 Amp.	No. 0 B. & S.	250 Amp.	No. 0 B. & S.	200 Amp.

*With oil transformer

Foreman and Employment Office

BY A. SCHLEIMER

In a factory in which the control of all employees was vested in the employment office a foreman made complaint to that office that one of his men was undesirable and should be transferred or discharged. The employment manager investigated the case, satisfied himself that there was nothing radically wrong with the employee and endeavored to persuade the foreman to reconsider, but the latter was obdurate. Finally the manager said:

"I know from what you say that this man is not doing right—that he is not attending to business—but is he a good workman?"

"Yes."

"If he will overcome his faults, will you be satisfied to keep him?"

"Why, yes."

"Have you taken the matter up with him at all?"

"I have warned him repeatedly, but it does not seem to have any effect."

"All right. Now here is my proposition. If this man leaves it is a mark against your department. It is a bigger mark against me, for it not only increases our labor turnover, but brings my judgment in hiring him into question. You can see why I am as much interested in keeping him as you are, and you also know that I am interested in the efficiency of your department. Now, I will make a bargain with you. Who is the best man, in your department and the one that can be relied on most?"

"Johnson."

"Ever give you any trouble?"

"No."

"All right. Now you send Jones in to me. I will have a talk with him and send him back. You agree to keep him two weeks and promise me that no matter what he does you will treat him exactly as you do Johnson. It is understood between us alone that at the end of the two weeks I will discharge him unless you see fit to request me not to. But remember your promise to treat him just as you do Johnson."

When Jones came in the manager had a heart-to-heart talk with him. He pointed out his faults, showed him that they were due either to carelessness or thoughtlessness, and impressed on him that the foreman was very anxious to keep him in his department, but felt that as his shortcomings were due to a lack of interest in the work his stay there would soon affect the entire department.

Jones admitted that he had not been doing his best, but had an idea that the foreman disliked him personally. The manager convinced him that the foreman bore him no ill-will; that there was nothing personal in the matter at all, and obtained a promise from him to forget it and make a fresh start.

Jones went back to his department, and the foreman, true to his promise, accorded him the same treatment that he gave Johnson. The effect of this was soon apparent. Seeing that the foreman bore no grudge and had evidently forgotten the incident Jones took hold of things in a new spirit, and before the week was out there was an example of teamwork between them that never had existed before.

Needless to say, at the end of the two weeks the foreman reported that he would retain Jones.

"Tell me," said the foreman, "how did you do it?"

"I didn't. You did it yourself. I simply pointed the way, which you followed unconsciously. Your trouble, John, is that you are too hasty. When things go wrong it is more important to know the reason why than who did it. Don't jump to the conclusion that it is carelessness. Be reasonable. Don't argue. Argument is a fool's weapon and it does not get you anywhere."

Mix your work with a little milk of human kindness, and when you remember that the other fellow, while differently constituted from you, is just as much of a human being you will find him with you to the last ditch.

WAR-TIME REPAIRS IN THE NAVY



VI. Forging and Pattern Work

BY FRANK A. STANLEY

The operations described show the method used in forging a difficult piece of work, shaping it from a round bar into a forked connecting-rod. Some examples of work done in the various shops are described and illustrated. Formulas are given for many of the alloys used by the Government.

DURING my stay aboard the United States repair ship "Vestal" I had the opportunity one morning to watch the process of forging a new connecting-rod for a 10 by 20 by 10-in. stroke, highspeed, compound dynamo engine. The work was accomplished in the "Vestal's" smith and boiler shop, which has among its important items of equipment a 300-ton steam-hydraulic forging press, a small steam hammer, an oil-fired heating furnace, plate rolls, oxyacetylene welding and cutting outfit, electric-welding machine, power saw, punch and shear, air compressor and so on.

The broken rod to be replaced is shown in Fig. 56 and its dimensions are given in Fig. 57. The forging drawing is reproduced in Fig. 58. The rod was forged to ¼ in. over these dimensions all the way around and weighed when ready for machining about 175 pounds.

The blacksmith had as a guide this drawing and the old rod which was of considerable service in aiding caliper settings for the various dimensions of the new forging. The start was made with a 14-in. length of hammered steel cut from a 10-in. bar. This was heated and worked down at one end, in the forging press, to a diameter of 3½ to 4 in. for a distance of 8 or 9 in. to form a shank for holding the work by the tongs. Then the other end was worked in the forging press to a square section about 5 in. on a side by 18 in. long. Then the remaining round portion was forged down to rectangular section, height blocks being used on the forging-press anvil to gage the thickness of the work as manipulated under the ram. After the sides had been roughly flattened, round spreading tools were used to flow and spread the metal, the action being to form a series of half-round checks across the area, after which square spreaders were used to flatten the surface so that when the ram of the forging press was brought down upon the bare metal it trued it up quickly to fairly even flat surfaces. The thickness and height were determined closely to forging limits by means of gage blocks on the press as shown at *G*, Fig. 59, and then the ends were rounded as at *H* by turning the work on the anvil and bringing the ram down to the height blocks for each position of the forging. This resulted in a series of short flats, indicated at *I*, which gave a close approximation to an arc of the proper radius.



FIG. 56. THE BROKEN CONNECTING-ROD

The neck was then outlined by forging in the half-round grooves at *J*, Fig. 60, at a distance of 5 in. from the under side of the head, and the forging was then placed on a floor anvil and two cuts made lengthwise at *K*, Fig. 61, by hand chisels and sledges to outline the material to be removed from the sides of the neck. The chisel cuts were made to a depth of 1½ in. The rough forging then appeared about as represented by the sketch, Fig. 62.

The square end of the forging was cut off to 16 in., as indicated in Fig. 61, the forging reheated and the head end and round shank cut off in the forging press, leaving the head about 6 in. long, as shown by Fig. 63. The type of chisel used under the press is shown at *L*.

The work as cut off under the machine has a roughly beveled edge all the way around, which is afterward trimmed off to a flat surface and squared up by means of a hand chisel and sledge.

Following this the neck was trimmed out to give the general outline of the taper section at this point, the

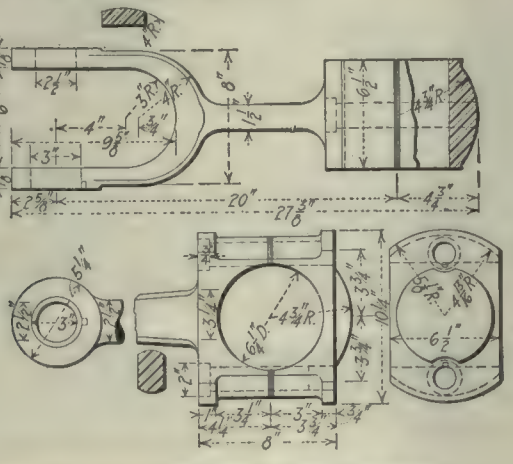


FIG. 57. CONNECTING-ROD DETAILS

dimensions of the trimmed portion being somewhat as shown at A and B in Fig. 64.

Next the forging was placed on the face of the anvil in upright position, Fig. 65, and tested with a square for general truth and squareness of outline. Then it was heated and forged down with sledges and formers in the corners *M* of the neck, then placed flat under the forging press where it was straightened under the head, a square spreading tool being placed upon the neck for this operation. Reheating the neck the forging was placed on an anvil or floor block and a half-round chisel used for trimming out all of the corners around the neck.

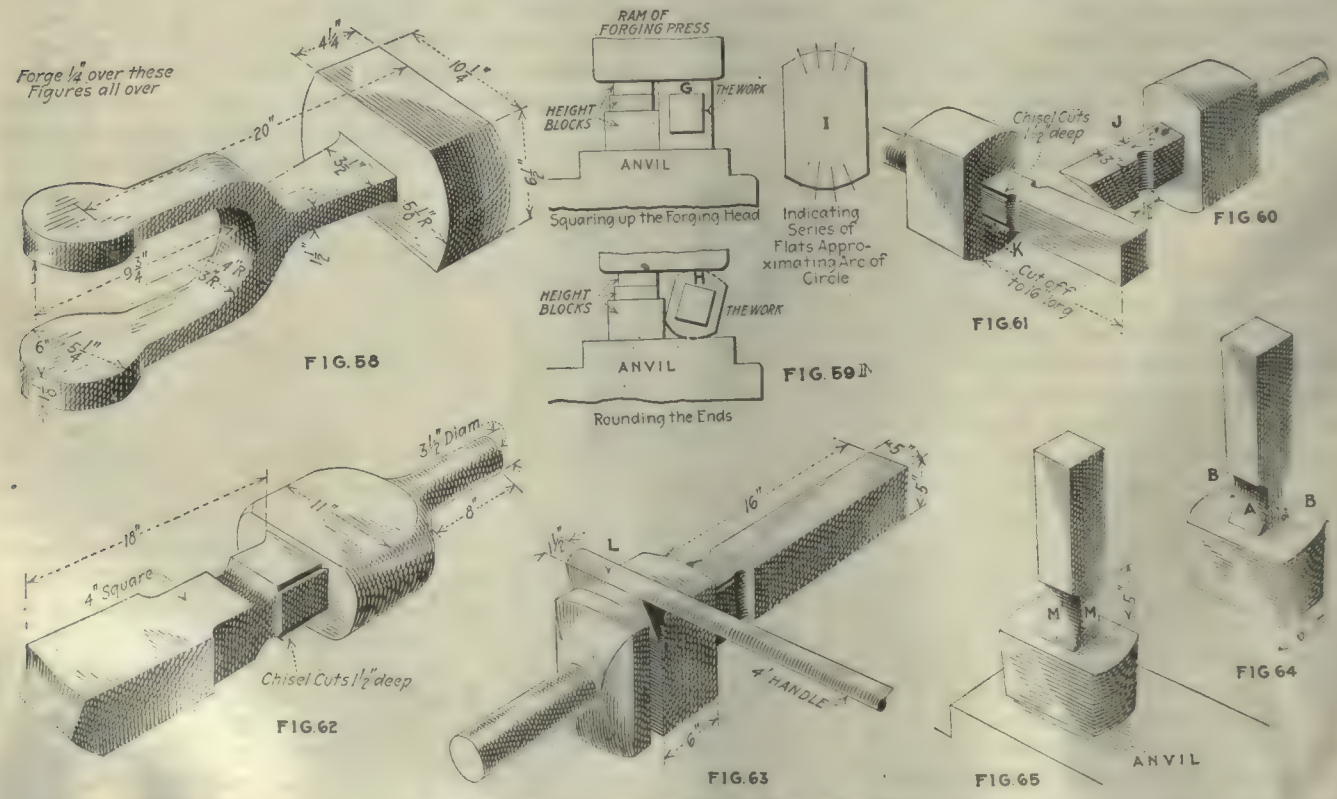
After trimming with chisel and sledge the forging was placed under the steam hammer and forged down to true it evenly under the head and along the neck. Then it was placed upright on the floor anvil and the sides trimmed with chisel and sledge to remove any high spots.

The next heat allowed the forging to be worked around the head under the forging press to round up the curved ends again to the desired radius for turning, and at the same time the head was squared along the sides to the necessary thickness. Then the shoulder under the head was placed on the anvil and the end face upset as in Fig. 66. Here the work was held upright by a pair of tongs gripped on the square body and resting upon a supporting bar underneath with a helper at each end of the bar and another holding the tongs. At the same time the head and neck were given a general dressing and truing around all corners.

The operations in forming the forked end consisted first in spreading out the body under the forging press, as in Fig. 67, and punching a hole through at the point indicated. This was to allow the forging to be split, as indicated in Fig. 68. Cuts were made from each side and most of the stock removed from the split by forcing the splitting chisel down under the forging press. This was followed by a hand-trimming process which cut out the fork openings as in Fig. 69.

The steam hammer was then used to dress the neck and body, and forge down the sides, as represented in Fig. 70, where the material worked down is indicated by the fine dotted lines along each side of the forging.

Following this the forging was placed on the anvil and the two legs of the fork bent out to about 90 deg.,

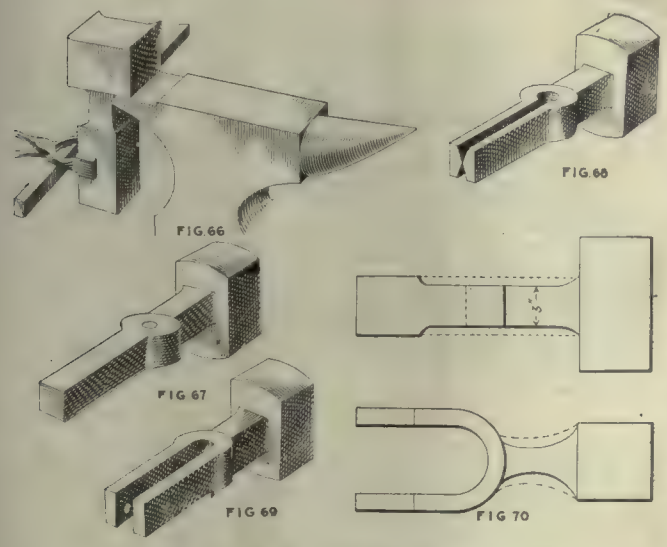


FIGS. 58 TO 65. STAGES OF THE FORGING

Fig. 58—The forging. Fig. 59—Shaping the head. Figs. 60, 61 and 62—Outlining the reach. Fig. 63—Head of forging cut off. Figs. 64 and 65—Drawing the neck

Fig. 71; then in the forging press, Fig. 72, the fork ends were flattened with a spreader to a width of 5 in. and a thickness of 1⅜ in. Next the throat was dressed out and hammered on the anvil, Fig. 73, to form the rounded interior prior to closing the fork ends; then with the fork over the anvil horn the arms or sides were hammered to parallel position. The steam hammer was then resorted to to square up the neck and forks again, after which the ends of the forks were rounded off on the anvil by sledge and chisel, as in Fig. 74. This completed the forge-shop operations and left the work ready for finishing in the machine shop.

The operations in the pattern shop and foundry on board the United States repair ship "Vestal" may be likened to those in a general jobbing plant ashore except that there is if anything a greater variety of work handled by the ship's mechanics than would be likely to come to the average establishment of the same kind "on the beach." While at first thought the "Vestal's" work has to do directly with marine repairs and ship's equipment, which might lead one to suppose that there



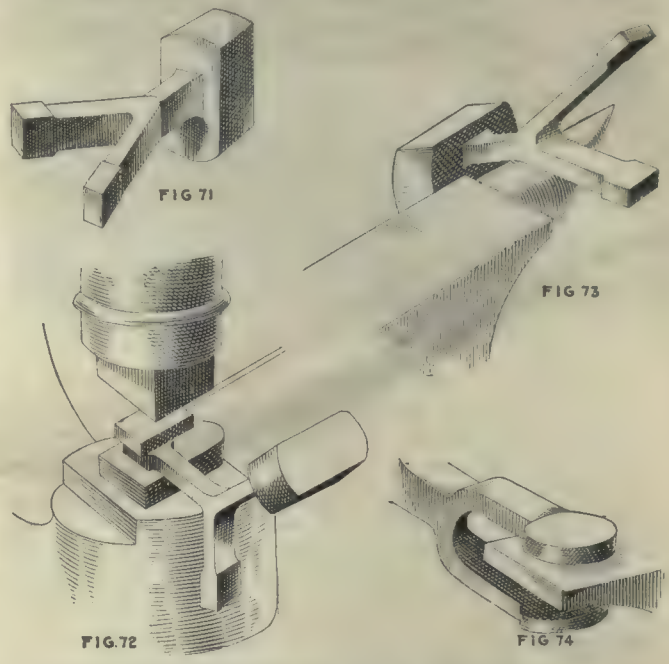
FIGS. 66 TO 70. FURTHER OPERATIONS
Fig. 66—Upsetting the end. Fig. 67—Punching to start the fork. Fig. 68—Splitting the fork. Fig. 69—Spreading the fork. Fig. 70—Drawing of forging

is a similarity about all the undertakings in the pattern shop and foundry on this vessel, a little consideration of the actual conditions in the upkeep of every department of the fleet of warships will bring one to the conclusion that a wider range of work could not be found anywhere for the attention of one establishment.

A man-of-war has in the first place the same general power-plant equipment as any first-class modern steamship and a similar outfit of auxiliary machinery in the way of steering engines, deck apparatus, pumps, dynamos, motors, etc. In addition there is much machinery peculiar to war ships, such as turret apparatus and a host of details not found on merchant vessels. Besides the navigating instruments and equipment there are a multitude of complex appliances connected with the handling of guns and the control of gun fire. The work constantly coming to the repair ships is therefore of almost endless variety, and while much of it is of a kind that is handled directly in the machine shop or optical department there is a large percentage which must be started in the pattern shop and foundry.

The pattern shop is located in a gallery at one side of the ship and is fitted up with the usual apparatus for such a department, including a speed lathe, a gap lathe, saw bench, band-saw, and jointing, trimming, boring, mortising, core-box, and saw-filing machines.

Fig. 75 shows the gap lathe with a pattern being



FIGS. 71 TO 74. SHAPING THE FORK
Fig. 71—Spreading. Fig. 72—Flattening. Fig. 73—Rounding up. Fig. 74—Finishing.

turned for a pump plunger. This is a comparatively simple piece of pattern work, finished mostly in the lathe, but a large share of the jobs coming to the pattern shop is more complicated. There are many items such as steam-chest, valve, pump cylinder and other patterns where intricate core work is necessary and where a high degree of skill is required on the part of the pattern makers. As with all special marine work, there must be no time lost in getting the patterns

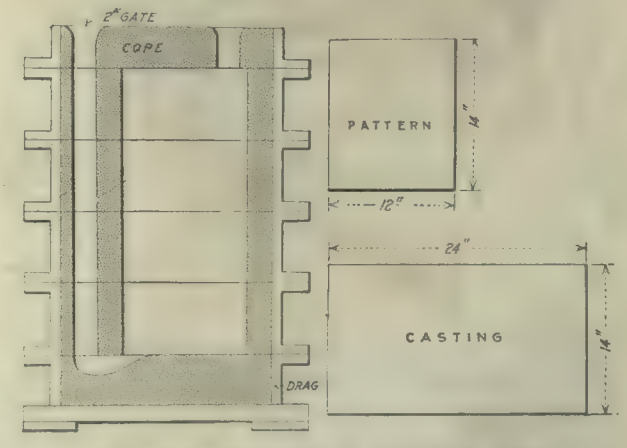


FIG. 76. SECTION OF A BUILT-UP MOLD

through making the castings and finishing the parts in the machine shop. Necessarily a great many patterns accumulate for different jobs handled by the ship, and these are all classified and stored as compactly as possible and a card index of them kept, so that they may be instantly available if wanted.

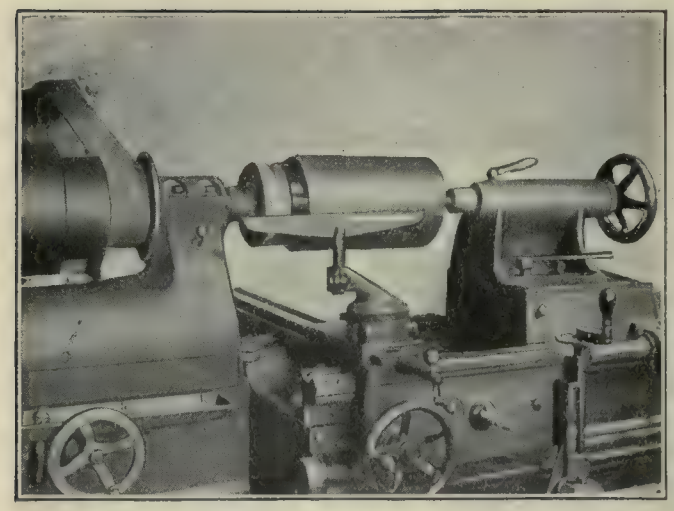


FIG. 75. A PATTERN IN THE GAP LATHE

The foundry pours castings from a few ounces in weight up to a ton or more. In one instance a bending plate has been poured weighing over 2200 lb. For a typical three-months' period last year this department poured over 40,000 lb. of metal and produced a multitude of castings of nearly every conceivable type that can enter into a ship's makeup. The equipment consists of two cupolas, several brass-melting furnaces, an overhead crane and the usual sand piles, sand pit, core ovens, pouring ladles, flasks, etc.

SPECIFICATIONS FOR VARIOUS METALS

Composition A.—Admiralty Metal (copper, 70; tin, 1; zinc, 29)—For condenser tubes, distiller tubes, feed-heater tubes, evaporator tubes.

Composition BC.—Commercial Metal (copper, 62; zinc, 30; lead, 2; tin, 6)—For name plates, cases for instruments, oil cups, distribution boxes.

Composition BE.—Brass for electrical appliances (copper, 88; tin, 2; zinc, 10)—For junction boxes, switches, distribution boxes, connection boxes, W. T. bells, buzzers, etc.

Composition Cu.P.—Phosphor Copper (copper, 90; phosphorus, 10, minimum).

Composition D.C.—Muntz Metal (copper, 60; zinc, 40).

Composition F.—Brazing Metal (copper, 85; zinc, 15)—For flanges for copper pipe and other fittings to be brazed.

Composition G.—Gun Metal (copper, 88; tin, 10; zinc, 2)—For valves, valve seats, water cylinders, buckets, stuffing boxes, glands, bearing boxes, bearings, etc.

Composition G.Ag.—German Silver (copper, 64; zinc, 20; nickel, 16)—For valves, manifolds, cocks, relief valves, hose couplings, fittings, resistances.

Composition Mo.C.—Monel Metal (copper, 23, min.; nickel, 60, min.; iron, 3.5, max.; aluminum, 0.5, max.; manganese, 3.5, max.; carbon and silicon, 0.8, max.)—For valve fittings, plumbing, propellers, pump liners, valve seats, castings requiring great strength.

Composition N.C.—Naval Brass (copper, 62; tin, 1; zinc, 37)—For hatch frames door frames, scuttle frames, fittings for tables and benches, chest fittings, stanchions, belaying pins, brass pipe flanges.

Composition P.C.—Phosphor Bronze (copper, 85.5; tin, 10.0; zinc, 4.0, max.; phosphorus, 0.5, max.)—For gears, driving nuts, bearings and castings requiring strength and bearing qualities.

Composition S.C.—Pipe-Fitting Brass (copper, 80; tin, 4; zinc, 16; lead, 3, max.)—For composition screw fittings.

Composition W.—Antifriction Metal (copper, 4.0; tin, 89.0; antimony, 7.0)—For white-metal liner bearings and for bearing surfaces.

Composition Mn.C.—Manganese Bronze (copper, 56; zinc, 37; ferromanganese, 4; Norway iron, 1.75; aluminum, 1.25)—For propeller blades, hubs, engine framing. All castings requiring great strength.

Composition XY.—Hydraulic Metal (copper, 84; tin, 11; lead, 4; zinc, 1)—For castings subject to steam, water and air pressure.

The molders on the "Vestal" find no monotony in the practice of their trade. It is one piece or a half dozen of a kind, then something else entirely different. About half of the work is run in composition or special mixtures of one kind or another, and these are all in accordance with the definite specifications of the Navy Department elsewhere in this article.

Economy in Flasks and Patterns in Foundries

The space devoted to the foundry is about 50 by 50 ft., and it is evident that no great amount of room is available for storage of flasks not actually needed, so the number is held down to what is essential. For unusual cases extra large flasks may be stowed below decks.

For molding cylindrical castings of plain form it is customary to simplify the pattern work and difficulties of storage by using one pattern for different lengths of the same diameter, the flask being set up with as many cheeks as may be required to give the necessary height.

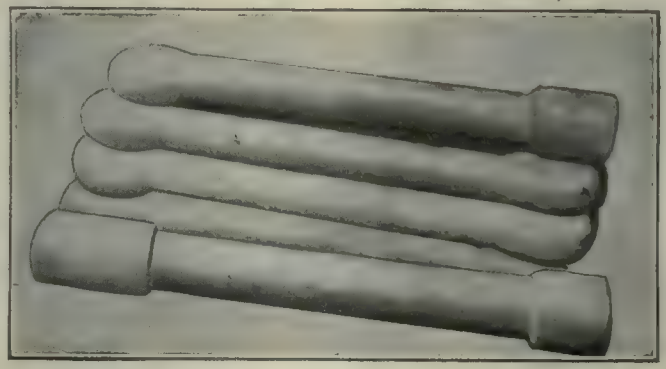
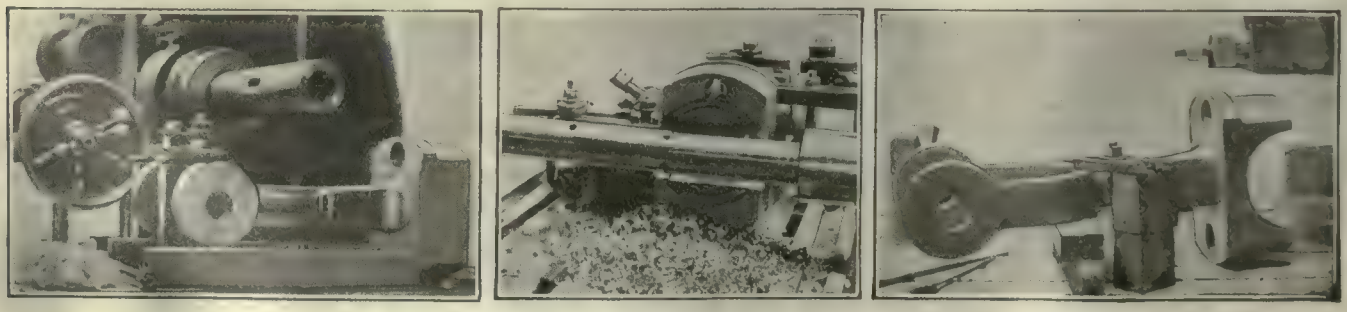


FIG. 77. SHACKLE FORGINGS

An example is given, in Fig. 76, which shows a pattern 14 in. in diameter by 12 in. long, which is used for castings up to 24 in. or more in length.

The pattern is first molded to nearly its full height as it stands on end, then it is drawn up for say 6 in., and another cheek put on, which is rammed up and followed by the lifting of the pattern again and the addition of another cheek, the different settings of the pattern being such that the top of the pattern comes above the cheek joint each time. The gate is formed in the same manner. The illustration shows the arrangement of bottom board, drag, cheeks and cope after the molding has been completed. The mold is gated at the bottom into the middle of the job to provide an easy upward slope for the metal and thus prevent washing the sand with the rush of the molten iron.



FIGS. 78 79 and 80. MACHINING THE CONNECTING-ROD

The forgings in Fig. 77 are for steel shackles, which are made up in fair-sized lots from time to time. In the size illustrated the shackles are forged to a body diameter of 2 in. and their length before bending is 22½ in. The ends are flattened and rounded to a diameter of 4 in. The stock from which the shackles are forged is 3 in. in diameter and is cut off to a length of 14 inches.

The work is bent up under the hammer before drilling. Then a hole is drilled through one side a free fit for the body of the shackle pin. The pin is 2 in. in diameter and is threaded at the end so that the hole in the opposite side of the shackle body has to be drilled and tapped to receive the thread on the pin.

A few operations in the machine shop in connection with the finishing of the connecting-rod mentioned earlier in this article are here described. The pictures show the form of the rod very clearly.

In Fig. 78 the work is seen on the table of a horizontal boring machine where the holes have been bored through the forked end for the wristpin. Before the rod was brought to this machine it was milled on the head and sides to the required width and thickness, drilled for the cap bolts and then placed on centers in the lathe and turned to diameter of head and the desired form of fork and neck.

After the fork had been bored on the horizontal machine the table was readjusted horizontally but without disturbing the setting of the work on the table. Then in the position in Fig. 79 the head of the rod was bored out in the manner represented.

The rod completed, so far as machine work is concerned, is shown in Fig. 80 undergoing the final touches with hand tools, scrapers, etc., used in removing sharp corners and burs. It is also tested while strapped in position for alignment of bearings and truth of faces.

Conservation of Material in the Shop

BY E. ANDREWS

This article by an English machine-shop foreman should be of particular interest at this time as showing the feeling toward conservation among English workmen. The illustrations he uses to explain his points sound as if they might have happened much nearer home. The material prices quoted in the table are recent enough to give an idea of relative costs here and abroad. The equivalents in our money are approximate.

THE editorial on page 543, Vol. 49, of the *American Machinist* is full of interest to me and should be to all shop managers, foremen and employees, as it is timely. You make the very forceful point that not only is it essential to prevent waste but that there is an imperative need for rigid economy in the use of "our present-day precious metals."

Experience as a foreman in a large engineering establishment for some years leads me to give a few views in regard to preventing unnecessary waste of material. I am strongly in accord with the editorial statement calling for a material-conservation department in industrial plants, and not only is this need felt in construction work of all kinds, but in the conservation of scrap-pile waste. Indeed we did not realize fully what economy meant until we were forced to it by the scarcity of material and high prices. However, it can be safely said that millions of dollars' worth of valuable castings, machine parts and tools are now being reclaimed from the scrap heap by employing modern oxyacetylene-welding methods. Probably no other equipment introduced into the mechanical industries has made possible greater economies during recent years.

I believe that if the workers only knew the value of materials much greater care would be taken in their manipulation in the shops. It may be said that it would be against the employer's interests to make generally known among the workers the price paid for material. I agree in some cases, but there are undoubtedly many instances in manufacturing operations where the lack of this information is the direct cause of unnecessary waste of material. To cite a case in point I recently found it necessary to investigate the reason for the heavy consumption of an expensive solder. This material is known as "best" or "fine" solder, and contains 67 per cent. tin and 33 per cent. lead, its present price being about £250 per ton (2240 lb.). It was found that it had been used in the manufacture of a large number of terne-coated sheet-steel tanks that were required for commercial motor vehicles instead of the much cheaper solder known as "half and half," which would have been equally suitable. It was also found that not only did the workers use this more expensive material but they used it extravagantly and to such an extent that it was possible to reduce its use by one-half and still obtain adequate strength and a neater job. Had the price of the first solder been known it probably would have been used far more reasonably.

Of late I have frequently demonstrated the high cost of material to workers in the shops and in practically every instance they were amazed at the prices. On one occasion I asked a coppersmith who was making a number of cylindrical tanks from copper sheets 0.125 in. thick (weighing 93 oz. per square foot) if he knew the value of the material. He replied he had not the slightest idea, and when I told him that the firm paid 9s. a square foot for it he was astonished. The majority of workers appear to be ignorant of the high cost of material. Why this should be so is a little difficult to understand, but at present it ought to be evident to almost anyone that material conservation is of vital importance.

Demonstrating the cost of materials to employees was put into operation a short time ago by a large manufacturing concern as part of its war-time program to give its work people some idea of the importance of eliminating waste of material in the shops. The lists were prominently displayed in the shops and the approximate price given of each class of material. It

is advisable to revise them monthly owing to the fluctuations of the market.

X Y Z WORKS, MATERIAL PRICES, DECEMBER, 1918

Coppersmith's and sheet-metal-working shops, be careful with the company's materials and you will cultivate a habit to your own benefit.

"WHO SAVES SERVES"

		s.	d.	
Aluminium, sheets	per lb.	2	6	($0.60)
Aluminium, rivets	per lb.	2	8	(.64)
Aluminium, ingots, 98 to 99 per cent	per lb.	2	0	(.48)
Brass, sheets	per lb.	1	5	(.34)
Brass, wire	per lb.	1	5	(.34)
Brass, tubes (solid drawn)	per lb.	1	6	(.36)
Brass, tubes (brazed)	per lb.	1	8	(.40)
Copper, sheets	per lb.	1	6	(.36)
Copper, bars and rods	per lb.	1	6	(.36)
Copper, rivets and wire	per lb.	1	7	(.38)
Copper, tubes (solid drawn)	per lb.	1	8	(.40)
Copper, tubes (brazed)	per lb.	1	8	(.40)
Solder, fine	per lb.	2	4	(.56)
Solder, half and half	per lb.	2	0	(.48)
Solder, coarse	per lb.	1	8	(.40)
Spelter solder (brazing)	per lb.	1	6	(.36)
Sheet steel (20 gage) black	per lb.	...	2½	(.05)
Sheet steel, galvanized	per lb.	...	3½	(.07)
Sheet steel, tinned	per lb.	...	4	(.08)
Sheet steel, terne coated	per lb.	...	3	(.06)
Tin, ingots	per lb.	2	8	(.64)
Tin plates, XXX 20 x 28 in	each	1	0	(.24)
Lead, ingots	per lb.	...	3½	(.07)
Lead, sheets	per lb.	...	4½	(.09)
Zinc, sheets	per lb.	...	10	(.20)

SCRAP MATERIAL PRICES

Every Scrap of Scrap Helps

		s.	d.	
Aluminium, 98 to 99 per cent	per lb.	1	6	($0.36)
Brass, red	per lb.	...	9	(.18)
Brass, yellow	per lb.	...	6	(.12)
Copper, heavy	per lb.	...	10	(.20)
Copper, light	per lb.	...	8½	(.17)
Lead, heavy	per lb.	...	3	(.06)
Zinc	per lb.	...	4	(.08)

MATERIAL CONSERVATION MUST BE YOUR INSISTENT AIM

The World Is Learning the Need of It

The chief reason for this particular list being selected is that the materials used in the above-mentioned shops are expensive. Consequently the prices illustrate more pointedly than those in other departments and serve to encourage the workers to save in these times when economy is so urgent. The whole question is also well worth the best thought of every manufacturer, as it affects not only his welfare but the efficiency of the nation as a whole.

Value of Women Workers in the Machine Shop

By Anne C. Halvorsen

Will the women who served in the machine shops for Uncle Sam during the war hold their places in times of peace?

It is safe to predict with reference to the plants that employed women during the war that they will continue to do so. During the readjustment period, however, there will hardly be a demand for women workers in the shop; at least not until conditions have become more settled and our soldiers have been reëmployed. The patriotic war worker is glad to step back until that time, and then she hopes and deserves to be reconsidered, and will be of course to a greater extent than before the war.

The women engaged on actual machine work have been successful. They not only made good on inspection, assembly and light bench work, but as machine operators setting up their machines and work. I have observed in my capacity as instructor for girls taking up work as machine operators that they are eager and ambitious, and if given full opportunity they become as efficient as men and often turn out a larger output.

Aside from the interest and earnestness women take in their work there is another strong factor in their success, namely, they know they are being constantly watched and sometimes criticized for minor mistakes that would have been ignored were they men. This compels them to assume a "friendly defensive attitude," so to speak, which enables them to concentrate their efforts and accomplish greater results.

It is my conviction that under well-developed management there will be increased production where women are employed on the same work as men if they are given some training before entering the shop, because the girl who shows mechanical possibilities in training will prove ambitious, steady and quick.

Inefficiency is a curse, but it can be easily remedied, as higher standards are being planned which are working out successfully. This means more production, higher wages, better living conditions and a better world.

Training School for Women

Every well-organized plant should favorably consider establishing a training school for women, and the work should be a part of the production. Under the supervision of a competent instructor, whose greatest possessions must be patience, an agreeable disposition and a mind for system, and who will prepare the student and teach her to be accurate, little work is rejected from the school; in fact the school can be made self-sustaining by the work it turns out, thus relieving the plant of any expenses in its upkeep.

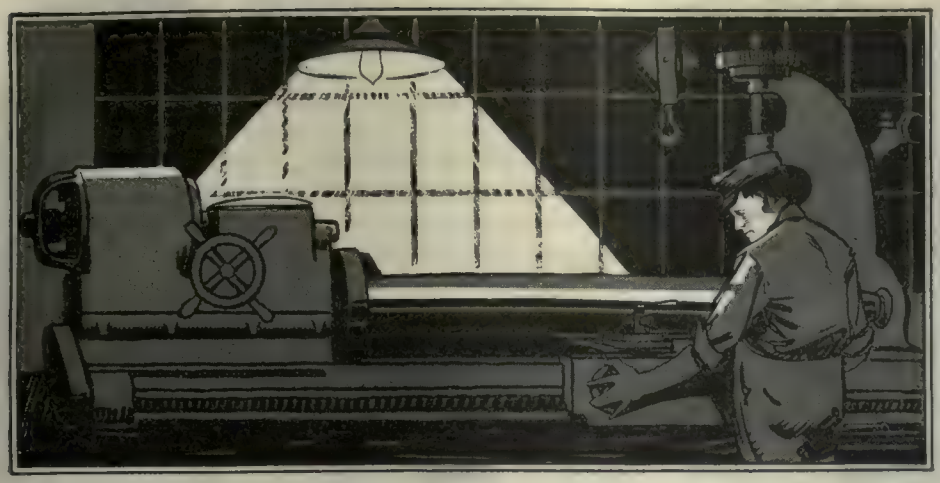
The girls in a school like to chose their own machines, and they should be given this privilege, as it means added interest. However, it may be necessary in some cases to decide for them as, for instance, when a short girl wants to operate a planing machine.

All students are enthusiastic over the school training, as it gives them confidence and a chance to prove whether they are fitted for machine work. When they learn to operate a machine they become so interested that they invariably want to learn more, such as setting up machines for turning a tapered tool or determining the different dimensions of a gear, etc.

Some men think (or is it lack of thought?) that further knowledge for women in the mechanical line other than machine operating is superfluous or beyond the scope of a woman's brains; but the woman who is really interested feels that this indifference or unawakened understanding on the part of the men is a hindrance to her progress. It is, however, gratifying to know that the majority of men understand and have expressed the value of the intelligent girl in machine production.

The greatest asset of a modern factory is a capable employment manager who understands not only shop problems and conditions, but also human nature, and the success or failure of shop conditions and production in a measure falls at his door. So also with women workers. As far as possible women should supervise women, and only intelligent girls of good character whose ages are between 21 and 35 should be considered.

Many war workers will go back to their old jobs in other factories, but those who made good at machine work and choose to remain at it should be given a place in the industrial world again.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Electric Drive for Punching, Shaping and Slotting Machines

This article contrasts the duty cycle of punching, shaping and slotting machines with the continuous performance of drilling and boring machines discussed in a previous article. The characteristic load requirement of the punching machine is illustrated by a graphic chart, which brings out important points in the operation of this class of machines. A brief reference is made to the underlying advantage of the individual-motor drive and illustrations of punching, shaping and slotting machines are used to bring out some of the different kinds of motors and controllers. A comparison of direct- and alternating-current motor equipment is made with notes on the use of geared as compared with belted drives.

IN A previous issue some points of importance connected with the driving problem for drilling and boring machines were discussed. The demands for power in such machines are continuous in one direction during the operation of the machine. In this

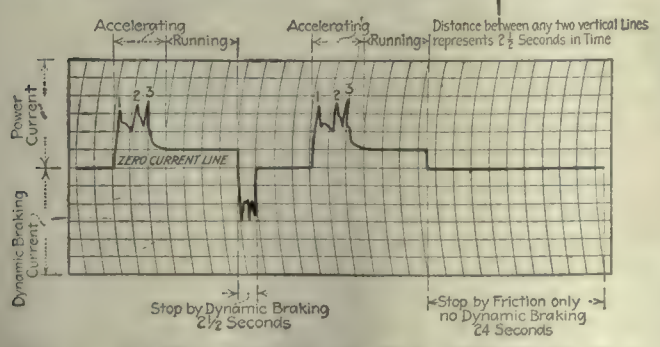


FIG. 1. GRAPHIC RECORD OF THE OPERATION OF A PUNCHING AND COPING MACHINE EQUIPPED WITH A LARGE FLYWHEEL

article the discussion is continued on a basis of punching, shaping and slotting machines in which the duty cycle throughout given operations consists of two directions of motion, and in which the limit of travel may introduce the element of time economy if the machine is brought to a quick stop by some method of braking.

Fig. 1 shows a graphic record prepared by H. F. Stratton for a punching and coping machine. This curve shows that for each duty cycle there is a short period during which the machine is brought up to speed, a period of running and a braking period. The particular machine to which this record corresponds had a heavy flywheel so that it was necessary to accelerate a load of large inertia for each new cycle. Mr. Stratton showed in an earlier issue of the *American Machinist* that this punching machine was formerly equipped with a clutch, this clutch being used to start the punch after the motor had been brought up to speed. To stop the punch due to its friction only, that is, with no braking device, required 24 seconds.

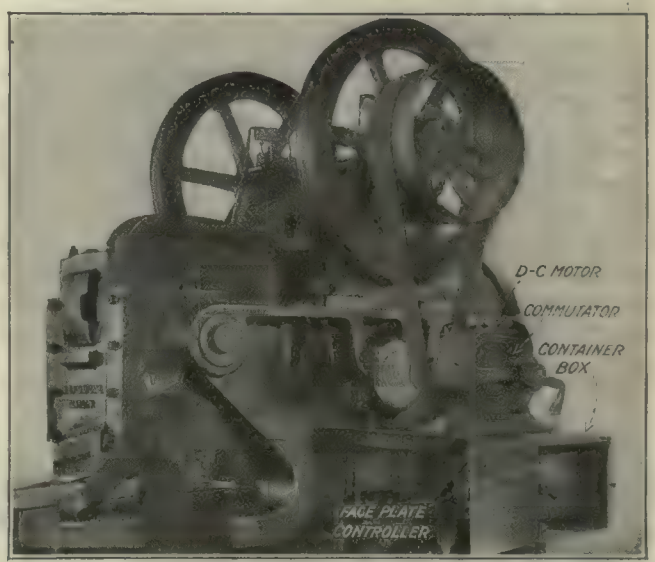


FIG. 2. PUNCHING AND SHEARING MACHINE EQUIPPED WITH A 10-HP., 850-R.P.M., DIRECT-CURRENT MOTOR

Later an automatic controller was installed which made it unnecessary for the operator to use a clutch, the process of starting requiring him merely to throw in a small lever and the motor and machine were to-

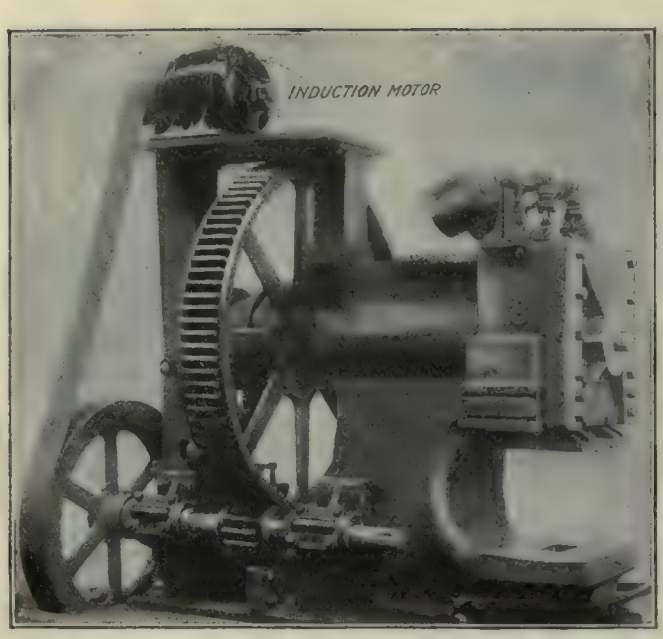


FIG. 3. PUNCHING AND TRIMMING MACHINE EQUIPPED WITH A SQUIRREL-CAGE INDUCTION MOTOR

gether brought up to normal operating speed. By this controller the machine was also stopped promptly and effectively at the end of the stroke by the dynamic braking action of the motor, this being accomplished by merely throwing the starting lever in the reverse position. Tests on machines of this class have shown that the time required to stop by this means can be reduced to about one-tenth of the time required by a friction stop.

It can be seen from Fig. 1 that a modern automatic controller with a suitable motor is capable of reducing the time required per cycle for machines of this group, and to summarize the points of advantage possessed by the motor and its automatic controller Stratton has shown that four elements stand out as follows: (a) The convenience and accuracy of starting up the machine, (b) the convenience of adjusting the speed of driving at any prescribed value and of being sure that this speed is maintained, (c) that the motor always automatically reaches this given speed after each duty cycle when the new cycle is under way without any attention on the part of the operator, and (d) that when the control element is placed in a position to stop the machine by dynamic braking, the motor as well as the machine is brought to a dead stop, thus removing the need of clutches and countershafts and avoiding the disadvantage of the driving mechanism running idle when the machine is at rest.

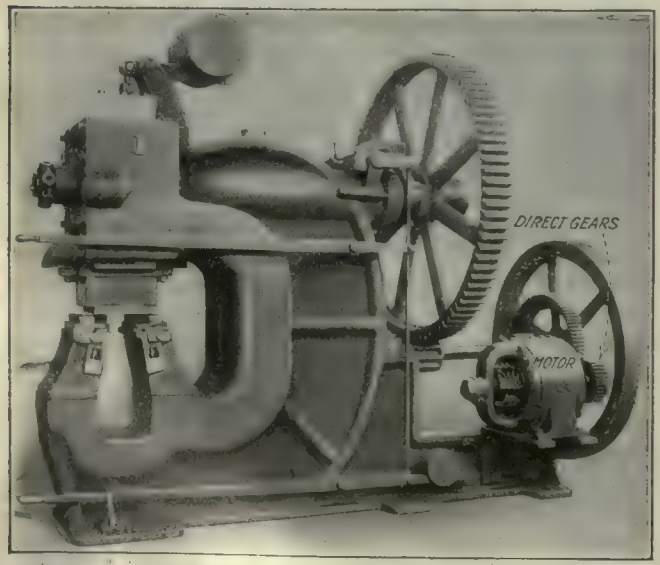


FIG. 4. PUNCHING AND SHEARING MACHINE WITH MOTOR DIRECTLY GEARED

It should be remembered in the foregoing explanation of Fig. 1 that the advantages mentioned do not necessarily accompany motor drive unless the control equipment for the motor is properly selected, this pointing to the importance of the controller as well as the motor.

In shops with direct current only, the types of motors

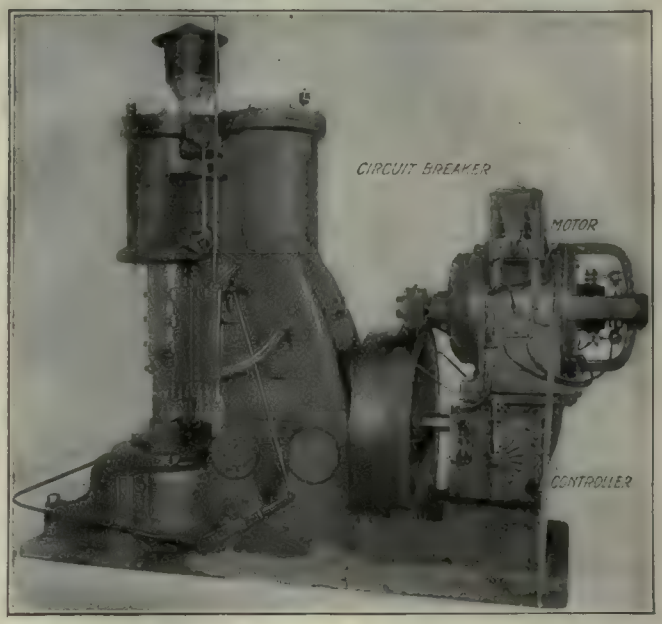


FIG. 5. AIR FORGE HAMMER WITH A 25-HP., 750-R.P.M. MOTOR GEARED TO THE MACHINE. THE BED OF THE MACHINE IS DESIGNED TO ACCOMMODATE THE MOTOR

for machines of this class are the adjustable-speed shunt-wound for use where wide limits of driving speed are required, and the constant-speed shunt or compound wound for use where only one speed is required or where various speeds are obtained through the use of speed boxes or the ordinary cone-pulley arrangement.

Where alternating current is used the induction motor may be employed. In this type, the so-called squirrel-cage motor corresponds in its speed characteristics very closely to that of the constant-speed direct-current motor and must be used with a speed box or cone pulleys and belts if a number of different speeds are required. The other type of induction motor is that of the wound secondary class for use with loads which call for large starting torque. Where the machine has a large inertia effect, as with punching machines, large starting torque is sometimes provided in squirrel-cage motors by making the resistance of the rotating member higher than ordinary; that is, in arranging it to operate with a larger drop in speed between no-load and full-load conditions than is usually the case. This is known as a squirrel-cage motor with large slip.

In the previous article on drilling and boring machines a simple formula was given for the horsepower rating of the motor required to operate a drill on a basis of the number of cubic feet of metal removed

per minute and certain empirical constants for the approximate horsepower per cubic foot of metal removed per minute. In machines of this class, however, with operating cycles like that shown in Fig. 1, the determination of horsepower is not subject to quite such a simple relation because of the changing current requirements throughout each cycle. A number of ways have been developed for the determination of horsepower corresponding to a varying load of this kind, but it is not the purpose to discuss that phase of the problem in this article other than to call attention to the tables of horsepower ratings recommended by the Westinghouse Electric and Manufacturing Co. for machines of this group of different sizes.

To illustrate the scope of these tables several are given for both punching and shearing machines. For

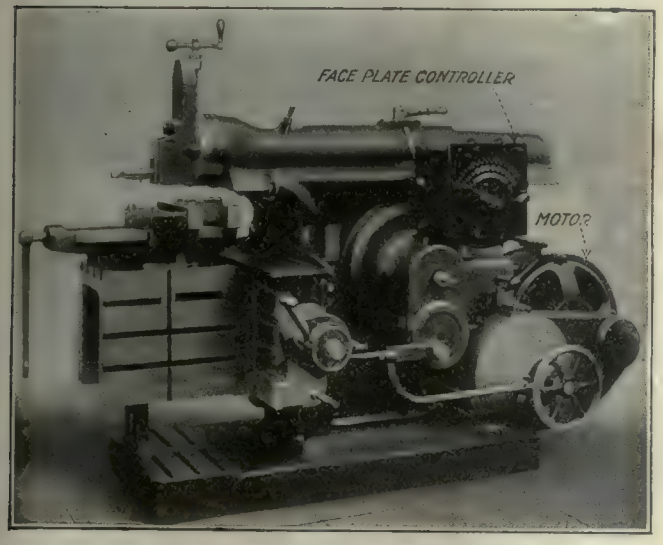


FIG. 6. A 25-IN. SHAPING MACHINE DRIVEN BY A 3-TO-1 ADJUSTABLE-SPEED, DIRECT-CURRENT MOTOR WITH FACEPLATE CONTROLLER

small machines used to notch sheet iron any one of the three standard types of motors may be used in sizes ranging from one-half to several horsepower. For the machines listed in the tables, however, the direct-current motor should be of the compound-wound type in the constant-speed class, and if an induction motor is employed it should be either of the wound-secondary type or a squirrel-cage type with large slip (approximately 10 per cent.) in the larger sizes, as explained above.

TABLE I. APPROXIMATE HORSEPOWER RATING RECOMMENDED FOR PUNCHING MACHINES

Diameter in Inches	Thickness in Inches	Hp.
¾	¼	1
¾	⅜	2 to 3
¾	½	2 to 3
¾	⅝	3 to 5
¾	¾	5
1	⅝	5
1	¾	7½
1¼	1	7½ to 10
1¾	1	10 to 15
2	1	10 to 15
2½	1½	15 to 25

To illustrate the points in the use of motors for punching machines, reference will be made to a number of photographic reproductions. In Fig. 2 a punching and shearing machine is shown with a direct-current motor belted to the pulley. The controller employed is an ordinary faceplate hand-operated rheostat.

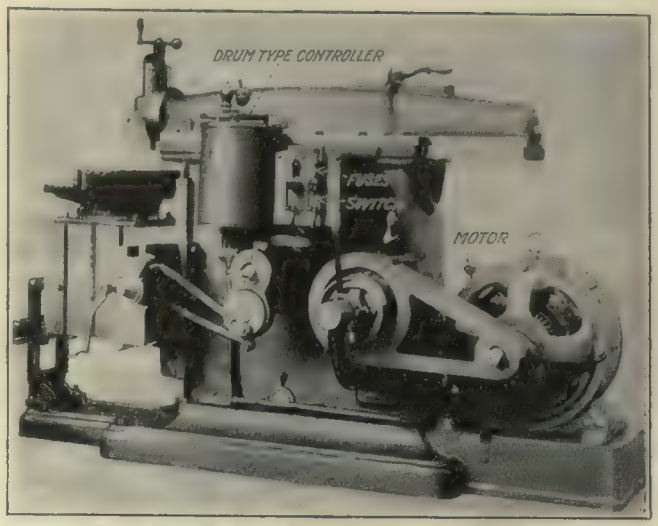


FIG. 7. A 28-IN. SHAPING MACHINE DRIVEN BY A 4-TO-1 ADJUSTABLE-SPEED, DIRECT-CURRENT MOTOR WITH DRUM-TYPE CONTROLLER

A good deal of attention has been given to the relative merits of motors with belt connection and with gear connection to the machine, an example of the former being shown in Fig. 2 and of the latter in Fig. 4. A representative machine-tool manufacturer, in commenting on this point, states that all later designs

TABLE II. APPROXIMATE HORSEPOWER RATING FOR SHEARING MACHINES

	Horsepower	
Width in In.	Cut ¼-In. Iron	Cut ½-In. Iron
30 to 42	3	5
50 to 60	4	7½
72 to 96	5	10
Bolt shears		7½ hp.
Double-angle shears		10 hp.

of his machines are arranged for belt-connected motor drive in preference to the gear-connected motor equipment, the reasons given being as follows: With belt drive the efficiency with a properly designed driving equipment is as great as with gear connection; the belt drive is classed as safer, and among the advantages given are quietness and smoothness of operation and low maintenance of the belt compared with the gear-driven machine. This opinion is given for what it is worth

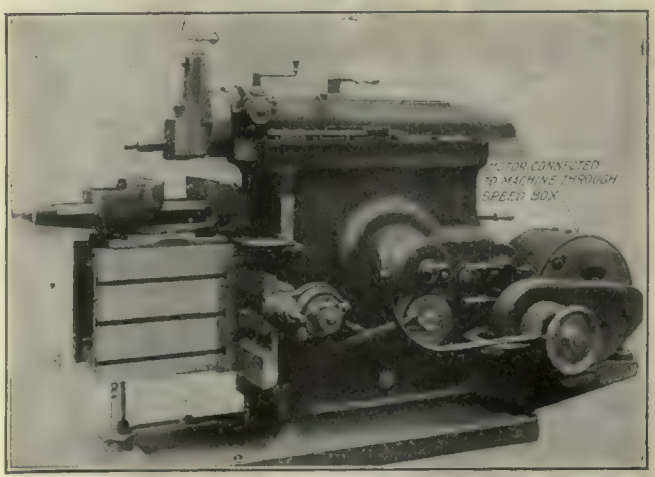


FIG. 8. A 24-IN. HEAVY-SERVICE SHAPING MACHINE ARRANGED TO BE DRIVEN EITHER BY A CONSTANT-SPEED OR AN ADJUSTABLE-SPEED MOTOR THROUGH A GEARED SPEED BOX

as a comment on the general arrangement of Fig. 2. Special attention is directed in Fig. 2 to the use of the direct-current motor. The fact that the controller is placed in an inclosure is partly an evidence that a good deal of dirt and grease is thrown off by the belt and gears of the machine tool. It can readily be seen that a motor with a commutator as in Fig. 2, which has sliding contacts where the carbon brushes press on the commutator, would be subject to a certain amount of falling dirt in the form of grease particles or even grit, which is likely to act as a disadvantage in the operation of the motor, as such deposits gather on the face of the commutator.

From this standpoint there is an advantage in the use of the squirrel-cage induction motor without a commutator as in Fig. 3, although the comparison between Fig. 3 and Fig. 2 is not a good one since the motor in Fig. 3 is mounted well above the machine and would quite naturally be less subject to scattered

TABLE III. APPROXIMATE HORSEPOWER RATING FOR LEVER-SHEARING MACHINES

Size in In.	Hp.
1 x 1	5
1½ x 1½	7½
2 x 2	10
6 x 1	...
2½ x 2½	15
1 x 7	...
2½ x 2½	20
1½ x 8	...
3½ x 3½	30
4½ round	...

dirt than a motor placed as in Fig. 2. The belt connection in Fig. 3 is to be noted, and also the very heavy inertia of the moving parts of this machine, making a fairly large starting torque essential in the motor if the machine is to be accelerated up to its normal speed from rest promptly. As indicated in connection with the horsepower tables this feature is accomplished in the squirrel-cage induction motor (the type shown in Fig. 3) by the use of rather high permanent resistance in the rotating element of the motor, which gives

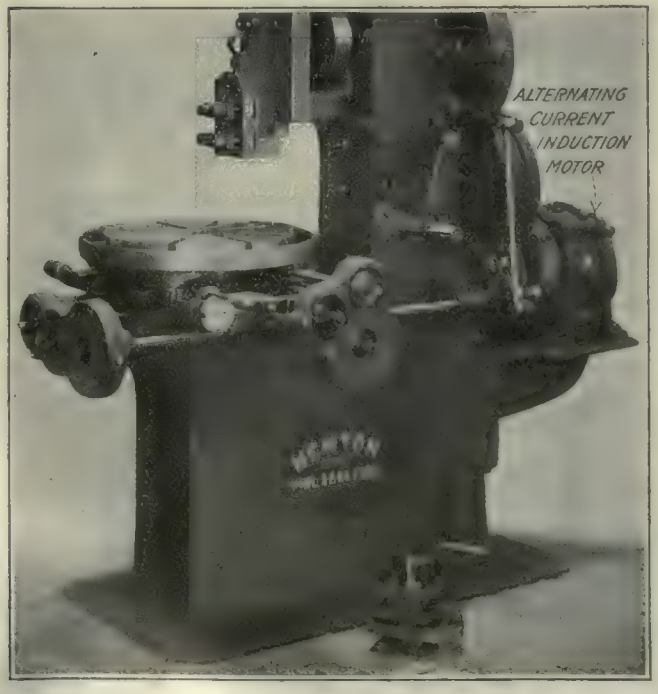


FIG. 10. SLOTTING MACHINE DRIVEN BY AN INDUCTION MOTOR THROUGH FULLY INCLOSED GEARS WITH A LEVER FOR CONTROLLING SPEED

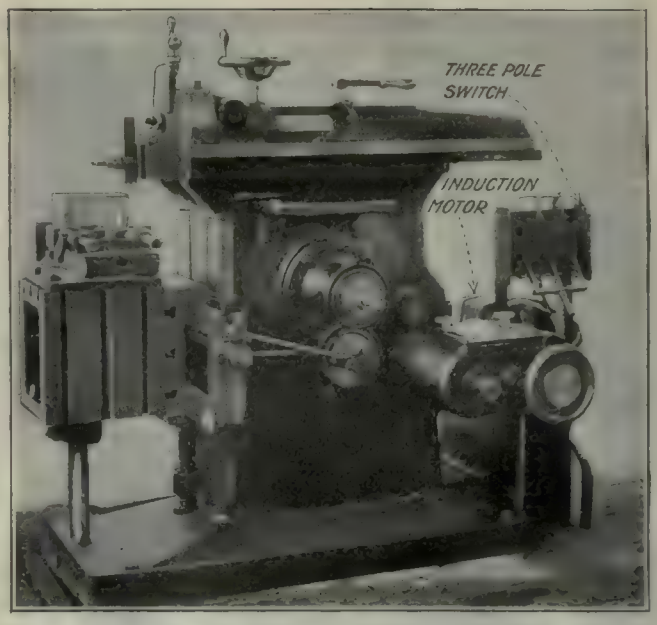


FIG. 9. A 15-IN. SHAPING MACHINE OPERATED BY AN ALTERNATING-CURRENT INDUCTION MOTOR

it somewhat worse speed regulation but accomplishes the necessary torque requirement at starting.

Turning to Fig. 4 we have a good example of a direct-gear-connected motor-driven punching and shearing machine. This case is included to show clearly the contrast between the geared arrangement and the belted machines of Figs. 2 and 3. It will be noted in Fig. 4 that the motor is mounted on a special bracket attached to the bed of the machine, thus making the motor and the machine a unit. The flywheel effect is indicated in this machine by the large gearwheel and the flywheel to the right.

A somewhat different machine is that in Fig. 5, which shows an air forge hammer with a 25-hp. motor mounted on a special support to the right. This motor is operated at 750 r.p.m. and is geared to the machine through a protected gear. The control equipment consists of an open-dial type hand-operated rheostat attached directly to the support for the motor with protecting circuit-breakers on a small panel mounted on the motor frame. It will be seen from the illustration that the bed of the machine has been designed expressly for suitable attachment of the motor.

Motor Drive for Shaping Machines Presents Some Problems

The shaping machine presents some problems in the type of motor to employ and the methods of mounting it and the controller on the machine. Fig. 6 illustrates a use of the direct-current adjustable-speed motor in conjunction with a regular faceplate hand-operated controller. The motor in this case has a range of speed of 3 to 1. Geared connection is employed and the rheostat or controller is attached to the side of the machine within convenient reach of the operator. It is perhaps apparent that an automatic controller could be placed in the same position as the manually operated rheostat shown in this illustration, thus removing from the operator the necessity of starting the motor by a hand-graduated controller and giving to the equipment the advantages that were described in connection with the graphic record shown in Fig. 1.

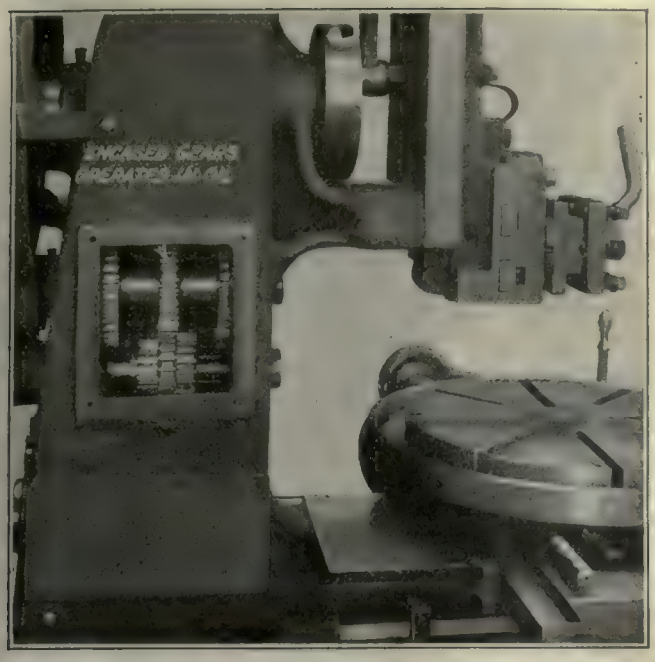


FIG. 11. SLOTTING MACHINE WITH COVER PLATE REMOVED SHOWING THE GEARS FULLY INCASED SO AS TO OPERATE IN OIL

In order to contrast the method of control shown in Fig. 6 with the method employing a drum type of controller, which has become so widely used in machine-shop practice, Fig. 7 is shown. Here an adjustable-speed direct-current motor having a speed range of 4 to 1 is employed along with a drum-type controller, shown to the left of the illustration. Immediately to the right of the controller a small panel is mounted on the side of the machine, with a switch and fuses for a protection to the motor circuit. It may readily be seen by comparing Figs. 7 and 6 that the drum type of controller lends itself exceptionally well to shop work. The contacts are inclosed in the case and the handle is not only a convenience to the operator but is here placed so that it may be reached without leaving the normal position of operation.

Both the examples of Figs. 6 and 7 have shown applications of the direct-current motor with wide ranges in speed. There is no reason, however, why a constant-speed motor may not be employed provided due regard is given to the requirements of speed changes. In Fig. 8 a 24-in. heavy-service shaping machine is shown with the motor arranged to supply power through a speed box so that a constant-speed motor may be employed; although an adjustable speed unit may also be used, in such a case giving just that much more flexibility in the control of speed. The compact appearance of each of the shaping machines in Figs. 6, 7 and 8, is apparent since the motor has been adapted to the machine in a way to produce a good mechanical as well as electrical result.

To illustrate the use of an alternating-current induction motor for shaping-machine operation Fig. 9 shows a 15-in. machine driven by an induction motor mounted in the rear of the machine. The three-pole switch for the motor is indicated clearly to the right immediately above the motor with the electric wires of the power supply passing directly from the switch through a flexible conduit to the iron conduit in the floor.

In Fig. 10 a slotting machine is shown equipped with an induction motor mounted on a special bracket to the right. In this case the power is transmitted to the machine through completely inclosed gears (not shown in Fig. 10), and a lever is employed for securing speed changes. The gears as used here are so incased that they may be operated in oil, and this general arrangement is classed by the machine manufacturer as an excellent method of applying power to such machinery. In Fig. 11 the cover plate is removed so as to show the gears in their inclosing case. It is possible to use the reversing motor, as with the modern method of planing-machine driving, instead of the ordinary induction motor in Figs. 10 and 11, this latter scheme being a good one because of the reduced amount of gearing required.

Finally in Fig. 12 a slotting machine is shown with an individual motor attached to the side of the machine frame and the outer gearing being exposed to view. In all of these illustrations the adaptability of the motor to almost any position of mounting and for practically any condition of service will be apparent.

A good deal might be said regarding the economy and advantages of the individual motor for machinery of this class in contrast to the group method of driving. In conclusion there seems no better way of summarizing the foregoing remarks than to include a brief statement made some time ago by E. P. Bullard and quoted effectively by Mr. Stratton in his article in the *American Machinist* previously referred to, in which he says in part:

"In analyzing the various elements of machine tools the question naturally arises, Wherein can they be improved? There are many ways. First, let us consider the question of control. Control is the essence of machine-tool operation. It plays the largest part in the production of work. Control is everything. We

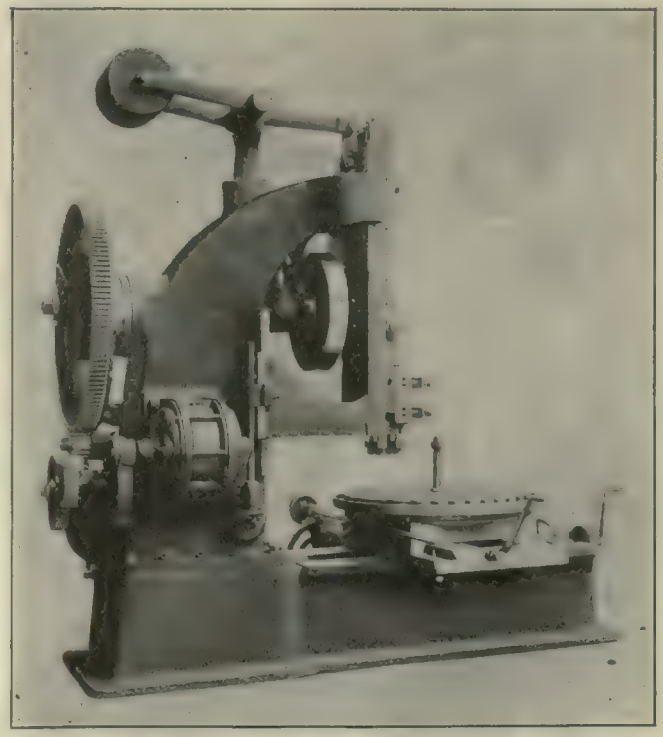


FIG. 12. A MOTOR-DRIVEN SLOTTING MACHINE WHERE THE MOTOR IS ATTACHED TO THE SIDE

see it in other products and think nothing about it. When you touch a typewriter key and the letter is impressed on the paper we think little of that; but there is infinite exactitude in getting that impression.

"And so with the machine tool. It must not merely be started and stopped; it should be started precisely at the right time, under perfect control, and should be stopped exactly when you want it. The machine tool should do the work; the operator should use his energy solely in directing it. He should not be called upon to spend his valuable time or his mental energy in operating an oil can on 60 or 100 different holes which are supposed to be oiled. He should not be called upon to shift dangerous belts or move heavy parts. We can do all of these things by power."

Operations of the United States Employment Service

For the first time in the history of America's development employers have the opportunity of selecting from a large and varied list of highly educated and experienced men individuals especially equipped to meet their particular requirements.

Engineers, executives and men of college training and practical experience in the business and technical fields are returning from Army, Navy and war work. The Professional and Special Section of the United States Employment Service, a branch of the Department of Labor, has been organized for the benefit of employers in need of these men, and its service is entirely free of charge. The organization already has thousands of well-educated skilled men on its lists and is daily putting many of them in touch with employers.

The country is divided into two great zones for the purposes of the Professional and Special Section. The New York Office, headquarters for the Eastern Zone, at 16 East 42nd St., is in charge of the following states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Ohio, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida and Alabama. The Chicago office, headquarters for the Central Zone, at 63 East Adams St., is in charge of the remaining states. Later zone offices will be established to take charge of part of the territory now in the Chicago zone.

The United States Employment Service is represented in each of the 48 states by a head office under the immediate jurisdiction of the federal director of that state. All local community labor boards are responsible directly to the federal director in their work of placing skilled and unskilled labor. The office of the federal director is particularly charged, however, with filling requisitions from employers for the highest type of business, professional and technical men. These men are registered only in the Professional and Special Section. In case the office of the federal director for a particular state cannot supply the high-grade man required by an employer the requisition for that man is forwarded at once to the zone office to which that state is responsible. Likewise the applications of men qualified for important positions are forwarded through the same channels.

The zone offices at New York and Chicago have therefore become clearing houses where returning men are classified in accordance with their qualifications and where the requisitions of employers are matched against them. So complete is the system of classification and so diverse the qualifications of the thousands of applicants that the most exacting requirements of an employer as stated in his requisition can be met in each detail.

The United Engineering Societies, composed of the four great engineering organizations—the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers—are now coöperating with the Professional and Special Section in placing men in the engineering professions. The high standard maintained both by the Government organization and by the societies has proved to be of the utmost benefit to employers as well as to experienced engineers seeking employment.

A branch has been organized for the registration and placement of teachers. At present this branch is operating in the head office of each state under the management of the federal directors, and whenever necessary both positions and applications are cleared to the zone office.

The interests of women fit for high-grade business and technical and professional positions are cared for by another branch, which is administered by experienced professional women. In order to register in the women's branch an applicant must be either a college graduate or experienced in some particular line of executive or administrative work.

The type of men and women registered is indicated by the following partial list: Statistical workers, stenographers, typists, clerks, accountants, advertising and publicity workers, agricultural experts, artists, auditors, bacteriologists, bankers and brokers, biologists, chemists, chemical engineers, cost experts, credit managers, dentists, draftsmen, editors and journalists, electrical engineers, executives, general managers, household-economy experts, industrial engineers, lawyers, librarians, mechanical engineers, metallurgists, mining engineers, nurses, office managers, pharmacists, physicians and surgeons, production managers, purchasing agents, real-estate and insurance workers, refrigerating engineers, safety engineers, sales managers and salesmen, secretaries and correspondents, social, civil and religious workers, superintendents, surveyors, teachers, traffic managers, works managers and inexperienced college graduates.

The employer should get in touch with the office of the federal director in his state or write direct to either the New York or Chicago zone offices. It is important that complete and specific details be given of the position to be filled, together with the maximum and minimum salary he will pay. These details are regarded as confidential by the Government and are withheld from the applicant.

Once introduced to each other the employer and applicant are left to work out details. Often a number of applicants with equally good qualifications are referred to the same employer in order that he may decide for himself on the basis of their personalities.

The New York and Chicago zone offices are now placing men at salaries ranging from $1000 to $15,000.

Disability Under the Compensation Acts—I

By CHESLA C. SHERLOCK

Do you know what constitutes "disability" or "incapacity for work" under the Workmen's Compensation Acts? Or how long a workman should be paid for temporary disability? The statutes of the various states differ somewhat on these points, of course, but the general principles are the same. The discussion of temporary disability in this article throws a good deal of light on the probable interpretations of the courts which, after all is said, have the greatest interest for employer and workman. Coming articles deal with other forms of disability.

ACCORDING to the workmen's compensation acts the employer is bound to pay compensation to workmen for "disability" or "incapacity for work," provided such disability or incapacity is the result of an accidental injury arising out of and in the course of the employment.

The statutes very generally recognize that there are several degrees of disability and proceed to define them, outlining in each case the measure of the compensation which the employer shall pay in case the workman sustains such disability.

As to what constitutes compensable disability and as to what injuries are to fall within the limited classes mentioned by the statutes there is considerable dispute. Only by an examination of the cases decided by the courts bearing on this point can we find any light as to just what is meant by the legislative phrases mentioned above.

Disability is generally divided into: (1) Temporary, (2) partial and (3) permanent. The best general definition of these classes that can be given is to say that each class means just what the words given above signify. There is no difficulty in saying that a temporary disability is one which is merely for the time being; but to attempt to classify a given injury such as may arise in practical experience is an entirely different matter.

The reason for this is that two workmen may sustain an identical injury, but it will affect them differently. One man may be suffering only from a temporary disability and have his full earning power restored within the course of a few weeks, while the other, by nature of his previous condition of health, may have his suffering prolonged indefinitely and may never recover the earning power he enjoyed prior to his injury.

The final analysis rests of course with the courts, but it is really becoming the practice to rest the matter largely with the opinion of competent medical men. In a given case where it is doubtful whether the injury is temporary or permanent, and it is desired to adjudicate the workman's compensation rights, the final decision will rest largely on the opinion of medical experts familiar with the injury in question.

The statutes have said in most instances just what the measure of compensation shall be for a temporary disability, and these statutory allowances are based on what is assumed to be a reasonable time for all injuries of such a nature to be completely restored. But the statutes go further in many instances and specifically limit the amount of compensation which shall be paid for certain schedule injuries.

For instance, the statutes say that if a workman loses a foot he shall receive a certain amount of compensation extending over a certain period of weeks. Let us say that the law allows the workman 50 weeks' compensation for the loss of a foot. If the foot has been completely severed by the accident or has been amputated the workman should be able to resume normal employment within the period mentioned. Suppose, however, that he has not had his foot amputated, but has lost the entire use of it. It is the practice under such cases to award him compensation for the loss of the foot, 50 weeks as we have put it. In the course of time the 50 weeks are up and the workman is still unable to return to his employment. His foot is still useless and always will be, but in addition it causes him such pain and suffering that he cannot ignore it as he would an artificial foot. He is unable to walk on it because he has lost control of his muscles and it trips him. Just what is the measure of the disability of this man?

It is not possible to go into all the perplexing situations which are arising in industrial employment every day, but it is hoped that this discussion may serve to express the law in such a way that much of the doubt of the past concerning disability will be removed.

Meaning of Disability

Disability does not necessarily mean loss of earning power. It may mean more than that, and very often does. Disability means something more than loss of earning power, for a man may receive an injury and still be entitled to compensation. The mere fact that he is able to continue at his work and draw his wages is not the controlling factor, but it may be in the case of temporary disability, and it may not.

If a workman suffers an ordinary temporary disability so that he is unable to resume his work for two weeks, but has apparently received no injury other than a bad shaking up or bruising, his loss of earning power is the controlling factor in his right to compensation.

However, if the workman loses one of his fingers and has it bandaged up and returns to work in two days perfectly able to go on with his work his compensation cannot be denied him, because loss of earning power is not the controlling factor in his right to compensation. He has received a permanent injury which the law deems to have impaired his efficiency in a certain measure and the law awards him a certain scheduled amount of compensation for the loss of his finger. The workman, in such a case, may actually lose no wages whatever but still be entitled to draw his compensation.

The proper distinction then between disabilities arising in industrial employment is very necessary to employers, for it may mean a saving of money to them. Compensation should be paid when due, but it should be withheld when not due. To place one injury in the

wrong class may benefit the worker and harm the employer and it may harm the worker and benefit the employer.

While loss of earning power is not a controlling factor it is certain that some impairment of the worker's efficiency must exist if compensation is to be payable. An injury which causes no loss of earning power and which in no way impairs the efficiency of the workman in his employment is not a compensable injury within the meaning of the compensation acts.

In arriving at the question of whether disability exists a long line of decisions holds that the rating is to be made on the basis of the employment in which the workman was engaged at the time of his injury. He may still be able to carry on his duties in that employment without any impairment of efficiency and not be entitled to compensation unless he suffered a schedule injury, while in another employment he would be hopelessly inefficient.

It is impossible to hold employers for problematical impairment or to attempt to base a disability rating upon any other than the employment in which the man was at the time of his injury. Thus, to say that a machinist should have compensation for an injury which impaired his efficiency as a farmer, clerk or salesman would be manifestly unfair. He can obtain compensation only on the basis of his disability as a machinist unless he has suffered a schedule injury, which is entirely out of the hands of others than the legislative authority to determine.

Entitled to Full Compensation

However, if the machinist suffers a total disability as a machinist he is entitled to full compensation as allowed by the statute regardless of the fact that he might still have earning power in other occupations and might even make more money in such other occupation than he did as a machinist.

Many of the acts use the expression "incapacity for work" in this connection. A dispute has arisen as to just what the expression includes. Does it include inability to find work to do, as well as inability to do such work as the workman was accustomed to do prior to his injury?

In England it was said that the inability of a workman to walk to his work amounted to total incapacity and that he was entitled to compensation. In Massachusetts it was said that inability to obtain work resulting directly from the injury causing the incapacity was an "incapacity for work" within the meaning of the statute, while a like inability arising from another cause, such as an altered condition in the labor market, would not be. In one case a workman lost an arm, and it was held that he was entitled to compensation until he was able to obtain employment again, although he had during a portion of the time been physically able to work but could obtain no employment because one-armed men were not wanted.

The attitude taken by the courts is well expressed in the opinion of Cozens-Hardy, a British authority of international reputation: "The question which the judge put to himself appears to have been: Was the man able to earn the same wages that he was before the accident? I do not think that was the right question. The question should have been: Is he hampered in the labor market by reason of the accident? Is he not less likely to secure employment? If he is it would not be right to disentitle him from ever saying that his capacity was diminished by reason of the accident."

Very often workmen, especially those working with machinery, receive injuries which affect their muscular capacity and also cause mental pain and suffering. The muscular effects may be actually cured before their mental effects have been removed. If a man is able to return to work, so far as muscular capacity is concerned, but still believes that he is unable to work, a very nice question as to the duration of the disability arises.

Mental Effects of Injuries

The shock to the mental state of the man may amount to nervousness and fear—fear of the work which caused his injury. Until he is restored to his full vigor, both physical and mental, can he be said to have recovered from the effects of his injury?

Another quotation from Cozens-Hardy: "The effects of an accident are at least twofold: They may be merely muscular effects—they almost always must include muscular effects—and there may also be, and very frequently are, effects which you may call mental, or nervous, or hysterical. I cannot for the moment think which is the proper word to use in respect to them. The effects of this second class as a rule arise as directly from the accident which the workman suffered as the muscular effects do, and it seems to me entirely a fallacy to say that a man's right to compensation ceases when the muscular mischief is ended but the nervous or hysterical effects still remain."

The Massachusetts court has even gone so far as to say that the mere fact that a workman by the exercise of sufficient will power could have overthrown the effects of his nervousness and returned to work is not sufficient to deprive him of his right to compensation.

The question of whether such a distinction as is noted in the jurisdictions where the compensation is payable for "incapacity for work" would obtain in the jurisdictions where it is payable for "disability" naturally remains in some doubt, but the general assumption is that the two terms amount to the same thing and that such distinctions would obtain everywhere.

With these general considerations in mind we can now proceed to a discussion of the subject matter a little more intelligently.

Duration of Temporary Disability

In the case of temporary disability it is impossible to give a legal definition which will cover all of the states in which compensation is in force. Such definitions are found in the respective acts. It is possible to give one, however, which expresses in general terms the legal significance of the term.

In New Jersey it was said that temporary disability, as distinguished from permanent disability, is a condition that exists until the injured workman is as far restored as the permanent character of the injuries will permit.

The acts provide that so long as the workman suffers from temporary disability he shall be compensated according to a certain percentage of his "average weekly

wages," as set out by the acts, not to exceed a certain number of weeks. This figure is generally placed at 300 weeks. It is deemed that a man suffering from temporary disability should have recovered his normal usefulness within that time.

This very often comes within 100 weeks of the amount of compensation granted for a permanent disability. Employers are frequently unable to understand why the acts should allow nearly as much compensation for temporary disability as they do for permanent disability. The reason for this can best be shown by an example taken from an actual case.

Some Permanent Injuries

A workman received what was called a temporary disability under the law, but his injuries were permanent in some respects. In addition to the temporary disability he suffered as a result of the injury the following permanent injuries: (1) A fracture and dislocation of the right wrist, resulting in an enlargement which interfered with the use of the wrist and hand; (2) a fracture of the small toe of the right foot, which caused it to protrude in an unnatural manner and caused the workman considerable annoyance; (3) a fracture of the pelvic bone which shortened one leg, making the workman permanently lame, caused annoyance and occasional pain and interfered with his ability to carry on his work.

Because it was shown that the workman had been able to resume his former employment in spite of these permanent injuries and receive his former wages the trial court granted compensation only for the temporary disability; that is, for the time he lost from his work. The supreme court of New Jersey, however, held that this finding which refused to grant a reward for the permanent disability was erroneous.

Experience of Authorities

Unquestionably a man so injured is entitled to more compensation than his mere temporary loss of time would allow him. The long period of time allowed under the acts is for the purpose of taking care of workmen who receive injuries which require some time to heal, and the experience of the authorities is that the great mass of disabilities will be restored if given a sufficient length of time. If a man drags through several hundred weeks and still fails to recover his usefulness his injuries, which at first appeared to be temporary, may be found to have acquired a permanent character and an adjudication so made.

But it is seldom found that a workman who has received compensation for a long period as suffering from temporary disability can, upon a finding that his injuries are permanent, recover the full amount of compensation allowed for permanent disability. The amount of compensation he has received when his temporary disability took place is deducted from the statutory amount allowed for permanent disability.

A man may be technically entitled to compensation for temporary disability and for permanent disability at the same time, but he is not generally allowed to recover for both of them separately and independently. Such payments are deemed to run concurrently, he receiving compensation for the greatest length of time which the statute allows him for his injuries.

While this is sometimes not true, due to statutory enactment or judicial construction, in the main it expresses the rights and liabilities of the parties.

Temporary disability commences from the time the workman is incapacitated from work and extends until such time as he is restored to usefulness and earning power. It may even extend to greater lengths. It has been held in some states that it extends to the time that the workman is able to obtain employment, provided his inability to secure it is due to the injury.

But the period of temporary disability will not be prolonged through any fault on the part of the injured workman himself. If the man receives an injury to his leg, for instance, and is prevented from recovering his normal earning power and employment because of his failure to properly exercise such leg then there is no legal justification for prolonging the compensation payments. The California commission has so held.

Prolongation of Disability

This prolongation of disability is very frequently the case with workmen. They find it easier to receive compensation than to work, and they prefer, for reasons unto themselves, to prolong the period of payment just as long as possible. They know that when they return to work, having suffered no impairment of efficiency, their compensation will cease.

Malingering is not a compensable disability under the acts, and as soon as the workman commences to feign disability it is proper to cease the payment of compensation. This difficulty is more frequent in temporary disability cases than in any other.

However, if a workman is suffering from neurasthenia, a state of mind which has arisen out of his injuries, and, while able to return to work, honestly believes that he is incapable of working there is no justification in stopping the payment of compensation.

Malingering and neurasthenia are the two extremes of the normal difficulty with injured workmen in getting them to return to work after suffering from temporary disability. In the first case there are no methods too harsh to compel a workman to return to work. The employer is justified in stopping all payments when such a case exists.

But in neurasthenic cases the situation is vastly different. The workman is still suffering from a disability arising out of the injury, a nervous shock which has affected him quite as much as the loss of a member. He is entitled to compensation until he can be brought back to the normal usefulness of his mind, for he is still suffering from a compensable disability under the law. He is also an object of pity, for there is nothing more pathetic than a true sufferer of neurasthenia. Such cases should be handled only by the most competent medical men, and no efforts of coercion or force tending to induce him to return to work, as are justifiable with malingerers, should be practiced, as the probability is that the period of disability will be increased rather than diminished.

There is another situation arising in cases of temporary disability closely akin to malingering. It is what the Germans called "compensation hysteria;" that is, a desire for compensation. The workman feigns injury as well as disability in the hope of recovering compensation. The less said of this the better.

The mere fact that the injured member is sensitive or tender will not prolong the period of compensable disability. The Wisconsin commission has pointed out the fact that a workman must return to work even at the cost of inconvenience to himself or that his period of disability will be deemed to be at an end.

Compensation is not payable for further periods when it is shown that by the mere use of injured members the workman would be able to resume his employment. It is natural that even after the member has completely healed there should be some soreness and stiffness in it, but the employer cannot be held for compensation for mere inconvenience or pain. The man may actually be put to great inconvenience for a few days, but if his injuries have actually mended then it is proper to discontinue payments if he refuses to return to work.

What These Examples Show

These examples only go to show the need of each case being determined and governed according to the circumstances immediately surrounding it. If a man is unable to work he is suffering from "disability" or "incapacity for work." If he will be able to return to work within a course of time then he is suffering only from temporary disability, unless his injuries have been permanent in character, such as the loss of a finger or hand.

Where there is a true temporary disability the employer's liability dates from the time of the accident to the time the workman is restored to normal usefulness. The loss of earning power may be said to govern largely cases of this nature.

If the injury has been permanent in character, but the disability or incapacity from work only temporary in time, then the loss of earning power is not the controlling feature of the case, but the impairment of the workman's efficiency in the employment is the controlling feature, and the employer's liability will be based upon the schedules contained in the law.

It is hard to draw the distinction for the reason that few injuries received by workmen are clear cut in their application to the disability classes, but nearly always embrace one or two or all of them at some time in the history of the case.

Tool Grinding

By B. L. Van Schaick

In the old days when a foreman was a foreman because he was the most skilled worker in the department every man was allowed to go to a stone and grind or set his own tools. Then too every man was a real mechanic, stayed on the job for years and knew the "why" as well as the "how" of his work. The cribs were small, the tools comparatively simple, the various grades of high-speed and carbon steel unknown and the quantity production and accuracy of work demanded today undreamed of.

Under present conditions, with workers trained for certain operations only, and with a multitude of differing grades of steel, small tolerances and high-speed production, the more the grinding wheels are centralized the better the general results will be. The location of all tool-grinding apparatus in one or more maintenance cribs will reduce the percentage of rejections, lengthen the life of the tools and increase production. When a productive worker goes to a stone to grind a tool he not only loses productive time and allows his own machine to lie idle but he also wastes effort, for he cannot grind as well or as quickly as a skilled tool-repair man. In addition to the time lost greater damage is often done, as every worker has his own ideas as to how a tool should be ground and in suiting his personal fancy he turns out a tool that is not standard to the shop nor fitted for another worker's use.

Proper Grinding

In cutters especially, frequent proper grinding prolongs the life of the tool and increases production. The worker, if driven for production or working on a piece basis, is apt to lose sight of this and run a slightly dulled tool which leaves burs and slows down the work. Cutters should always be ground to blueprint by skilled tool men in order to obtain standardization of product, and care should be used in selecting the proper wheel for each particular job. The use of an improper wheel tends to burn or draw the temper from the thin edge of almost any tool, and grinding wheels therefore should be soft and free cutting, the cut always light and never forced. If the wheel is too soft its rapid wear makes it difficult to keep the cutter a true cylinder or to leave a sharp edge, and if too fine the wheel is apt to burn the work.

Although lathe tools seem at first glance to be less susceptible to centralization the reverse is usually true. One argument against individual grinding is the attitude of the workers themselves. Almost anyone who can run a lathe will apply for a job as a toolmaker at every opportunity. Give a man a lathe job for a few weeks and he considers it a slight not to be allowed to design, let alone grind, his own tools.

Reasons for Centralized Grinding

As a matter of fact there is less reason for allowing the individual grinding of lathe tools in a general machine shop than for the grinding of cutter wheels. Lathe tools are designed by a skilled tool designer for turning out a special part. A full set of tools is designed to complete the part, and even though they may be used on various machines the parts must assemble properly. Allow a worker to change a tool by grinding and the assembly department will begin to have its troubles, as the process inspectors will condemn the goods. Ordinary common sense should tell us that the best brains are selected to design the tool in the first place, and that if the worker knew better he would have the designer's job.

Another reason for centralized grinding is that no lathe tool should be ground without a print or gage if standardization is to be maintained and it is not practicable to have a complete set of tool drawings available for every operator.

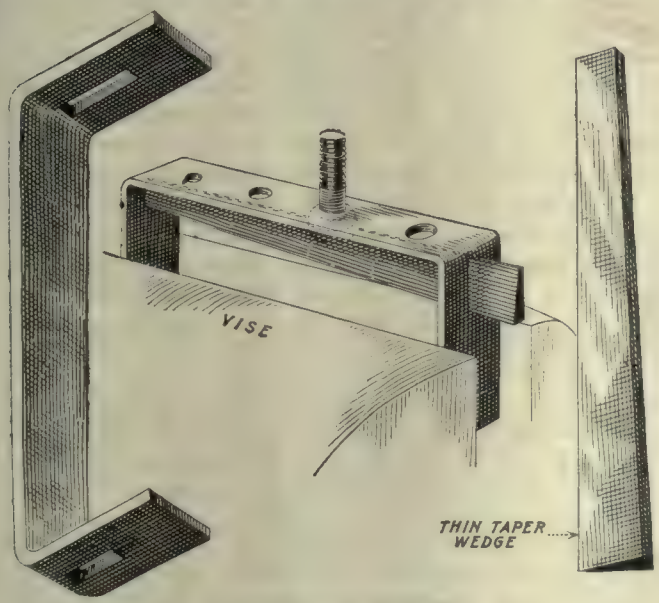
A central tool-maintenance crib will also develop valuable records as to the comparative life of different makes of tools and grades of steel. A tool which would be scrapped by a worker is reground and issued as a new or different type of tool by the skilled toolmakers of the crib. In 99 shops out of 100 a centralization of all tool maintenance and repair will prove a profitable investment.



A Vise for Holding Small Screws

By Charles H. Willey

This simple device is worth adding to the bench-vise attachments. It is made from a piece of ⅛ x 1-in. flat stock. The top edge of the wedge must be made narrow enough to fit the slots in the heads of the screws, for it is this that holds them from turning.



A VISE FOR SCREWS

Making 25 5-In. Sine Bars

By John Teckeer

Recently I had 25 5-in. sine bars, as at *A*, Fig. 1, to put through the toolroom. The number was just sufficient to appear worthy of specials and not great enough to warrant them. Thinking the job and method used may be of interest and possibly some benefit to your readers my solution is here given in detail, designating the time on such articles as tools, operations, etc., and disregarding the time on operations that were not a factor in deciding any special requirements. Also bear in mind this job was done in the toolroom of a contract shop, where there is no repetition work to any extent, and all jobs move at toolmaker's speed, which, to say the least, is variable.

The advantage of checking each operation cost with and without specials rather than comparing the aggregate figures is readily apparent. First I lay out the operations, study them and decide on probable operations wherein time can be saved and quality improved, as shown in Fig. 2. Those that appear worthy of specials I bracket and roughly sketch the suggestion in mind.

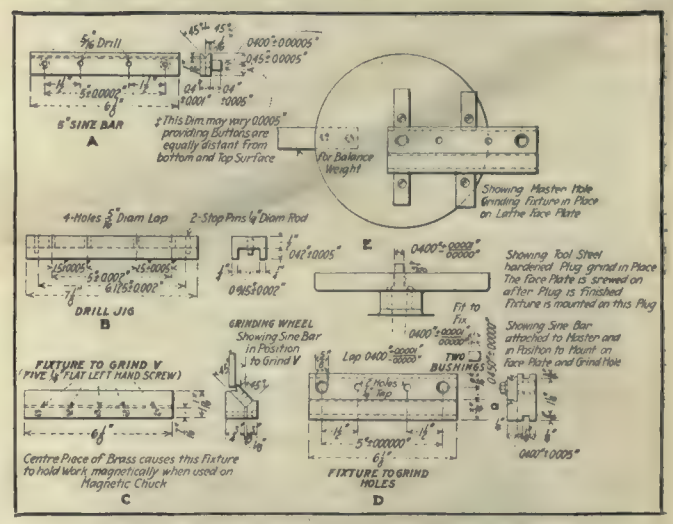


FIG. 1. THE SINE BAR AND THE TOOLS

Using this as a key I develop the ideas to completion, and set down on comparative sheets the results in time, labor and material to be expended both with and without special tools. This, with impartial judgment of the merits of each method, decides the operations as shown in Fig. 3. We find the formed cutter and fixture for

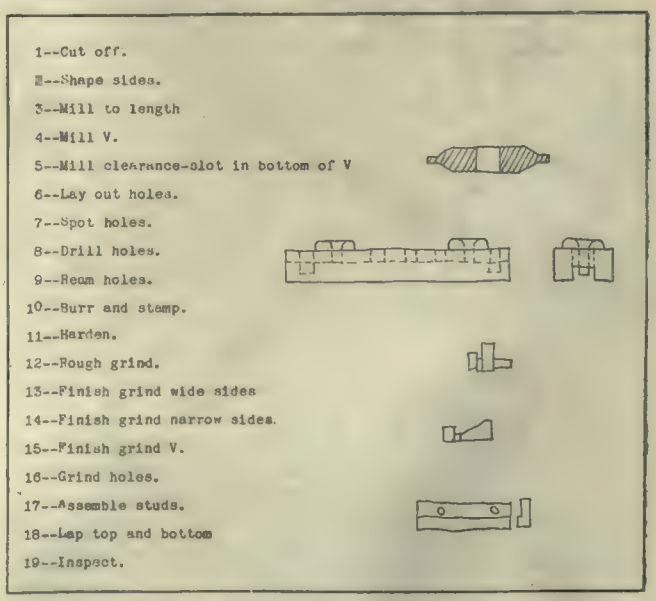


FIG. 2. THE TENTATIVE LAYOUT

grinding the narrow sides eliminated, but the drill jig and the fixture for grinding the Vs are warranted.

These two, with the master fixture, the necessity for which cannot be questioned, are drawn up and made as shown at *B*, *C* and *D*, Fig. 1.

Regarding the grinding fixture, the holes can be ground in an average time of 3 hours for each bar, and I feel that a description of its construction may be of interest.

The making of this fixture required the highest degree of skill, as the distance from center to center of the holes, and from the centers of the holes to the surface *a* (sketch D, Fig. 1), was held practically without

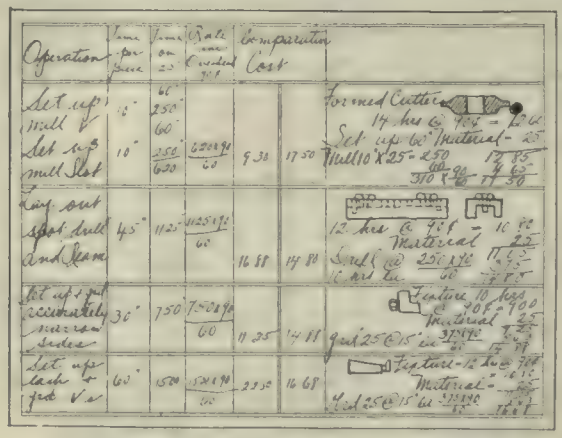


FIG. 3. THE COMPARATIVE COST SHEET

tolerance. Holding the master to these limits led us to assume that it would duplicate itself within 0.0002 in., which was the greatest tolerance permissible on the completed sine bars. Cast iron was used for the fixture body and was shaped to form.

The master holes were buttoned and bored to $\frac{5}{8}$ in. diameter, leaving 0.005 to finish on surface *a*. The distance between centers was made as nearly perfect as could be accomplished. The hardened and lapped bushings were then inserted and finish-lapped to 0.400 in. diameter. The bushings were indicated for parallelism, using a 5-in. radius trammel, and held within 0.0005 in. of indicating true. This on the bushing length amounts to 0.000025 in. on each bushing, or a possible collective error of 0.00005 in. The fixture was then ground all over in proper relation to the holes and the 0.450-in. dimension finished last.

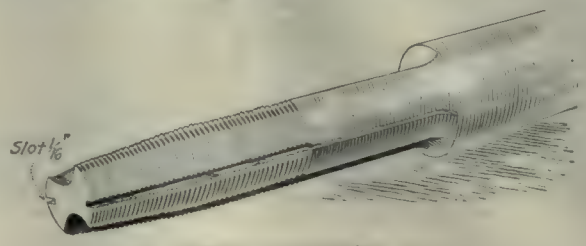
To use on the bench lathe a plug was ground and lapped in place, as shown at *E*, Fig. 1, to 0.400 in. in diameter, the faceplate being put on afterward. The fixture, with the sine bar attached, is then slipped on the peg and the hole is ground. Without moving the sine bar the fixture is then reversed and the operation completed. The finished plugs were then inserted and the job was ready for inspection.

A Special-Purpose Tap

By A. Kirby

In the course of our work difficulty was experienced in tapping a 0.202 x 36 United States Standard thread to a 0.003 limit. At first we used a high and low thread gage, but found when the screws were assembled that many would not screw down tight, but slipped as though the thread was stripped, although the screws were to size and the tapped hole passed the gages.

On investigation it was found that the holes had been drilled too large or the tap clogged, and there was only about one-quarter of the proper depth of thread inside the hole, so we discontinued the use of the high thread



A SPECIAL-PURPOSE TAP

gage, and used in its place a high plain-core gage so that the low gage was to go in and the high core gage not go in.

Then our troubles commenced. We tried every known means to stop the tap from clogging (we were tapping soft brass); we tried tapping them dry and we tried various kinds of lubricant, but it was of no avail.

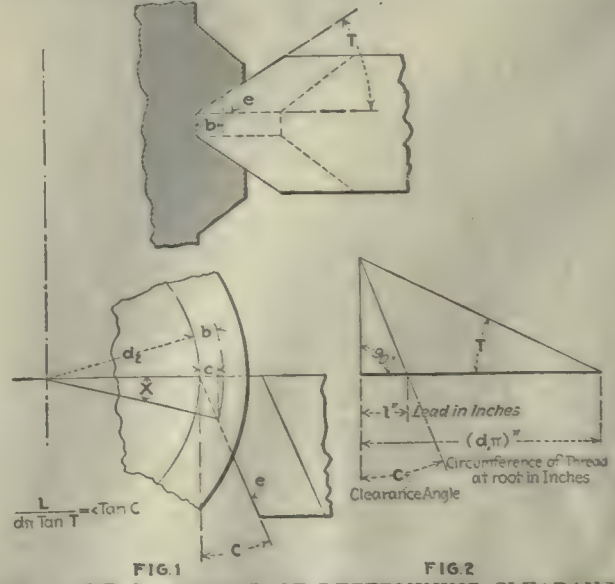
As an experiment I had a tap made with only two flutes of standard depth and width, and, with a $\frac{1}{16}$ rubber wheel ground a flute in each land about 0.010 in. deeper than the bottom of the thread.

This ended our trouble. The land being wide had a steadying effect on the tap and the narrow flutes ground in each land broke up the chips. Whenever I have fine threads to tap in soft metals, especially where close limits are required, I now use this style of tap with satisfactory results.

The Graphical Solution for Clearance Angle of Form-Ground Thread Tools

By S. C. Bliss

A problem often encountered in the design of form-ground thread tools of the type shown in Fig. 1 is that of determining the clearance angle *C* necessary in order to avoid interference of the tool edge *e* with the surface of the thread helix.



FIGS. 1 AND 2. METHOD OF DETERMINING CLEARANCE ANGLES ON THREAD TOOLS

Referring to Fig. 1 let d equal the root diameter of the thread in inches. Let l equal the lead of the thread in inches.

Then $\frac{l}{d\pi}$ equals the tangent of the helix angle H. Let T be the angle between the side of the thread and a line drawn perpendicular to the axis of the screw. Let x be the value of the angle X expressed in radians.

In order to avoid interference: I. $\left(\frac{d}{2} + b\right) x \tan H = < b \tan T$.

From Fig. 1 we have: II. $\left(\frac{d}{2} + b\right) \sin X = \frac{C}{\tan C}$.

Dividing I by II we get: III $\left(\frac{x}{\sin X}\right)\left(\frac{c}{b}\right)\left(\frac{\tan H}{\tan T}\right) = < \tan C$, and when the angle X becomes infinitely small we get the following equation, which is the solution of the problem:

$$\text{IV } \frac{\tan H}{\tan T} = < \tan C, \text{ or } \frac{l}{d\pi \tan T}.$$

Fig. 2 shows the graphical solution of equation IV for the value of the clearance angle C. It is advisable to make the clearance angle on the tool slightly larger than C. This solution is correct for both external and internal threading tools. In using it for internal-threading tools it should be noted that d is the root diameter of the thread.

Cutting Threads of Unusual Pitches

By Miles C. Smith

In the jobbing and maintenance shop occasion often arises to cut a thread of so uncommon a pitch that we have no lathe equipped to handle it. Of course we could make a new gear to comply with the requirements, but an easier and much less expensive way is to utilize the taper attachment in combination with an offset of the tailstock. In this way we may set our lead screw at the nearest approach to the lead wanted and make

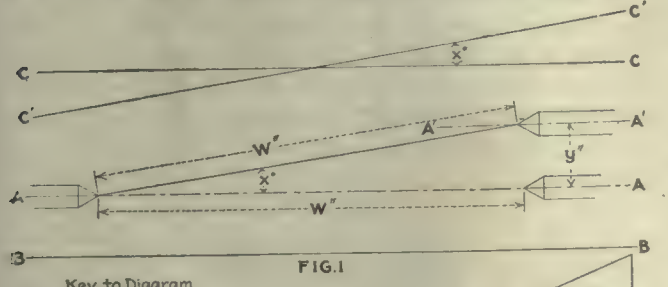


FIG. 1 FIG. 2

FIGS. 1 AND 2. CENTER LINE DIAGRAM OF VARIOUS LATHE CENTERS FOR CUTTING SPECIAL THREAD

up the necessary error, at the same time cutting a perfect thread.

This method is no doubt familiar to those of the trade who are widest awake, yet I have never found anyone who employed a formula to set his lathe but set it by trial, so I will give a formula which will be found to be absolutely accurate and will also show its derivation.

Fig. 1 gives the center lines of all the essential factors with the taper attachment and tailstock in both their normal positions and in the positions they take to accomplish our purpose. We know the values of all except x deg. and y in. They may be found by solving the following formula:

The cosine of the angle x is found by dividing the number of threads per inch required by the number of threads per inch nearest it on the lead screw. From a table of natural angle functions or by laying out the triangle we find x in degrees. Then taking the natural function of the sine of x deg. and multiplying it by the length of the work in inches we have y, or the required throw of the tailstock in inches.

Let n = Number of threads to the inch on the lead screw, and

n' = Number of threads to the inch required.

Then the length of one thread on the lead screw would be $\frac{1}{n}$ in. and the length of one thread required would be $\frac{1}{n'}$ in. Now if we take the small right-angle triangle in Fig. 2 and substitute for the side a, $\frac{1}{n}$ and for the side c, $\frac{1}{n'}$ and solve the triangle for the angle x, we have cos . $x = \frac{a}{c} = \frac{\frac{1}{n}}{\frac{1}{n'}} = \frac{n'}{n}$, two values we know.

Solving this will give us the natural function of the angle x by which we find x the angle necessary for the throw of the taper attachment and the angle the work must be thrown off the horizontal to accomplish the desired result.

To find y we take the same small triangle, and for the side c we substitute W in., the length of the work, and for the side b we substitute the unknown y and solve for y, letting the angle x remain the same angle which we now know the value of in degrees. Then Sin . $x = \frac{b}{c} = \frac{y}{W}$, which gives us the value of y in inches.

This may seem rather complicated for the average machinist, but when we consider that every handbook has a table of natural-angle functions and that if no handbook be available it is but a few moments' work to lay out the two triangles with square, dividers and protractor, and also considering the time saved from the old cut-and-try method, it will be found to be well worth while. The two formulas could be combined and one solution would give the throw of the tailstock from which the taper angle could be easily found, but the two simple formulas seem to me to be the most useful.

We wish to cut 19 threads per inch on a machine screw which measures $6\frac{1}{2}$ in. over all. Our nearest lead on the lathe index is 20 threads.

In this case $n = 20$, $n' = 19$, $W = 6\frac{1}{2}$ in. Cos. $x = \frac{19}{20} = 0.950$; from which $x = 18$ deg. 10 min. Now taking the natural sine function of 18 deg. 10 min. which is 0.3118 and substituting again,

$0.3118 = \frac{y}{6\frac{1}{2}}$; $y = 2.026$ in., or approximately $2\frac{1}{32}$ in. Then setting our taper attachment at an angle of 18 deg. 10 min. and throwing our tailstock over $2\frac{1}{32}$ in.

we will be ready to go ahead and cut our thread in the usual manner with our index gears set for 20 threads per inch.

The principal factor in this setup is to be sure that the center line of the work and the working center line of the taper attachment are absolutely parallel, otherwise the thread cut will be imperfect.

Efficiency in Crating Machinery

By J. V. Hunter

Machine builders as a rule make every effort to obtain the maximum degree of efficiency in building their machines, but after the machines are finished and have passed final inspection too often efficiency ends before they get to the crating department, or boxing room, as many term it.

In the plant of the Ransom Manufacturing Co. at Oshkosh, Wis., however, efficiency has been extended even to crating its grinding machines. The steel framework shown in Fig. 1 is for storing the lumber that is required for crating these machines. It has a separate section for each of the standard sizes of lumber used the heavier pieces being on the right-hand side. When removed from the rack they fall on the crosspieces *A*, which are on an exact level with the saw table, and the lumber may be slid along to the saw without further lifting effort.

The saw and its table are shown in Fig. 2. The saw was designed and built by the Ransom Manufacturing Co. and has remarkably easy motion in its forward and backward swing. The table is of special interest. It has been laid out with the spaced holes *A* in an iron plate, so that the operator using the adjustable block *B* for his lengths of lumber need never stop to make a measurement. The stop block has two pins on its lower side, which fit in the holes in the table, holding it firmly in position during cutting of the lumber pieces.

The finishing touch of efficiency is obtained by the



FIG. 1. STEEL-FRAME RACK FOR LUMBER STORAGE



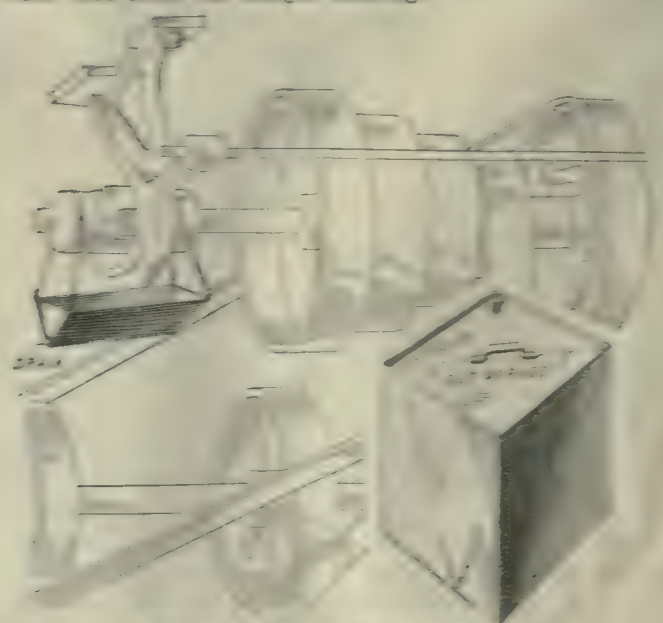
FIG. 2. THE SAW AND TABLE

series of data tables seen at *C*, one for each size of machine manufactured and each detailing the number of pieces and size of lumber required for that particular crate. Each table gives the complete list of parts for a machine. In reality there are two crate lists for each machine, one for domestic shipment and the other for foreign. Working from this list the operator pulls the required size of stock from the rack, sets the gage on the saw table for the proper length, and in a short time has all of the pieces cut for a complete shipping crate.

Use for Old Oil Tins

By Charles H. Willey

The sketch shows a good use for empty 5-gal. oil tins such as are used for petrol, automobile oil, etc. The can is cut across, as indicated by the dotted line, and the half that has the screw cap on it is suspended with wire from the hanger bearing.



DRIP PAN FROM OLD OIL TIN

Optical Projection for the Inspection of Screw Threads—I

By JAMES HARTNESS

President Jones & Lamson Machine Co., Vice Chairman National Screw-Thread Commission

In this article, which is reprinted from "Mechanical Engineering" (formerly the "Journal of the American Society of Mechanical Engineers"), the author gives an analysis of screw-thread elements essential to strength and dependability. In the second installment a description of a new and improved optical method for their accurate inspection will be presented.

THE screw, one of the most important elements in mechanism and found in nearly all forms of machinery, is invaluable as a means of fastening two parts together, as a means of precision adjustment and as a means of transmitting power.

In machines in which the weight must be kept as low as possible, as for instance in the airplane, it is of prime importance to have the screw as small as consistent with the strength and reliability required.

On account of the vagueness of our general knowledge of the conditions under which it takes its stress we frequently underestimate the importance of the screw, and through ignorance continue practices that greatly increase the hazard of life in travel by rail, automobile or airplane, as well as lessen the reliability of performance of other pieces of machinery. A screw-thread fastening is very dependable if the two component parts are properly fitted.

Analysis of Various Elements

While it is not possible to attain perfection in this work an analysis of the various elements that are essential for strength and dependability and the reduction of weight will greatly simplify our efforts and make it possible to attain a point much nearer perfection.

Briefly stated a screw's reliability depends upon the following elements: (1) Material; (2) form of profile of the thread; (3) diameter of the screw; (4) lead or the number of threads per inch.

After the foregoing general characteristics have been determined we must consider the following details which depend on the methods and skill employed in production: (1) Smoothness and density of surface; (2) fit, which relates particularly to the exact relationship of the size of the two component parts; (3) precision of lead, which relates to the precision of advance of the helix or degree of precision with which the number of threads per inch are made; (4) uniformity or steadiness of advance of helix; (5) form, relating to contour of a single thread; (6) roundness, as relating to the circular parts of the helix; (7) parallelism or taper. These elements are all interrelated.

Modern practice in constructing machinery is driving more and more toward absolute interchangeability of parts. In the older practice it was customary to fit one part to another either by doing the final finishing at the time the parts were assembled or by selective process, such as picking out the larger screws to be used with the larger nut or tapped holes and smaller screws to be used with smaller holes.

To a certain degree this method of fitting at the time of assembling, either by changing the size of the parts that go together or by selective process, is still necessary in the highest requirements of very close fits, but the trend is strongly toward perfect interchangeability.

This requires working to stated standards so that the size of the thread of the screw and nut will never exceed certain boundaries. But whether the boundary allows no freedom when the largest screw is turned into the smallest nut or a certain predetermined freedom of play there still remains the necessity for determining how large an internal thread may be made and still be acceptable, and how small the screw may be made and still be acceptable; in other words, what is the greatest degree of looseness that can be tolerated without impairing the dependability of the screw and nut for service.

Projection Lantern a Better Method

Thus far we have had no satisfactory way of specifying all of the elements that are required to make a screw dependable, but we are now finding that the projection lantern offers a better method and makes it possible to simplify specification and practice.

It will be understood that the largest percentage of screws must be made with sufficient play to make it possible to screw them together rapidly by hand and resort to the wrench only for setting them up to full tension. This is essential for convenience of assembling, which is an important part in the production of the machine and for the use of the product in service.

As an example we may take the bolts of the demountable tire rims of the automobile wheel. The nuts for these bolts should be a reasonably good fit. At the same time, in order to get quick interchangeability, they must not be too close; that is, they must turn with a certain degree of freedom; yet the service they render is so important that they must be a little closer than a wrenching fit, but must not be a tight wrench fit, at least at the outer end of the screw. While the limits of a screw fastening for this service are very small the case illustrates the fact that a given degree of freedom of play is necessary, but must not exceed a certain boundary. In certain kinds of agricultural machinery, for instance, a much larger freedom may be tolerated, and in fact is desirable.

The gaging not only determines this boundary line, but also establishes another boundary line which constitutes the maximum freedom of play of the two components.

For instance, a 1-in. 10-pitch screw, nut and bolt, measures 1-in. at the largest diameter (called crest of the thread) of the bolt, but since the crest is not of

great importance we measure the screw at the flanks of the thread with V-point calipers. This we call the pitch diameter, expressed P. D. The P. D. of a full-sized ¾-in. bolt is 0.6851 in. This we call the basic diameter for this thread. In general practice it constitutes the maximum size for a close-fitting screw, and in some instances the smallest size of the nut. In other instances, the smallest nut is made a few thousandths of an inch larger in order to give a certain degree of looseness. If the smallest nut is made to this basic size then this figure becomes the minimum boundary of the nut and the maximum boundary of the screw.

Since it is not practicable to produce screws of exact uniformity it is customary to allow a certain range of variation. The range of variation is expressed in thousandths of an inch of tolerance. For instance, for fairly good work we allow a range of two and one-half thousandths of an inch, usually expressed as 0.0025 in., and sometimes given in exact size, such as in this case would be 0.6826 in., which is 0.0025 in. less than basic size, 0.6851 inch.

The Tolerance of Variation in Diameter of the Nut

The tolerance of variation in diameter of the nut in the same way is expressed as 0.6851 in. as minimum size plus 0.0025 in. for maximum of 0.6876 in.; or if there is to be a neutral zone between the largest screw and the smallest nut then the smallest screw may be any size that meets the requirements, 0.006 in. being a certain ordnance practice for neutral ground. Then the P. D. of nut becomes 0.6911 in. for minimum to 0.6936 in. for maximum, the tolerance of variation of product remaining the same, 0.0025 inch.

In the old practice of fitting one piece to another or even in the selective fitting it was a comparatively easy matter to keep within certain boundaries between two pieces, but in the new practice, if the total freedom of play between two parts is 0.004 in. and the minimum freedom of play between two parts is 0.001 in., we will see that it is necessary to have 0.001 in. for the neutral space and divide up the other 0.003 in. in tolerance in variation in the sizes of the two component parts of the screw-thread fit. If the tolerance is equally divided between the two parts this makes a total variation of 0.0015 in. that will be tolerated in the nut and 0.0015 in. tolerated in the screw.

The interchangeability system therefore imposes upon us greater precision in uniformity of production in order to get this interchangeability; but notwithstanding this important handicap the advantages of the interchangeability system are so great as to offset the disadvantages. In fact a high degree of interchangeability brings a reduction in cost of product and a greater reliability.

The purpose of our gaging is to guide us in manufacturing these parts and to serve as a means for finally inspecting the work before it is put into service, for if a screw, for instance, is made by one manufacturer or department and sold to or delivered to another manufacturer or department the screw must be passed on by suitable gages to determine whether or not it comes within specified boundaries.

The form of the United States Standard thread, originally known as the Sellers Standard, is made by a cutting tool having an included angle of 60 deg. This tool is truncated or flattened off at the end to an extent that amounts to one-eighth of its travel per revolution. The top of the thread has a similar flat, and although this describes a perfect thread it is well known that a perfect thread is seldom found in practice. Therefore it is our object in gaging and inspection to measure not only the diameter and the various parts of the screw, but also the truth of the helix for a given advancement per revolution, the degree of departure of the screw thread from the specified 60 deg. of angle, and in fact each characteristic on which its form and reliability depends.

Threads are specified as having a lead of helix expressed by the number of threads per inch. For instance, a ¾-in. United States Standard screw has 10 threads per inch. It is essential that there should be as nearly as may be exactly that number of threads per inch. If we count off 10 threads on a screw and find that we have advanced more or less than 1 in. we say the lead is not true; that it is off so many thousands of an inch.

If the lead of a ¾-in. screw is off more than 0.003 in. or 0.004 in. per inch of length of engagement it is unsuited for the best work, for when screwed into its threaded hole, which we will assume is accurate, the threads will not match; consequently if they are approximately the same size the two may not screw together. But let us assume that the diameter of the inner member is enough smaller than standard to offset the difference in lead; then although the two may screw together they become less dependable when subjected to stress than if the threads of the two component parts matched each other, for it is obvious that there would not be an equal distribution of the stress of the work on the various threads that should be engaged.

Determining the Roundness

Thus it will be seen that we not only have to consider the diameter but the lead, and in addition to this the form of the thread; that is, the form as shown by taking a profile that shows the flats of the angles of the sides. Then, since the helix may not proceed uniformly, may stagger forward, producing a thread which is known as a drunken thread, we must know about the degree of uniformity of this advance.

Besides this we have to determine the roundness, for die-cut threads are frequently out of round, due to excessive clearance of the cutting tools and inequality of distance between the two pairs of cutting edges in a die having four cutting edges.

We have also to inspect the screw for character of its surface. A die-cut thread, especially threads of 10 pitch and coarser, may be very rough and a microscope may show its surface as mountainous.

Furthermore, in addition to the measurements and character of its surface, the entire surface, including the tops and sides of the mountains, may be, as expressed by one authority, "like a plowed field," as a result of the action of the cutting tools which instead of cleanly removing the metal have pushed or torn out the metal as if pulled out by the roots. This analogy of course is not perfect, but it gives a fairly true conception of the character of the surface, especially of a screw that has been produced by a single passing of the die.

Although some screw-cutting dies are designed to supplement the cutting process by a burnishing process which levels the mountains and compresses the plowed-field surface the fact remains that nearly all screws of pitches coarser than 10 or 12 per inch have rough surfaces.

It is customary for the inspector to pass on surface characteristics by close scrutiny. If it appears smooth the screw is accepted, and if it is unduly rough for the service for which the screw is to be used it is rejected.

Deficiences of the Usual Gaging Methods

The process of gaging screws by the use of ring gages for the screw and the plug gage for the threaded hole is far from satisfactory for many reasons. The best practice uses at least two gages for each part. In gaging a screw, for instance, two ring gages are required. One is the upper boundary of size into which the screw must easily turn with a finger fit, the other gage is the lower one into which the screw must not enter more than one or two threads, according to the condition of the gage and the work.

In still finer practice other gages are used to determine the lead, form and diameter of the crest and root, but in all such gaging processes the gage merely rides over the tops of the mountains, so far as the surface is concerned, and the extremes of the irregular helix, so far as the wabbling of the lead is concerned. Thus it will be seen that even with the best practice in use of the ring and plug gages the process of gaging does not give a true indication of the dependability of a screw as a means of fastening.

A ring gage which is used for testing screws may become deceptive by the possibility of a fine, thin chip becoming lodged at some invisible point in the valley of the thread. For instance, if this is a no-go gage, and if the practice of the plant is to allow a screw to enter one or two turns into the no-go gage on account of the wearing of the gage, a screw may enter until it encounters a chip of this kind, and then since it can go no farther it is passed as acceptable because it will not enter the no-go gage beyond a specified distance for that particular gage.

The other elements of uncertainty readily come to the mind of one accustomed to precision measurement, and it is not necessary to go into all of these details.

In addition to the ring gages we have the adjustable caliper in the form of the regular micrometer and the thread micrometer, and the fixed calipers, in which the points, although adjustable, remain fixed so far as the workman is concerned. These calipers, whether fixed or adjustable, give the diameter of the thread, usually measuring it on the flank, but this diameter does not give a true indication of the roundness of the screw. For instance, if the screw is die cut the advance of the cutting of the die may be irregular, so that although any two opposite points in the diameter of the screw may be uniform to a certain measurement, as a matter of fact the screw has wabbled in passing through the die so that it has a series of longitudinal flutes or waves of more or less amplitude.

The caliper points for such work will find substantially a uniform diameter, although on one side one point may be resting on a crest, while on the other side of the work the other point may be in a valley.

In the usual methods of inspecting there is also to be considered the personal equation of the inspector.

We speak of loose fits as very loose, or with very little shake, or still closer with no shake.

Close fits are designated as finger fits when they can be turned on with the finger, as wringing fits when they require a litle greater force, and as wrench fits when they require more force than can be exerted by the hands without the aid of a wrench.

These are some of the shop terms that are in common use between men who are skilled in the work of making screw-thread fits of a dependable kind. They were fairly satisfactory between men skilled in this work, but they become misleading when put in general use.

To the skilled worker they meant that the fit for two component parts of a screw-thread fastening that were of known lead, shape of thread and fineness of finish should be made to satisfy this tactile test, but the tactile test leaves the science of screw-thread gaging in a most difficult situation, especially with the modern advance in which specialization has so divided the work that the various parts of a piece of mechanism may be made in different cities. A screw, for instance, may be made in one city and the threaded hole into which it fits be made in another city.

When we realize that for a close fit the total allowance is extremely small and wholly disappears by the usual variation in machine product we begin to see the difficult situation that has come with the higher development of machine construction, and we see that this tactile method, which depends so much on the personal equation of the individual inspector, leaves the producer always in doubt as to what will be acceptable, for he has no positive indication of the ruling of the purchaser.

Gages Do Not Definitely Determine Shape and Character of Thread

What has been said thus far applies merely to gaging screws that are known to be correct both in form and finish of surface. A simple plug or ring gage gives no indication of the exact form of a thread. In fact when these gages are supplemented by others cleared at the root and crest we are still in doubt as to the form of the effective surface. With this important element unmeasured our gaging system is incomplete even if it were satisfactory in other respects.

Thus far also we have considered the two component parts of a screw-thread fastening as if made of material that was neither elastic nor plastic. If this were true our screw threads would be most undependable, but since it is not true, and since the threads of the two component parts may be forced together under wrench or subjected to the stress of work, the engaging flanks of the threads of the two component parts are gradually squeezed into fitting surfaces. The stress levels the mountains and compresses the surface, and if the angles of the flanks of the two threads are not similar this stress to a certain degree compresses the metal into a shape that gives perhaps a nearly perfect form of contact.

This squeezing changes the size and form of the thread surface and hence our gages cannot indicate what the shape and diameter of the screw will be when these mountains have been leveled and the plowed-field

surface compressed by the action of the working stress. Our gaging method is such that we must never exert pressure that will level down this surface, for by even the most careful use the gage wears out of shape and it is considered very bad practice to force a gage.

Thus it will be seen that although we use our greatest care in the measurement of the screw thread as it comes from the machine in which it is produced our gaging system makes little recognition of the shape, form and dimensions of that screw after it has been put under its working stress. It must be remembered that nearly all screws, excepting those used for precision adjustment, must be subjected to considerable stress in service and that the end and aim of our gaging system should be to determine the fitness of a screw for its service.

Screw-Thread Requirements in Advanced Practice

The advancement of the art which has come about through the development of the bicycle, the automobile and the airplane has reached a point in which it is absolutely necessary to inspect screws in a way that will give a much better indication of their dependability. Before the art had advanced to the point where it was necessary to obtain the greatest strength for a given weight a simpler system of gaging was satisfactory, but now, to make the most dependable airplane, a screw thread should be gaged for form, diameter, pitch, roundness and compactness of surface. The gaging should be done with full consideration of the changes that are produced in the lead, form and diameter when subjected to the working stress.

It seems probable that with the advance of requirements in machine construction we must go a step further in our gaging methods and make use of the projection lantern to help us solve our screw-thread gaging problems. The optical method of inspection and measurement of screw threads by the use of microscopic apparatus and projection lantern has been found invaluable in inspecting gages, but it has not been generally used for the inspection of the work itself.

The Touch Method of Inspection

The tactile, or touch, method of inspection does not give us a true indication of the form of a screw, and even with a variety of instruments it gives only an approximate conception of the lead.

Notwithstanding the shortcomings of the ring and caliper types of gages they still remain among the most practical gages in the workman's hands, and although the projection lantern brings the gaging to a definite science and should be the basis of specifications for screw threads and the final arbiter in accepting or rejecting the product its function is more to keep a check on the simpler forms of gages than to supplant them.

For instance, the first and last pieces of a lot of die-cut screws should be tested by the lantern. A change of dies, either through wear or important adjustment, should be checked by sending a sample screw to the lantern. This, supplemented by the percentage test of the final product, would be sufficient check, for it would give a definite knowledge of the character of the form, lead, roundness, etc.

Who Was the Victim of This Joke?

By H. H. Armstrong

In the days of my apprenticeship in the old machine shop there were times that the boss was too busy to find work that was suited to my limited ability and on such occasions I was allowed to ramble around the shop and pick up such points as I could on my own initiative. During one such period I asked the repair man if he had any thing I could do. His reply was affirmative and he handed me a hexagon-head bolt about 1¼ in. in diameter by 8 or 10 in. long with the request that I get it hardened.

Glad of the opportunity to pay a visit to the blacksmith shop where I, like the children in the poem, delighted to "see the flaming forge and hear the bellows roar" or something to that effect, I put on my hat and coat and, seizing the bolt, departed.

As I left the room I noticed that several of the men were looking in my direction and laughing, but I did not connect their merriment with my mission—then. Arriving at the blacksmith shop I hunted up the foreman, showed him the bolt and told him what was wanted. He directed me to a workman who presided over a nice hot fire and to him I took the bolt and the order. The blacksmith put the bolt in the fire, leaving one end sticking out, while I sat down on the edge of the quenching tub to watch the proceeding.

Pretty soon I noticed that the visible end of the bolt was taking on a peculiar appearance and was settling down into the fire. Also an unwarrantable amount of blue smoke was being thrown off. I called the attention of the blacksmith to this, upon seeing which he grabbed the bolt with his tongs and yanked out of the fire what there was left of it, for the erstwhile bolt had been made of lead.

The blacksmith spoke very rudely to me, and I could not think of telling you the words he said, but during his discourse his features suddenly took on an appearance of perturbation and his flow of language stopped, while a chill crept into the atmosphere and down the back of my neck as I turned around to find the superintendent standing behind me.

Explanations were in order and I was made to understand that somebody had been made the victim of a joke, but I don't know yet who it was. And when I told the repair man all about it and that the superintendent was going to call him up to the office to explain how it happened, he didn't know either.

Drafting-Room Kink

By A. R. Anderson

Draftsmen who have occasion to make drawings in which there are a considerable number of radii of 1½ in. or more realize the difficulty of obtaining a pencil point for the compass which is sufficiently hard to hold the necessary sharpness yet at the same time soft enough to produce lines that can be plainly seen by the tracer. When the tracing cloth is placed over a drawing the tracer sometimes finds it hard to decipher it and wastes valuable time in discovering the trouble. If all such radii are inked in with fine lines much time will be saved both by tracer and draftsman, for no confabs will be necessary to explain the drawing.

Forty Million Dollars
Worth of
Machine Tools for France!

George N. Peek of the War Industries Board, writing under the date of February 19, says:

"We have a cable from Mr. Baruch indicating that the French government is willing to allow sales to French merchants of forty million dollars' worth of machine tools conditioned upon commercial credits being arranged for one year.

"By this we understand that it is the intention that individual American companies are to deal directly with the individual French companies under the same conditions as formerly existed, except involving deferred payments."

EDITORIALS

Human Interest in the Shop

IT MAY be safely said that the main concern of the machine-building industry is economical production, and as economical production depends upon several factors the successful manager must understand and appreciate them all.

Machine equipment and manufacturing methods play an important part in economical production. But without an adequate corps of trained workers the best machine equipment is of little value.

Proper supervision of men and methods and enough system to keep things running smoothly but not to hinder, as is too often the case, are also necessary factors in the successful prosecution of any business.

We have been devoting our attention very largely and very successfully to mechanical methods and to systems for handling the routine of business. We have paid less attention to the human factor and to the changing trend of thought along these lines.

That we have not been idle is shown by the improved sanitary conditions of our shops, in the attention now being paid to the lighting, heating and ventilation of our industrial establishments. We also have laws dealing with accident prevention and compensation. These have come into being in spite of opposition in some quarters, but no one would now wish to have conditions changed back to old-time conditions.

Those of us who remember washing up in buckets or common troughs which were used by dozens of others would probably appreciate the modern shop washrooms more than does the present generation. But few of us can on the other hand appreciate the new spirit, or lack of it, which has become a part of many large manufacturing institutions. We have subdivided the shop work and devised ingenious fixtures to enable the employment of comparatively untrained men and women. But in so doing we have taken much of the interest out of the work and often made it monotonous.

This subdivision of work is due to our careful study of production methods, and it has come to stay. We are not going back to the old way, for the new is in the line of progress and is better—or can be made so. We must build on the foundation we have laid until the structure is better for all concerned.

We are not going back—we must go on. And this means the putting back of some human interest into work. This is not an easy task; it is more difficult than the subdividing of work, but it can be done. It will be an important factor in production by reducing the turnover of labor and by obtaining a greater spirit of coöperation and loyalty.

We have studied machinery and machine methods to such an extent that we have considered men and women as part of the machinery—that part which could supply certain motions which it was difficult to obtain otherwise. We sometimes planned every move of the hands and feet, prescribed every detail of operation and left the workers no opportunity to exercise intelligence, no matter how much they might possess. This is one of the readjustments which must be made.

There are strenuous years ahead of the machine-building industry, years which will take all the skill, all the intelligence and all the ideas which we can muster. We cannot afford to overlook a single source of supply, to neglect a single opportunity for helpful suggestion. We must utilize all the individual intelligence and skill which are now latent because they have no way in which to express themselves. We ought to have the finest body of workers in the world in the machine-building industry, and we can have it if we realize our responsibility and our opportunities.

The *American Machinist* has been criticized in some quarters for venturing outside of strictly mechanical fields. But as successful manufacturing requires efficient production, and as production depends upon much more than mere mechanical devices, it seems clear that we should not be doing our full duty unless we pointed out and discussed the other factors involved. This is particularly true when we consider that they affect not only the welfare of the machine-building industry but of the whole country.

Together with the rest of the world we are facing new and vital problems. The manager of every machine-building industry must help solve them in the best way for the country and for the world. They cannot be solved without considering more than the mechanical side of the problem.

The Machine-Tool Industry in Germany

THERE are several interesting points in a recent report on the machine-tool industry in Germany by Vice Consul Orsen N. Nielsen of Stockholm, Sweden. Mr. Nielsen quotes Walter Waldschmidt as paying high tribute to the quality of American machine tools and considering them as one of the best of America's products. He states that one-fifth of the manufacturers in this industry in Germany is organized as limited companies, the largest factories employing from two to three thousand men. The association, however, has 280 members and employs between eighty and ninety thousand men, which is from ten to twenty thousand more than were employed in our machine-tool industry during the past year. The average earnings of these companies previous to the war were 6 to 8 per cent.

Mr. Waldschmidt strongly advises a close coöperation between the science and technique of building and says that an attempt was made to form German organization for this purpose in December, 1917. Another step was taken last year, which resulted in the founding of a society for research in scientific manufacturing methods.

There can be no question as to the advantage of a closer coöperation between the technical schools and the machine-tool builders.

US ARMY ORDNANCE NEWS

History of the Aberdeen Ordnance Proving Ground—I

BY MAJ. F. P. LINDH

The story of the conception, authorization and development of the Aberdeen Proving Ground is a striking example of what a peaceful nation can do in the realm of war preparation when it has to. That we waited until war actually overtook us before beginning the project is not much of a recommendation for our foresight, but now that the job is done we have a modern plant that seems adequate to meet any need that might arise in the near future.

SHOULD you happen to be traveling by train or otherwise between Havre de Grace and Baltimore and hear sounds much like a distant thunderstorm it would be a safe bet that you were somewhere near the Aberdeen Proving Ground of the Army Ordnance Department. Here most of the ordnance tests which involve the actual firing of guns of more than 1-in. caliber are conducted. Although there are several other proving grounds their work is of a more or less routine and specialized character or they consist of testing the output of some large manufacturer, but the activities at Aberdeen comprise research and development tests of new guns, gun carriages and ammunition as well as a large number of acceptance tests. Back in 1874 our largest gun was the 15-in. Rodman smooth bore; rifled cannon were still in the experimental stage and high explosives and smokeless powder were only dreams. Even so the existing facilities for testing ordnance at Fortress Monroe were utterly inadequate and it was necessary to appoint a board of officers to select a new proving ground. They eventually recommended the site which we know as the Sandy Hook Proving Ground, although their report shows that they considered it too small and only a temporary expedient. The reservation is on a sandy peninsula about 5 miles long on the Jersey coast and 18 miles from New York.



A MINE EXPLODED IN BUSH RIVER

Some idea of its limitations for modern artillery testing may be gathered from a letter written in 1874 by the commanding officer of the New York Arsenal to the Chief of Ordnance, in which he said: "Ranges from 1500 to 2000 yd. can readily be obtained on this reservation, and if deemed important these distances can be considerably extended within the limits of the reservation." As a matter of fact most of the increase in length of range had to be over water with the attendant danger to shipping and the inability to recover exploded shells to see what actually happened to them. In addition there were the danger to the Fort Hancock personnel, the interference of fog with observations on firing to sea and the vulnerability of the location in time of war. The distance from Washington and from the plants of the big manufacturers was against it and the usually inclement winters interfered seriously with the regular performance of tests.

With the increasing range of the guns and the development of more powerful explosives, conditions became even less satisfactory and the need for a more suitable site became acute. The subject was discussed continually and various attempts were made to obtain some action, but they were without result until early in 1917. At that time a systematic search for a new location was undertaken by the commanding officer of proving grounds, Lieutenant-Colonel Ruggles, and the officers of his staff. They examined many possibilities

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and finally recommended the purchase of Kent Island in the middle of Chesapeake Bay.

When the recommendation was submitted to Congress the existence of a large and prosperous farming industry on the island caused rejection of the proposal, and the present site in Harford County, Maryland, was substituted in the recommendation. Conditions at Sandy Hook were so bad by this time that a $7,000,000 allotment for the purchase and construction of the new proving ground was obtained without difficulty. As it turned out the substitution of the 35,000-acre Aberdeen site for the 16,000-acre one on Kent Island was very fortunate, as the available space in the larger reservation was almost all in use within six months after its inception. The purchase of the land was approved by Congress in October, 1917, and four days later the survey of the reservation began. An extremely severe winter made construction work a heart-breaking task, but it was carried on somehow, and the first shot was fired on Jan. 2, 1918, in a blinding snowstorm. Since then construction and proving have been carried on side by side until now there are quarters available for 8000 men, $10,000,000 have been invested in construction work and 400,000 rounds of minor, medium and major caliber ammunition have been fired. Some idea of the size of the project may be obtained from the fact that in one day 7600 rounds were fired at Aberdeen, more than were fired in a whole year at Sandy Hook.



THE RESULTS OF A PREMATURE EXPLOSION

The reservation extends along the bay shore from Swan Creek, opposite the Susquehanna basin, past Spesutie Island and across the Bush River to the Gunpowder River, a total of about 15 miles. The proximity of the camp to the little town of Aberdeen suggested the name which was adopted.

The barracks, offices and batteries are situated near the northern end of the reservation, leaving the main portion of the grounds clear for firing except that the southern portion of Gunpowder Neck is occupied by the Edgewood Arsenal, a manufactory for poison gas and a large shell-filling plant.

Firing is done on five parallel ranges, each devoted to a particular class of work, which are laid out in a southwesterly direction. This arrangement gives an available range over land of 15 miles, and over water of 40 miles, which is ample for present conditions.

Nearly half of the proving ground is woodland, about a fifth is unwooded swamp and the rest cleared farm land. The country is level and broken up by the tributaries to Chesapeake Bay, and the marshes and weedy flats are a popular winter resort for the wild ducks that have made the bay a hunters' paradise in the past.

The necessity for so large a proving ground is not apparent until one becomes familiar with the scope and diversity of the work carried on. Every new type of gun, gun carriage, projectile, explosive, fuse and a hundred other devices must be rigidly tested before it can be approved for general use. The necessity for making essentially dangerous things safe to handle requires more careful and prolonged testing than is the case with the ordinary manufactured article. Durability must be determined by experiment and final adjustments made by trial no matter how carefully the original calculations were made. To test one gun carriage alone 50,000 shots were fired at Aberdeen, and thousands of rounds are required to test even a single design of fuse.

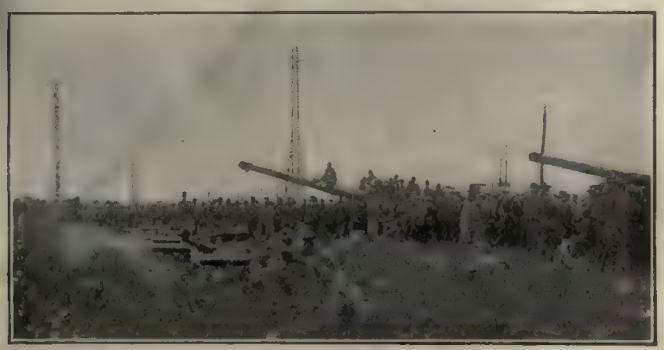
An entirely different field of operations is opened up when we consider the testing of ordnance material in the production stage to see whether it meets the specifications. No matter how reliable a manufacturer may be his work must be checked up by field tests, for it would be inexcusable to jeopardize the lives of our soldiers by allowing possibly defective ammunition to go untested. The proportion of manufactured ammunition tested is small, usually about one-tenth of 1 per cent., but every gun and gun carriage must be put to the proof individually, and the total volume of these tests during the war exceeded in amount those of development.

Another point to be considered in choosing the site was the desirability of providing sufficient space for each branch of activity to prevent its interference with other branches. Considerable territory had to be provided to fit in a trench-warfare range where a large amount of short-range firing went on, a main battery where nonexplosive projectiles were fired to test powder and guns, a water range where the splashes made by falling projectiles were accurately spotted by observers, several detonating ranges where officers watched bursting shell from bomb proofs close to the line of fire, and recovery fields where shell fired in the morning could be dug up in the afternoon and examined. Add to this an aviation field with shops and hangars, a bombing field where aviators could drop explosive bombs, and an antiaircraft firing range, and there was not

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much left after the gas plant was built on Gunpowder Neck. There was no room for a range for testing gas shell, and this work had to be done at a range established for the purpose at Lakehurst.

One other factor had to be taken into account. An antiaircraft shell bursting at 10,000 ft. scatters fragments over a considerable area, while a bursting gun or a big shell striking armor plate may throw pieces of steel a mile or more. If a high-explosive shell ricochets on striking the ground it may be deflected



MACHINE GUNS IN ACTION



A TYPICAL BARRACK

to one side and burst far from the target. While it might be possible to crowd the various proving-ground activities somewhat it is absolutely necessary to protect the inhabitants of the surrounding country by establishing a neutral zone within the reservation. This was done with care and has served its purpose admirably.

PERSONALS

Capt. Hoyle Jones, who left the service recently, was formerly a steel broker in Kansas City, Mo.

* * *

Capt. Thomas F. Frawley, recently discharged, lived in Eau Claire, Wis. He attended the University of Wisconsin.

* * *

First Lieut. Harry A. Tuke, who was formerly employed by the Truscon Steel Co., Youngstown, Ohio, has left the service.

* * *

Capt. Lawrence C. Dehn has been discharged. In civil life he was with Igoe Bros., Newark, N. J., as sales manager.

* * *

Lieut. J. S. Adams of the United States Air Service is now connected with the sales force of C. H. Westerberg & Co., New York.

* * *

Second Lieut. Glenn G. Dudley has been discharged. His home is in Athens, Ore., and he is a graudate of the University of Oregon.

* * *

Capt. Oscar H. Haugan, who was commissioned in June, 1917, has left the service. He was formerly vice president of the State Bank of Chicago.

First Lieut. Clinton C. Van Cise has left the service. He was formerly employed by the New York Telephone Co., 15 Dey St., New York, and is a graduate of Williams College.

* * *

Lieut. A. G. Kessler, U. S. N. R. F., who for six months has been in charge of the Gun Division of the Bureau of Ordnance, Navy Department, has been released from active duty to become vice president of the General Ordnance Co., Derby, Conn., and of the National Tractor Co., Cedar Rapids, Iowa, and will be in charge of purchasing and production at both plants. Mr. Kessler was formerly general manager of the Lakeside Forge Co., Erie, Penn.

* * *

First Lieut. Henry Swift has been discharged. He is a graduate of Boston University and a mechanical engineer. He was employed by the Cincinnati Ball Crank Co., Cincinnati, Ohio.

* * *

Second Lieut. Harold M. Foster, who was discharged on Feb. 18, is a civil engineer and a graduate of Delaware College. He was formerly with the Midvale Steel and Ordnance Co., Wilmington, Del.

* * *

First Lieut. John Mifflin Thomas is a mechanical engineer from the University of Illinois. He was employed by the Electric Bond and Share Co., New York, before entering the service in August, 1917.

* * *

Capt. Garrit S. Cannon has been discharged after 15 months of service. He is a Yale man and in civil life was with the Railway Improvement Co., 61 Broadway, New York, as an executive assistant.

* * *

Lieut.-Col. Charles J. DeWitt has been discharged. He was commissioned Major in November, 1917, and was with the Industrial company, 84 State St., Boston, Mass., as executive. He is an Amherst man.

* * *

Huntly H. Gilbert, who left the service of the Pressed Steel Car Co. and the Western Steel Car and Foundry Co. at the beginning of the war to enter the Army as captain in the Ordnance Department at Washington and later was commissioned major and transferred to

ARMY ORDNANCE NEWS

the Rock Island Arsenal, has reëntered the service of the above-named companies as assistant manager of sales of the western district, located at 425 People's Gas Building, Chicago.

* * *

Capt. Clarence W. Vogt has been discharged. He was commissioned First Lieutenant in June, 1917. He is a Cornell graduate and vice president of Vogt Brothers Manufacturing Co., Louisville, Ky.

* * *

First Lieut. Lyman D. Bothwell, Jr., who was with the Mathews Manufacturing Co., Cleveland, Ohio, before entering the service, has left the army. He was commissioned in June, 1917, Second Lieutenant.

* * *

Capt. George P. Raleigh, who was commissioned First Lieutenant in October, 1917, has been discharged. He is a graduate of Johns Hopkins University and was formerly vice president of the Equitable Trust Co., Baltimore, Md.

* * *

Capt. E. H. Livett, Engineers, U. S. Army, formerly located at Camp A. A. Humphreys, Virginia, has been discharged from the service and is now connected with John A. Stevens, consulting engineer, 8 Merrimack St., Lowell, Mass.

* * *

Maj. Thomas J. Buckley, lately discharged, was treasurer of the Consolidated Fruit Jar Co., New Brunswick, N. J., before entering the service in May, 1917, as captain. He is a graduate of the Stevens Institute of Technology.

* * *

First Lieut. Wesly C. Roche has left the service. He was formerly with the Turner Tanning Machine Co., Peabody, Mass., as mechanical engineer. He will return to his home at Beverly, Mass., but has not determined what work to take up.

* * *

Maj. E. A. Hunt has been discharged. He entered the service in September, 1917, as First Lieutenant. In civil life he was employed by Wheelock, Lovejoy & Co., Cambridge, Mass., as sales engineer. He is a graduate of Lehigh University.

* * *

Capt. Fay B. Williams, who was commissioned First Lieutenant in September, 1917, has been discharged. He attended the Massachusetts Institute of Technology, and before entering the service was employed by the Lamson company, Boston, Mass.

* * *

Capt. John J. Berry, who was discharged recently, entered the service as First Lieutenant in November, 1917. In civil life he was formerly plant superintendent for the American Can Co., New York. He is a graduate of Holy Cross College, Worcester, Mass.

* * *

Capt. Thomas F. Githens, who was commissioned First Lieutenant in November, 1917, has returned to civil life. He was graduated from Columbia University and was employed by the Chili Copper Co., 120 Broadway, New York, as a mechanical engineer.

* * *

First Lieut. Woodward W. Corkran, lately discharged, was commissioned Second Lieutenant in January, 1918. Before he joined the Army the Midvale Steel Co. employed him as assistant to the superintendent. He graduated from the University of Pennsylvania.

* * *

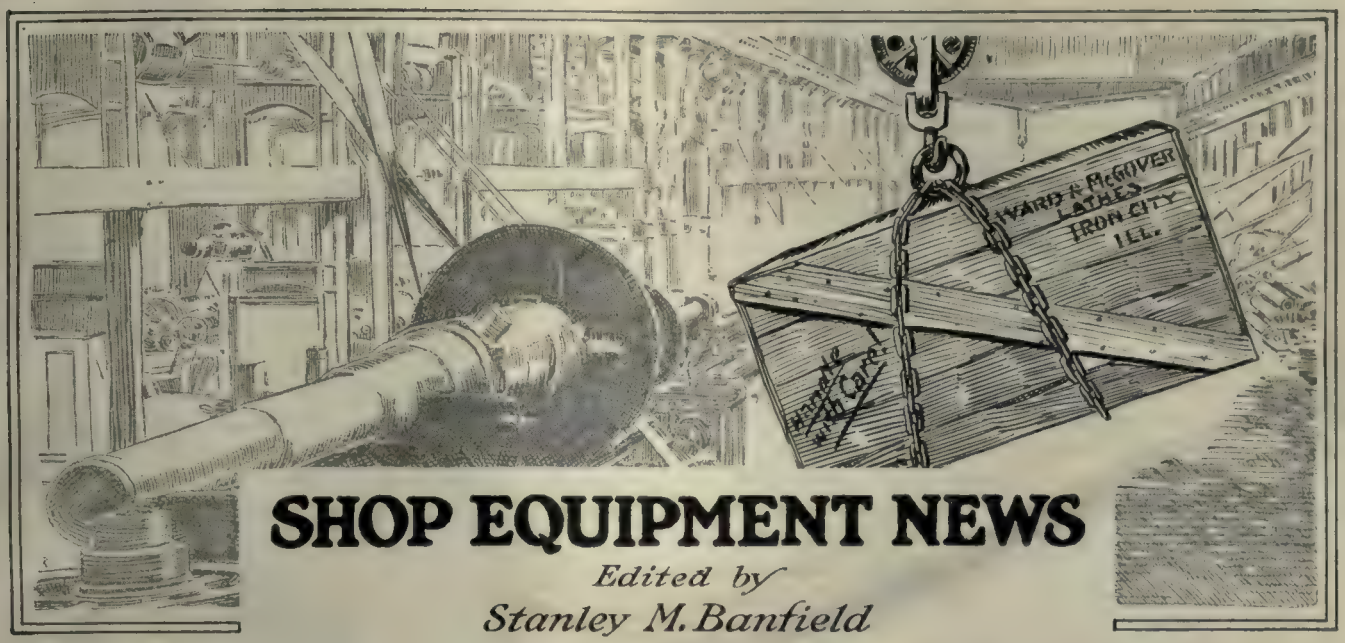
Thomas Slattery, recently discharged from the Army where he was in the Chemical Research Department, has taken a position as foreman of the electroplating department of the P. & F. Corbin department of the American Hardware Corporation, New Britain, Conn.

* * *

Capt. William C. Marshall went into the service in September, 1917, and was recently discharged. He is a mechanical engineer and a graduate of Yale. He was formerly employed by the Holt Manufacturing Co., Peoria, Ill. He has not yet decided what work he will take up on returning to Milford, Conn.



VISITORS WATCHING 37-MM. GUNS UNDER TEST



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Indicating Calipers

The Indicating Caliper Co., 506 East 19th St., New York City, has just placed on the market the indicating caliper shown, which is made in two sizes, to open 2 and 3 in. respectively, the illustration being of the latter size. The device is fitted with a large handle that fits

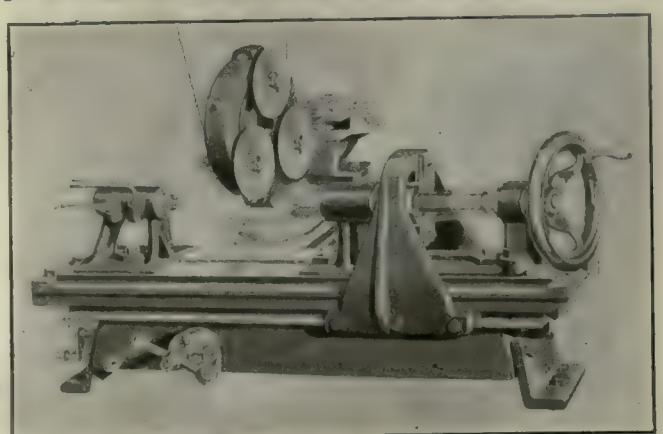


3-IN. INDICATOR CALIPER

into the palm of the hand, while the movable jaw is moved by pressing the trigger with the finger. When the points separate, a geared segment operating on the small gear wheel carrying the pointer causes this pointer to move over the graduated scale, indicating the distance between the points. A spring coiled in the barrel of the pinion actuates the pinion and the hand which is attached to it and draws the points of the caliper together. This constant pressure from one side eliminates any backlash and errors due to this cause. The part containing the movable jaw and the geared segment is set on ball bearings in a milled raceway, effecting an easy movement of the mechanism and the elimination of shake. At the bottom of the sector is a spur, and slightly below a nut which holds an adjustable screw bearing against the spur. This permits the adjustment of the points to the desired distance, allowing the opening of the points beyond the distance set, but preventing closing below this measurement until the screw is withdrawn. The indicating hand is fastened at two points—the lower over the pinion center and the upper in the projection on the pinion. The hole in the upper fastening is elongated, permitting compensation for any wear of the gear teeth, it being possible to make this adjustment in a few moments. The movable point of the caliper is attached in the geared segment by a screw and two pins, and various shaped points may be attached for special uses. The 2-in. caliper is graduated to read to hundredths of an inch, every tenth graduation being marked with a numeral, and the fifth intervening graduation being made longer to facilitate reading. The 3-in. caliper is graduated in sixty-fourths, every eighth mark representing an inch.

American Thread-Grinding Machine

The thread-grinding machine shown in the illustration has just been placed on the market by the American Thread Grinding Machine Co., 814 Gates Ave., Brooklyn, N. Y., and a number of unique features are claimed for the device. It will be noticed that three grinding wheels are carried on a head, which is the turret type. The wheels are positioned by means of the stop shown at the front of the turret while this is clamped by means of the screw shown at the top. By mounting the three grinding wheels, as shown, it makes it unnecessary to go through the changing operations customarily neces-

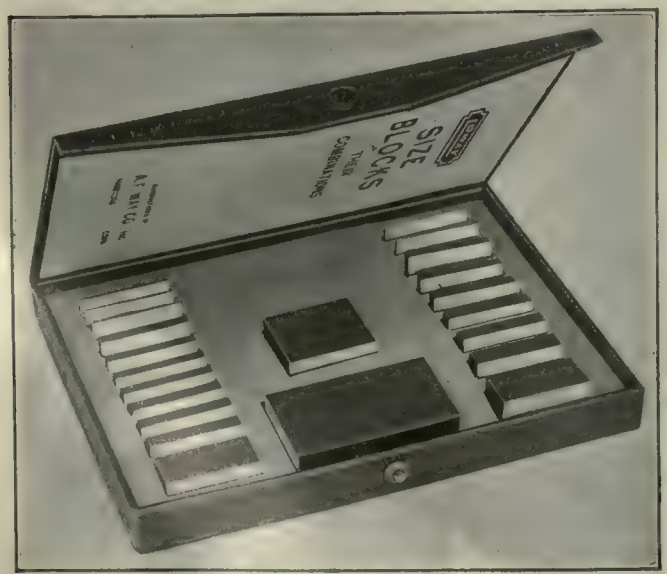


AMERICAN THREAD GRINDING MACHINE

sary in changing from roughing to finishing or changing to a wheel of different grade. It will be noticed that the turret carrying the three grinding wheels is mounted on a cylindrical shaped base, this construction making it possible to tip the wheel to the helix angle of the thread. A dressing fixture is located at the rear behind the wheels, it being the idea to true the wheel not in use while the actual grinding is being done. The truing device is provided with graduations, so that the diamond can be adjusted to the desired angle. The base carrying the wheel turret is also provided with graduations, so that it can be quickly set to the desired helix angle. The work is held between centers and is revolved by means of the handwheel at the right, this also serving to give the proper feed to the work. It will also be noticed that this wheel carries a master screw and is fixed to the main carriage in regard to longitudinal position. The arch carrying the nut engaging the master screw is fixed to the base of the machine, and when the master screw is turned it causes the sliding carriage to move under the arch and give the proper feed to the work. The handwheel shown at the front of the bed is used for feeding the grinding wheels to the work and is provided with a graduated dial. When a new piece of work is set up it is of course necessary to adjust it so that the wheels are in proper position along the longitudinal axis of the piece, and this is accomplished by means of the small adjusting handle shown projecting from the left side of the bed below the slide.

"Loway" Size Blocks

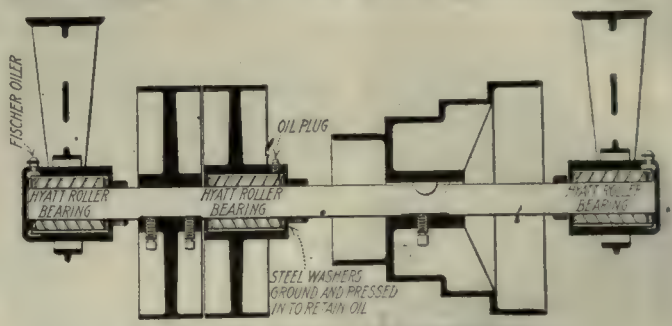
The A. F. Way Co., Inc., Hartford, Conn., has just placed on the market a new line of size blocks, the idea being to provide a set of blocks that are within the reach of every mechanic for his own personal use. They are made of selected material, and with the exception of sizes below 0.0937 in. are heat treated, hardened and seasoned. Blocks are ground and lapped a trifle over the exact dimensions, which bring them within the commercial limits of accuracy for the majority of work. It is stated that all blocks measure between their rated size and 0.0001 in. oversize, thus making the combined error of five blocks only 0.0005. Each size of block is marked with a letter for identification, and each set is furnished with a combination chart in which the various combinations obtainable are given with their letter equivalents, this table showing at a glance the necessary blocks to make up any required measurement. The blocks are put up in three sets. Set A, which is the one shown, combining sets B and C, consists of 21 blocks, including the 1-in. and 2-in. blocks and having a total over-all measurement of 6.293 in.; set B consists of 13 blocks in fractional dimensions, starting with $\frac{1}{64}$ in., it being possible to measure in steps of $\frac{1}{64}$ up to $4\frac{19}{32}$ in.; set C consists of 11 blocks in decimal equivalents, starting with a 0.025 in. and measuring in steps of 0.025 in. up to 4.825 in. The blocks are intended for the general run of machine-shop work only, and are not supposed to be used in competition with the various types of precision gage blocks now on the market.



"LOWAY" SIZE BLOCKS

Queen City Roller-Bearing Countershafts

All shaping machines hereafter placed on the market by the Queen City Machine Tool Co., Cincinnati, Ohio, will be equipped with a roller-bearing countershaft as shown in the cut. Ball bearings on the countershafts are of the Hyatt roller type and Fischer oilers are used. The cross-section illustration shows the construction of the device quite clearly.



ROLLER-BEARING COUNTERSHAFT

"Karge" Cushion and Flexible Couplings

The Three Rivers Machine Tool and Die Corporation, Phœnix, N. Y., has recently placed on the market the "Karge" cushion and flexible couplings, one type of the former being shown in the illustration. These devices are constructed of special alloy-steel coils terminating in couplings by which they are fastened to the ends of the solid-steel shafting. Cushion couplings are intended to be employed as a regular coupling in connecting up line shafts or to be inserted immediately ahead of heavy-duty machines to serve as a buffer or cushion and lessen the starting strains on motors. These couplings also take care of misalignment of the shaft up to 1 in. The flexible couplings are very similar to the cushion couplings except that a longer coil is used, permitting a continuous line of shafting to be carried over or under obstructions or around a corner, from one floor to another or even down one side of a partition wall and back on the other side without the use of gears or belts. Line shafting may be erected in haste over uneven surfaces without regard to align-

ment. Three different methods are used at present for connecting the couplings, the one illustrated making use of the ordinary type of setscrews. In the second type a split sleeve is used, one end screwing over the coil spring while the other end fits over a solid-steel shaft, the compression being obtained as in the ordinary compression coupling. It will be noticed that a solid steel plug is used inside of the end of the coil spring in order to prevent its decreasing in outside diameter when the compression is applied. The third method

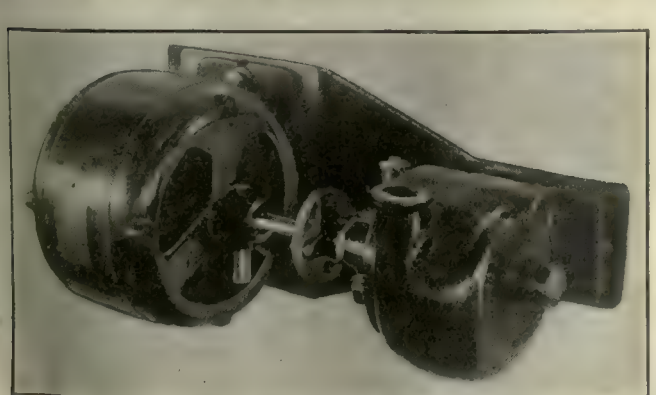


"KARGE" FLEXIBLE SHAFT COUPLING

of holding is to insert a steel plug inside of the coil spring and then shrink a sleeve on the outside, a keyway being cut in the outside of the sleeve to serve as a fastening. All couplings are made of cast iron and the compression sleeves of steel. It is the practice to make the inside diameter of the coil spring the same as the outside diameter of the shafting it is used to connect. When constructed in this manner the couplings are claimed to have 30 per cent. more strength in torsion than the solid-steel shaft. The devices are at present made in varying sizes for shafts from ½ to 6 in. in diameter.

"Fulflo" Motor-Driven Pumps

The motor-driven lubricant pump shown in the illustration is one of a line that has just been placed on the market by the Fulflo Pump Co., Blanchester, Ohio. These pumps are built in ⅜, ¾, 1 and 1¼ in. sizes arranged for either floor or wall mounting and are equipped with ⅛, ⅓, ¾ and 1 hp. motors respectively. The pump shown in the illustration is the ¾-in. size equipped with a ⅓-hp. motor running 2700 r.p.m. The capacity of this machine at this speed is 21 gal. per minute with an 11-ft. head, 20 gal. per minute with a 12½-ft. head, and 11 gal. per minute with a 24-ft. head, cutting compound being used. The pumps are of the centrifugal type and, having both intake and outlet located at the top, retain enough fluid for priming purposes without the aid of valves or other mechanical means. The impellers are of the semienclosed type and



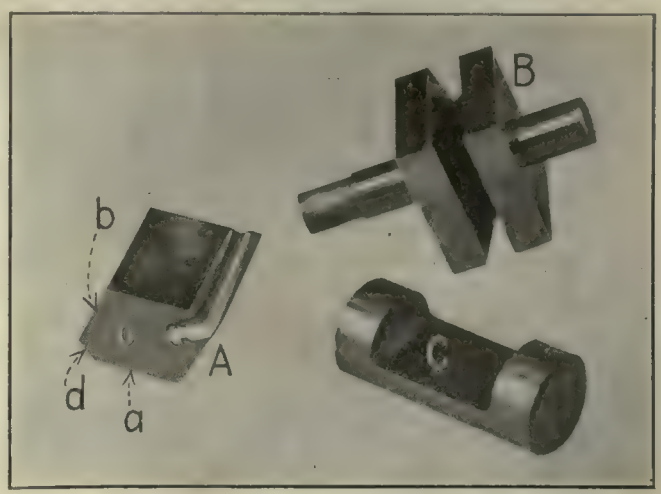
FULFLO ¾ IN. MOTOR-DRIVEN PUMP
Length, 19⅜ in.; width, 8 in.; height, 9¼ in.; weight complete, 58 lb.

are supported by a bearing at either end of the impeller shaft, the thrust on the suction side of the impeller being taken care of by a hardened-steel thrust collar on the shaft, which turns against the nose of the bronze bushing supporting the impeller shaft on the suction side of the pump. The main pump bearing also forms the pump gland and is of cast iron. The lubrication of this bearing is taken care of by a sight-feed oiler which feeds into a pocket completely surrounding the bearing. The shaft is hardened and ground and the packing used is of the flexible metallic type. It is claimed that the life of the pump is exceptionally long in that the impeller does not depend upon any contact fits for its pumping efficiency. Standard pumps have cast-iron bodies, covers and impellers, but may be furnished in brass or bronze if desired. The base is arranged for a three-point mounting, which enables it to be leveled without the necessity of machining the surface to which it is to be attached. The pump is attached to the base by six screws, three of which extend through the motor and pump base and three through the motor base only, the pump base resting on their points. This construction makes it possible, by adjusting these screws, to bring the pump into line with the motor. after which the screws are locked in place.

Arrow Thread Tool Accessories

Making precision threads requires that the utmost care be exercised in every step of the process, and at no point is this more necessary than in the preparation and setting of the tools with which the threads are cut. Three devices for the accurate grinding and setting of threading tools are shown in the illustration.

At *A* is a jig for grinding the ordinary form of tool used in the P. & W. holders for cutting threads of 60-deg. included angle. The tool is held in a suitable groove by three headless setscrews, and the angles



GAGES FOR GRINDING AND SETTING THREAD TOOLS

formed by the intersection of the planes of the various surfaces are such that all faces of the tool may be ground without moving it in the jig.

With the jig resting on the surface *a* as shown in the picture, either on the magnetic chuck of a surface grinding machine or on the elevating table of the common form of tool-grinding machine, one angular face of the tool may be ground, and turning the jig to rest on

surface *b* the opposite angle is brought into position. Setting the jig on surface *c* the tool is ready to be ground on the top to the correct angle, while resting it on surface *d* enables the operator to remove the apex of the angle to conform to the United States Standard form of thread. The width of the flat can be accurately computed from micrometer measurements taken over the surface *d* and the apex before and after grinding.

At *B* is a setting gage with grooves of four different angles. This tool is usually made round—as a matter of convenience in making—and is serviceable for but one form of thread, but when made square as this one is it can be made to accommodate four forms. This gage has grooves of 60-deg. angle for setting U. S. and V tools, 29 deg. for the Acme form, 55 deg. for Whitworth and 53 deg. 8 min. for Loewenherz threads.

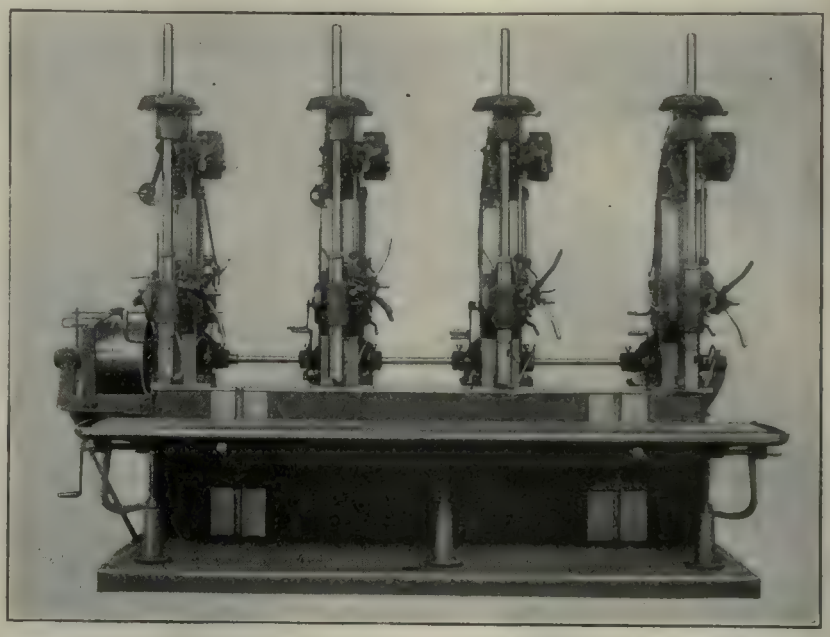
In use it is mounted on a mandrel, as shown, and placed between centers in the lathe. It is necessary to bring the face to be used to a vertical position by squaring from the shears of the lathe, in which respect it is less convenient than the round form, but this lack of convenience is more than offset by the greater utility of the tool.

Before setting the threading tool to gage *B* the gage *C* is used to bring the top of the tool exactly to center.

The flat surface of this gage cuts the center line, consequently when the gage is on centers and turned with the flat surface down a correctly set threading tool will just barely pass under it. These tools are the product of the Arrow Tool Co., 200 Cannon St., Bridgeport, Conn.

Barnes Adjustable-Head, Gang Drilling Machine

The Barnes Drill Co., 814 Chestnut St., Rockford, Ill., has just placed on the market a new 26-in. adjustable-head, gang drilling machine of the four-spindle type. One of the chief features of this machine is the lateral adjustment, which gives a spindle range from 18 in. minimum between any two adjacent spindles to a maximum of 96 in. between the two outside spindles. The first spindle at the left next to the driving pulley is fixed, but the other three may be adjusted in a lateral direction. The machine is all-geared, having no cones or inherent belts whatsoever except the driving belt from the line shaft. There are eight geared speeds and eight geared feeds for each spindle and all are independent of one another. The method of driving each spindle is as follows: On the driving shaft at the rear there is a bevel gear driven by an expanding friction clutch and controlled by the vertical lever shown at the left side near the base of each head. Thus the spindle may be stopped or started by throwing the clutch out or in without shifting the change-speed gears. On account of the lateral adjustment it is necessary to have counterweights for the sliding heads and spindle outside of the column, and the counterweight chain is brought over sheave wheels so that these weights hang back of the bridge construction back brace. The particular machine shown was provided with oil-pump attachment for delivering the cutting lubricant to the work on the table, there being two reservoir tanks to take care of the larger supply of cutting lubricant for the heavy-duty machine. The capacity of this gang is up to 2 in. solid drilling in steel and it will bore out cast-iron cylinders up to 8 in. in diameter.



BARNES FOUR-SPINDLE, 26-IN. GANG DRILLING MACHINE

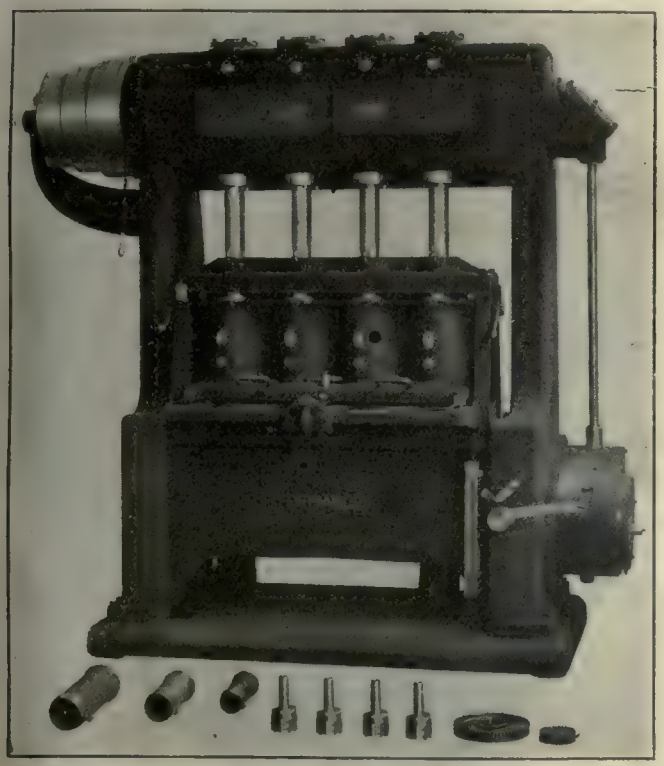
Defiance Cylinder-Boring Machine

The Defiance Machine Works, Defiance, Ohio, has just placed on the market a line of cylinder-boring machines, one of which is shown in the illustration. These are single-purpose production machines and are very similar except in size, the No. 7 machine taking 36 in. between housings, the No. 8 machine 48 in. between housings and the No. 9 machine 60 in. between housings. The machines are for rough boring, semifinish boring or finish boring gas-engine cylinders of either single units or with any number of units cast en bloc.

The drive to the spindle is transmitted from a three-step cone pulley through steel worms and bronze worm gears, but instead of following the common practice of securing the worm gears to the spindles by means of keys large tongues are cut integral with the spindles, the worm gears being cut out to fit. The spindles are made of hammered stock and each one is supported by three bronze bearings. The nose bearing is conical in shape and has a convenient means of adjustment for wear. All end thrust is taken care of by SKF ball bearings, of which there are two for each spindle. The momentum of the spindles can be overcome and a quick stop made after the power has been turned off by means of a friction brake located in the drive pulley and set with a lever located within easy reach of the operator. The boring tool is fitted to the spindle by means of a tapered shank and is held securely in place by means of a long bolt passing up through the spindle to the top, thus eliminating any possibility of the tool being extracted from the spindle on the return feed.

The feed mechanism is of unit construction to afford easy access and is tightly incased, retaining sufficient oil to effect a splash system of lubrication. All the feed-shaft bearings are bronze bushed, while end thrust is taken by SKF ball bearings. Feed changes are made by removing the gear-case cover and changing two gears. A hand adjustment for the table is provided, but when in operation the table feeds the work to the boring tools automatically, and when the cut has been finished a fast travel reverse is automatically thrown into action, returning the table to and stopping at the loading position.

The oiling system is a particular feature of the machine and consists of force feed and splash system combined, made possible by the all-inclosed feature of the machine. Both the feed and drive mechanisms are tightly inclosed and partly submerged in a bath of oil, while the bearings are lubricated through individual leads from a force-feed arrangement. Unit construction of the various mechanisms is followed throughout, and each unit is accessible without disturbing other parts of the machine.



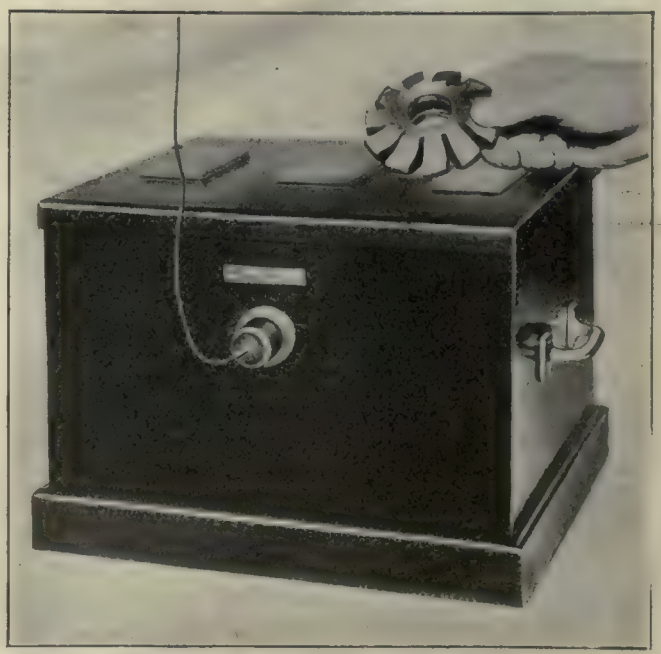
DEFIANCE CYLINDER-BORING MACHINE

Jack screws are used for raising and lowering the table, each screw being actuated by a heavy worm and worm gear through a bronze nut which is sleeved to the worm gear. Each jack is a unit in itself and its contents are packed in grease to insure thorough lubrication. A means for advancing or retarding the screws independently is also provided in order to maintain perfect alignment of the table, and all thrusts are taken on SKF ball bearings. The advantage of having a jack screw feed which is located directly beneath the work is said to lie in obtaining an absolutely vertical feed thrust, thereby eliminating all side thrust on the table, which is said to be a very important factor in obtaining work bored round and in vertical alignment. The table, columns and base constitute the frame and are of cast iron. The table is gibbed to the columns on each side. The columns and the base are of box construction reinforced. The base rests on the floor at three points only, thus eliminating the necessity for a concrete or other foundation of this type.

Extra attachments, such as motor drive, holding fixtures and tools, and equipment for cutting compounds or lubricants, including pump, tank, and pipe fittings, are furnished as extras.

"Bulldog" Demagnetizer

The Electric Brazing and Welding Machine Co., Inc., 30 Church St., New York City, has just placed on the market the "Bulldog" demagnetizer shown in the illustration. The purpose of this machine is to demagnetize cutters, flat tools, gages, rings, bearings, etc., that have been magnetized by being placed on magnetic chucks or by other causes. The device is intended to be attached to the ordinary electric-light circuit and the only operation necessary to demagnetize a piece of work is to pass it over or between the pole pieces as shown in the illustration.



"BULLDOG" DEMAGNETIZER

"Little Niagara" Pumps

The Hudson Pump Co., Inc., 17 Merseles St., Jersey City, N. J., has recently placed on the market the "Little Niagara" machine-tool lubricant pump shown in the illustration. The device is at present made in two sizes, No. 0 and No. 1, having capacities of 5¼ and 11 gal. per minute respectively. Fig. 1 shows an outside view of the pump and Fig. 2 a cross-section giving an idea of the construction of the device. The idea in bringing forth this pump was to provide a device with a large delivery at slow speed and containing no parts such as check valves, springs, gears, sliding blades, etc. The piston is made from a single casting having two openings, one on each end, these being larger than the suction or discharge to eliminate the possibility of clogging. The piston is driven by the rotor and the ends



FIG. 1. "LITTLE NIAGARA" LUBRICANT PUMP

Size 0—Capacity, 5½ gal. per minute; pipe size, ⅜ in.; size of pulley, 3½ in.; belt width, 1 or 1¼ in.; weight of complete pump, 12¾ lb.; extreme length, 8½ in. Size 1—Capacity, 11 gal. per minute; pipe size, 1 in.; pulley size, 4 in.; width of belt, 1¼ or 1½ in.; weight of complete pump, 23 lb.; extreme length, 10¼ in.

being machined at an angle impart a back-and-forth motion that gives the pumping action. The unique feature is the fact that the flow can be reversed with

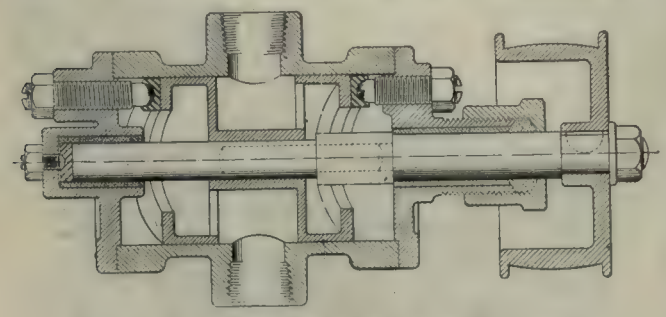


FIG. 2. CROSS-SECTION OF THE PUMP

the pulleys running in the same direction by simply turning the heads of the pump 180 deg. The pump is so made that any wear on the end of the piston can be compensated for by means of the adjusting screws.

"Tip-It" Welding Compound for Stellite

The "Tip-It" welding compound for Stellite that was described on page 1146, Vol 49, and on page 46a, Vol. 50, and which was said to be a product of the Haynes Stellite Co., Kokomo, Ind., is being manufactured by Tip-It, Inc., 120 Broadway, New York.

Jones Superior Gear-Hobbing Machine—Erratum

In the articles on the Jones Superior gear-hobbing machine on pages 275 and 328a an error was made. The work arbor and hob arbor can be brought within four inches of each other and the minimum diameter of gear that can be cut depends upon the size of the hob. The company states that gears as small as 4 or 5 in. in diameter can be cut if necessary.

How Should These Tables Be Placed?

A contributor would like to get an expression of opinion from the readers of the *American Machinist* as to the best arrangement of the tables in a drafting room where daylight illumination is used. If the light comes from side windows (not overhead), should the tables face the windows or not?

George Kinne Garvin

George Kinne Garvin, president of the Garvin Machine Co., Spring and Varick Sts., New York, died at his residence in Garden City, L. I., on Feb. 20, after a brief illness.

Mr. Garvin, who was a prominent figure in engineering circles, was born in May, 1859, in Hartford, Conn., where his father, the late Hugh Garvin, was contractor in Colt's Armory.

After the Civil War the elder Garvin started in business in New York, the firm name being Smith



GEORGE KINNE GARVIN

& Garvin. George received his education at Hasbruck's Institute, Jersey City, N. J., and after leaving school worked for a time in his father's shop, which in the meantime had been moved to Bricksburg (now Lakewood), N. J., eventually succeeding to the management of the business.

Mr. Garvin was a prolific inventor and made many improvements in machine tools, some of which are in use in all parts of the world. He possessed a genial disposition and last spring and summer befriended many of the soldiers passing through Camp Mills on Long Island.

Two of his sons, George K., Jr., and Frank W., are with the American Expeditionary Forces in France, while the other two, Burr K. and Hugh R., are connected with the Garvin Machine Co.

Mr. Garvin left a widow and six children and he is also survived by a brother, F. W. Garvin.

He was a member of the Engineers' Club, the American Society of Engineers and the Garden City Club.



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



Increasing activity is noticeable in the steel trade due to the large purchases of the automobile trade. According to estimates more than 90 per cent. of the business now being done at the mills is in sheets for the automobile industry.

An air record was established by Capt. Roy N. Francis in a Glenn-Martin bomber when he flew from Washington to New York with four passengers in 2 hours and 15 min. The distance of 240 miles was covered at an average of 107 miles an hour.

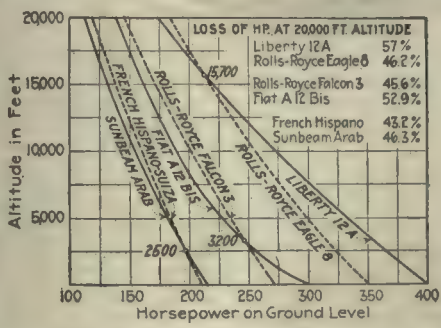
Sales figures of the United States Tire Co. indicate that the drift toward the use of large pneumatic tires on light trucks instead of solid tires has become noticeable. The company believes that the time is near when the accepted tire equipment for such trucks will be pneumatic.

The Army Aeronautic Corps has been successful in establishing communication between an airplane in the air and a regular telephone on the Washington city line. The conversion of radio to direct-wire communication was made automatically by an apparatus devised by Army officers.

The Eisemann Magneto Co., Brooklyn, N. Y., has a new type of combined magneto and generator for tractor use. The magnets in the magneto are horizontal instead of vertical. The generator is superimposed on the magneto so that it can be easily removed whenever necessary without interfering with the ignition magneto. In this way the tractor can continue its operation should any trouble occur to the starting or lighting generator.

That the abandonment of the De Haviland 4 planes for use in mail service was due to structural defects is clearly indicated by the issue of a bulletin by the Post Office Department asking bids for 17 changes in the planes. These include reinforcing the longerons and splices with steel and plates, enlarging wires and fittings, reinforcing sides of fuselage and bulkheads, landing gear to be strengthened and moved forward and other equally important changes. When it is considered that combat planes are subjected to greater stresses than any other the changes ordered by the Post Office Department are all the more significant.

The values of power losses given by the Technical Section of the Division of Military Aeronautics and compiled in the diagram shown afford a direct comparison of the power losses at various altitudes between the Liberty 12-A and the Rolls-Royce Eagle 8, Rolls-Royce Falcon 3 and Fiat A-12 bis, and the French Hispano-Suiza and Sunbeam Arab airplane motors. The 400-hp. Liberty 12-A shows superiority in power over the Rolls-Royce Eagle 8 350 hp. motor up to the altitude of 15,700 ft. Above this height the Rolls-



Royce gives more power, and at 20,000 ft. its superiority is approximately 16 hp. The power losses at 20,000 ft. are 57 per cent. for the Liberty engine and 45.6 per cent. for the Rolls-Royce. At approximately 3200 ft. the 270-hp. Rolls-Royce Falcon 3 has the same power as the 297-hp. Fiat A-12 bis, and from this altitude up to 20,000 ft. it has an average superiority in power of 7.6 hp. The 208-hp. French Hispano Suiza, while losing 43.2 per cent. of its power at the height of 20,000 ft., proves to be superior to the Sunbeam Arab 217-hp. motor above 2500 feet.

Looking back on the great tractor-manufacturing program of last year it seems to be worth while for the material-specialty manufacturers to produce some wear-resisting material to meet the requirements of such wearing parts as bull gears, pinions, sprockets, transmission gears, shoes, links, pins, lugs, spacing blocks, chains, rollers, etc. The use of manganese or other alloys in the construction of these parts or for parts which are adaptable to tractor usage is being advocated by some for the heavily loaded tractor wearing parts. Another manufacturing opportunity would seem to be in the investigation of the possibilities for the use of pressed-steel products in tractor construction. A big demand has been created for pressed-steel parts rather than for cast or malleable iron in the construction of practically all kinds of machinery, particularly in the various automotive lines.

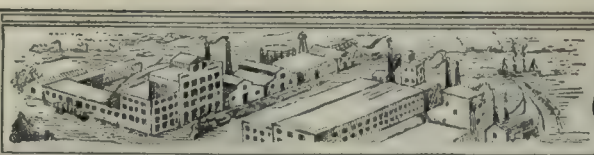
Agreement between automobile and pneumatic tire manufacturers to remove all war restrictions on sizes and styles of tires was announced by the National Automobile Chamber of Commerce. There are, however, many advantages in keeping the number of sizes and styles as low as possible.

The United States Senate and House have agreed upon the Post Office Appropriation Bill, including $200,000,000 for federal aid to highways and $300,000 to continue experiments with motor-truck transportation of parcel-post mail matter. This will be reflected in the building of all kinds of machinery.

A special building for motor cars has been erected at the great industrial fair at Lyons, France. Here several post-war models of foreign cars, chiefly of French and Italian makes, will be exhibited. America will be represented by the B. F. Goodrich Rubber Co., the United States Rubber Co. and the Willys-Overland Company.

There is a tendency among tractor manufacturers to adopt a compressed-air starter as a regular tractor equipment. This is not so much because the electric starter is not reliable but because the principles of electric apparatus of this kind are not so generally understood by dealers and farmers. This was well illustrated in the recent tractor investigation held by the United States Department of Agriculture. It has been found that a large per cent. of all tractor troubles originated in the ignition systems on account of the lack of knowledge on the part of users.

Aircraft contracts totaling $469,000,000 have been canceled or suspended by the War Department since the signing of the armistice. During the week ended Feb. 7 about $2,000,000 worth of airplanes and engines were delivered, leaving orders still to be filled valued at $10,000,000. On the day hostilities ceased outstanding orders for service planes aggregated $125,000,000. Up to Feb. 7 about 91 per cent. of these contracts had been canceled. The total production of Liberty motors to Feb. 7 was 20,147 with 331 still to be delivered. Contracts for 30,526 Liberty motors were outstanding Nov. 11, 1918, but orders for 23,622 were canceled. The production of the De Haviland planes up to Feb. 7 was 4600 exclusive of 204 shipped without motors. There are still 42 planes of this type to be delivered.



Sparks from the

Shipping Board Reduces Cost of Tracings

Mechanical Reproductions Hard to Distinguish from Originals—Cost But Fraction of Latter

By means of a recently patented process the Emergency Fleet Corporation has been producing at a cost of from 10 to 13c. per square foot tracings which if made by hand would ordinarily cost from $1.50 to $5 per square foot. The resulting tracings from this process are so nearly like the original that they are distinguishable as reproductions only on close inspection.

The table shows the amount of tracings delivered and the cost for the week of Dec. 5-12, 1918. A similar table submitted for the week of Oct. 17-24, 1918, shows 1137 sq.ft. at a cost of 12.9c. per square foot. Besides the simple operation of reproducing tracings either on cloth or paper the process has been used in a number of other

WEEKLY REPORT OF LITHO ROOM, DEC. 5-12, 1918

Number of men in room	2
Original tracings received	417
Process tracings made	1681
Number of plates of jelly poured	36
Number of square feet of tracing cloth used	2566
Number of square feet of tracing cloth delivered	2460
Number of square feet of tracing cloth wasted	106

APPROXIMATE EXPENSE OF SECTION FOR SEVEN DAYS

Cost of tracing cloth	$137.25
Miscellaneous supplies and jelly	29.00
Supervision	60.00
Labor	46.00
Total expense	$272.25

APPROXIMATE COST PER SQUARE FOOT

Labor per square foot	$0.019
Materials and supervision	0.093
Total cost	$0.112

ways and for a variety of purposes. It has been used for progress work, the reproductions, either on cloth or strong paper, being used instead of blueprints or Vandykes. It has also been used to produce new drawings, a large part of which are similar to those previously made, by blocking out the parts to be changed on either the transfer print or on the plate, with the new details drawn in by hand.

The work is done in the following manner: A matrix blueprint on a special transfer paper is made on any good blueprint apparatus, but it is not developed or washed before its use in the process.

When at the proper temperature a sensitized gelatine is poured over a zinc plate, usually 42 x 98 in. or 42 x 110 in., which rests on an inclined, adjustable table, the proper thickness of gelatine being obtained by the angle of inclination of the table and by the special pouring pot designed for the process. The overflow is caught and used again. As soon as the gelatine is poured the table is righted and the gelatine allowed to set a few minutes.

AN ESSENTIAL TREATMENT

From the adjustable table the gelatinized plate is put into a recess of a patented refrigerating table and undergoes the essential treatment on which the success of the process depends.

After a few minutes in the refrigerator the plate is placed, gelatine up, on the refrigerated top of the table, its temperature being maintained at the 60 deg. limit of efficiency. The unwashed matrix print is laid face down on the gelatine for a few seconds, which on removal leaves the reversed image on the gelatine, a reaction having taken place between the unexposed lines of the transfer print and the sensitized gelatine.

The gelatine plate is then inked with a squeegee roller spread with special carbon ink which clings only to the lines left by the transfer-print reaction, being repelled by the rest of the gelatine.

FINISHED TRACING IN 30 MINUTES

The paper or cloth on which the tracing is desired is then laid smoothly on the gelatine, pressed flat and immediately taken off, the complete tracing being transferred to the finest line. As many as 10 to 15 impressions may be made on tracing cloth from one gelatine plate, merely by reinking, and 40 to 60 copies reproduced on paper. The finished tracing is then complete and can be used within a short time.

The time from the transfer print to the finished tracings was 30 min. or less. Pouring and refrigeration of plates are so controlled that no delay occurs at any stage of the process, and although the stated limit of capacity for a one-table plant is 500 sq.ft. a day actual results, as shown by the table, have been greater than this.

* * *

Italian Machinery Imports

In the Feb. 6 issue of the *American Machinist* under the heading of "Italian Machinery Imports" a news item was published stating that an association of important firms had been formed at Milan, Italy, to carry on trade in industrial machinery and machine tools from allied countries. This item was taken from *Commerce Reports* of the Canadian Department of Trade and Commerce, which stated that such an organization had been formed under the name of Italian Association of Importers and Merchants, Milan, Italy.

Work of the Forestry Section of Engineer Corps in France

For use in producing lumber and timber products for the American Expeditionary Forces there has been produced and shipped to France 46 logging locomotives, 550 log cars, 200 miles of rail and 600 complete small-type sawmills with accessory logging outfits.

The banner month in production for these mills was October, 1918, when they cut 50,000,000 ft. of lumber. Plans were well under way for the manufacture of 100,000,000 ft. of lumber a month by January, 1919, and this figure would undoubtedly have been reached, as the men were becoming expert, roads were improving and in general conditions were in every way more favorable. Up to Nov. 30, 1918, the lumber produced by the sawmills operated by the Forestry section, Corps of Engineers, for the use of the American Expeditionary Forces would build enough barrack buildings 20 ft. wide to extend if placed end to end 600 miles and house 3,107,600 men. The standard-gage railroad ties produced would build a line of single-track railroad 1091 miles long, or from St. Nazaire to Berlin via Tours and Paris. The small ties for 24-in. track would build double tracks paralleling 185 miles of trenches. The pickets, posts and poles if cut into 6-ft. posts would make a fence with posts a rod apart reaching one-third the distance around the earth. The piling if stood end to end would make a flagpole 435 miles high. The wood fuel produced would make a rick 1 yd. wide, 1 yd. high and 600 miles long, or as cord wood a rick 4 ft. wide, 4 ft. high and 340 miles long.

* * *

Russian Central Union of Coöperative Societies Explained

The bulk of Russia's buying power exercised by 80,000,000 people through the membership of 20,000,000 families in 30,000 coöperative societies forming 500 provincial unions is concentrated in the All-Russian Central Union of Co-operative Societies.

As a means of establishing direct contact with forward-looking manufacturers of high-grade standard products the Central Union has opened a buying agency in America, to procure machinery and supplies where available quickly, advantageously and in quantity.

Controlling vast stocks of raw materials produced in Russia and Siberia the Central Union desires to promote on a large scale commercial intercourse with America.

The American representative is Alexander Zelenko, Liebes Building, 167 Post St., San Francisco Calif.

World's Industrial Forge

By E.C.Porter, News Editor

Sixth National Foreign Trade Convention

The chairman of the National Foreign Trade Council, James A. Farrell, has issued the formal call for the Sixth National Foreign Trade Convention to be held in the Congress Hotel, Chicago, on Thursday, Friday, and Saturday, Apr. 24-26, 1919.

This year, says Mr. Farrell, the convention has assembled a large amount of valuable technical information, which is available to all delegates who wish to use it. This information will be furnished by the volunteer trade advisers of some of the most experienced business houses and by the representatives of the Government trade agencies. A number of prominent business men of long experience in every branch of foreign trade have offered their services as volunteer advisers. The information they can give is based on personal experience and as such is doubly valuable. In addition the Department of State will coöperate by assigning to the convention some members of the consular service who will just have returned from Europe, Latin America and the Far East. The Department of Commerce will send a number of its experts from the Bureau of Foreign and Domestic Commerce. The Shipping Board will be represented. The Pan-American Union will be present to give information on Latin-American relations. These men are thoroughly familiar with their respective fields and can supply a great fund of valuable information if called upon.

* * *

A Method of Treating Burns

Surgeons used to consider that the sealing up of infected burns—and the majority of burns are infected—was contrary to all sound surgical principles. However, the successful treatment of burns by sealing them up with a neutral wax has made it easy to forget former theories and ideas.

Dr. Barthe de Sandfort, now a retired surgeon of the French navy, has made encouraging progress over a period of years in the treatment of burns by sealing them up with certain paraffines and resinous gums, thus protecting the delicate nerve endings that were exposed and allowing the body heat so confined to aid nature in repairing the injury.

Dr. de Sandfort's experiments have resulted in a special preparation of wax called Ambrine, which is now manufactured under his formula in the United States as well as in France. Briefly his treatment is as follows: The burn should be washed with distilled water or a mild antiseptic, such as a boric or saline solution; all blisters should be punctured and allowed to drain naturally, and the burn should be thoroughly dried by an electric drier fan before Ambrine is applied.

In applying Ambrine it should be melted by heating in a water bath and the heat brought to and maintained at about 150 deg. F. It should then be sprayed by an atomizer over the entire surface of the wound and at least one-half inch over the edges. Over this should be applied a very thin layer of medicated absorbent cotton while the wax is still soft, and on top of this another coat of Ambrine should be sprayed or brushed so that the whole will form a solid crust. After this the burn should be heavily padded and bandaged in the usual manner.

In a short time secretions form under the dressing, rendering the wax nonadhesive so that it can be readily removed without pain or injury.

The burn should be re-dressed every 24 hours until the granulating area shows only slight secretions, when the dressing need only be removed every 48 hours.

Ambrine can be used successfully not only with superficial burns, but with burns of the second and third degree. The advantages claimed are: painless application and dressing, almost instant relief from the pain from the injury and rapid healing with very little scar tissue.

No less an authority than Dr. William O'Neill Sherman, chief surgeon of the Carnegie Steel Co., says in *Surgery, Gynecology and Obstetrics* that Ambrine is in use in all the company's emergency hospitals and they have treated with it more than 3000 cases of burns. He further says: "It is useless to compare this method with any other method because of its undoubted superiority. It is an ideal treatment for burns."

* * *

Election of Officers

The American Institute of Consulting Engineers, Inc., New York, at its council meeting on Feb. 5 elected the following officers: L. B. Stillwell, president; A. M. Hunt, vice president, and F. A. Molitor, secretary and treasurer. At the annual meeting the following members of the council were elected to take the places of those retiring: S. Whinery, Desmond FitzGerald, J. Parke Channing.

* * *

Exports From Canada

During the past year the declared exports from Ottawa, Canada, to the United States were valued at only $40,074,709, as compared with $320,458,636 in 1917.

Kiln-Drying Methods for Airplane Stock

Tests Conducted by Forest Products Laboratory Show Superiority Over Air-Drying Method

A summary of results obtained at the forest products laboratory of the Forest Service is contained in a report of the director of the laboratory to the forester, Forest Service, United States Department of Agriculture.

At the time our aircraft program was launched practically no seasoned spruce stock was available. To air-dry green spruce 3 in. thick, such as is used in airplanes, requires from one to two years. The forest products laboratory specified a method of kiln drying by which green-spruce airplane stock can be dried in from 20 to 40 days to the proper moisture content. Kilns were designed for the Army and Navy and for commercial companies capable of properly drying airplane stock, and men were furnished to operate them until operators could be trained at the laboratory. Seasoned stock was thus insured equal, if not superior, to air-seasoned material.

A relatively slight advantage in lightness and strength over the best substitute makes spruce the preferred airplane wood and warranted the organization of a Spruce Production Division. The same importance attaches to any saving in strength, however slight, that is accomplished through proper methods of seasoning. Exhaustive tests are showing that the Forest Service specifications produce better material than can be obtained by drying in the air.

Strength of Airplane Woods

Over 300,000 tests made on about 130 species of wood afforded basic information for aircraft design. From these data the relative suitability of various species of wood, the influence of defects, the relation between strength and density and the influence of moisture can be determined. A table of strength values at 15 per cent. moisture was prepared by the forest products laboratory, and adopted by the Army and Navy as a basis for the design of the wooden parts of aircraft.

Practically all airplane specifications for lumber and parts accepted by both the Army and Navy were either prepared or reviewed by the Forest Service.

The relative strength of various woods was investigated. The results obtained were used as bases for determining the best substitutes for spruce and also in eliminating undesirable species.

The inspection of wood has played a greater part in the manufacture of air-

craft than in any other industry, and at the beginning of the war the number of men qualified to undertake such a responsibility was very limited. The laboratory assisted in educating men for this work, first by preparing an inspectors' handbook on wood and later by instituting regular courses in wood inspection.

TESTS OF BEAMS AND STRUTS

On account of the difficulty in obtaining suitable pieces for manufacturing the larger airplane parts and the necessity for conserving material several series of tests were conducted at the laboratory on built-up beams and struts of various designs and also on various types of splices. Present specifications of the Army and Navy for laminated and spliced beams and laminated struts are based on the results of these tests.

A waterproof coating for airplane propellers, which incorporates thin aluminum leaf in the finish, was developed at the laboratory and placed in production by the War Department.

Direct assistance was given by the laboratory in stimulating the production of the materials needed for making waterproof glues as well as the manufacture of the glues themselves, and a number of concerns were aided in developing satisfactory manufacturing procedure.

Several types of waterproof glues, both of the blood albumin and casein types, were worked out and were demonstrated to certain manufacturers upon request of the Bureau of Aircraft Production. One of these types is now obtainable in the open market.

NEW PLYWOODS DEVELOPED

Practically nothing was known of the mechanical and physical properties of plywood at the beginning of the war. The use of plywood in aircraft construction necessitated information of this kind, and the properties of plywood of many species were determined by the laboratory through elaborate series of strength tests.

The aircraft work of the Army and Navy Departments covers a much broader field than would seem possible at first thought. The results of real value that were obtained are many in number and far-reaching in application. At the time the armistice was signed production was increasing rapidly.

* * *

A New Bronze-Alloy in Norway

A captain in the Norwegian navy, Mr. Bull, has invented a new bronze-alloy, the so-called M-bronze, which is particularly adapted for bearings, armaments and machinery parts where a comparatively high hardness is required, and for welding and rolling. In order to satisfy different requirements the bronze is worked out in three qualities: One hard (M H), one medium hard (M M) and one soft (M B). For use where an especially good quality is demanded and for ship's use there can also be produced a finer quality, like mangan bronze.

New Process Gear Corporation Taken Over by a New Organization

The Meachem Gear Corporation, of which T. G. Meachem is president, T. W. Meachem vice-president and J. F. S. Meachem treasurer, Syracuse, N. Y., has been incorporated for the purpose of taking over from the New Process Gear Corporation the manufacture of New Process rawhide pinions and for the general manufacture of gears of all kinds. The company is incorporated at $300,000 and has purchased a three-story building at 411-415 Canal St., Syracuse, which is to be devoted entirely to the manufacture of gears.

The Meachems who organized this company are the same persons who owned and controlled the New Process Gear Corporation and the New Process Rawhide Co. for 30 years. Associated with them are George W. Wood, secretary and superintendent, and H. W. Kiddle, assistant superintendent, who had charge of the manufacture of rawhide and the rawhide-pinion department of the old company.

The plant purchased was remodeled and began operation on Mar. 1, at which time it took over the rawhide-pinion business, the hide plant at 811 Free St., and all of the raw materials and uncompleted orders pertaining to this branch of the business.

The company will also manufacture a full line of cut metal gears for mills and factories of all kinds.

* * *

Engineers' Club of Philadelphia to Hold Interesting Meeting

Dr. John A. Brashear will present an illustrated paper entitled "An Evening's Journey among the Stars" at the regular meeting of the Engineers' Club of Philadelphia at Witherspoon Hall on Tuesday evening, Mar. 18, 1919.

A special meeting will be held at the club house, Wednesday, Mar. 12, 1919. Prof. Warren P. Laird, Department of Architecture, University of Pennsylvania, will present an illustrated paper on "The Placement of the Delaware River Bridge."

The club has made preliminary announcement of a special meeting on Wednesday, Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will present an illustrated paper on "The Devastated Area and Its Reconstruction."

* * *

Cincinnati Machine Tools in Spain and Portugal

Cincinnati sells more machine tools to Spain and Portugal than all the rest of America combined, declared Henry S. Moos, president of the American Machinery Syndicate of Madrid, Barcelona and Bilboa (Spain) and Lisbon (Portugal), who made a business visit to Cincinnati recently.

"Since the beginning of the war Spain has become a manufacturing country," said Mr. Moos, "and now is making most of the commodities she formerly imported. Cincinnati is particularly well known in our country by reason of the superior machinery manufactured here, as well as the excellence of other products, such as soaps, leather goods, tools, hardware, etc. Some idea of the high esteem in which your machine tools and other machinery are held in Spain may be gained from the fact that when contracts are let for any sort of machinery in Spain the specifications almost invariably call for 'Cincinnati-American' machines.

"During the past year Spain purchased more than $2,000,000 worth of machine tools and machinery in Cincinnati. Most of this is being used to build other machinery in Spain."

* * *

Annual Exhibit at Pratt Institute

Thursday evening, Mar. 13, will be observed as visitors' night in the school of Science and Technology of Pratt Institute, Brooklyn, N. Y. From 8 to 9 o'clock the shops, laboratories and drawing rooms of the school will be open for the public to observe the students at work.

* * *

Books for Reconstruction Hospitals

The remarkable range of the reëducation program for disabled soldiers is shown by a list of books for reconstruction hospitals received by the *American Machinist*. It has been compiled by the American Library Association in support of the work of the Surgeon-General's office, and 150 subjects are covered.

Trades and occupations are fully treated in the list, giving the best American books which are neither too elementary nor to specialized for vocational purposes. Some of the books on machine-shop practice contained in the list are on airplane mechanics, blacksmithing, brazing and soldering, electrical engineering, engineering, machine-shop work, advanced mathematics, metal finishing, patternmaking, sheet-metal work, technical periodicals, trades and occupations.

Many of the books are now in the American Library Association libraries in reconstruction hospitals. Any book on the list is supplied to the hospital, where the librarian finds that the specific need for it exists.

* * *

Will Divide Profits With Employees

Announcement is made by John H. Schumann, president of the Hilo Varnish Corporation (formerly Moller & Schumann Co.), Brooklyn, N. Y., of a profit-sharing plan.

Mr. Schumann states that half the profits of the corporation will be distributed among all the employees annually; that each will receive a share proportionate to his salary or wages and the length of time he has been on the payroll of the corporation.

Export Opportunities

W. Rakers, 21 Chineesche Voorstraat, Sourabaya, Java, would like to establish connections with American exporters of tools, hardware and machinery.

Briscoe & Co., Ltd., Crawford and Bond Sts., Dunedin, N. Z., are importers of steel bars and plates, wire rope, etc., and invite correspondence with American manufacturers.

Juan Ortoll Delmotte, Santa Cruz, Teneriffe, Canary Islands, wishes to obtain exclusive representation of American lines of motor cars and accessories, hardware, wire and nails.

Joseph Boukez et Cie., P. O. box 604, Alexandria, Egypt, general importers specializing in chemicals, iron and steel, cement and building materials, desire to represent American lines.

Osaka Boeki Kaisha, Ltd., Osaka, Japan, solicits correspondence with American dealers in chemicals and metals with the object of obtaining Japanese and Korean representation of American lines.

Mohamedally Abdoolally & Co., Iron Jatha, Carnac Bridge, Bombay, India, are desirous of handling American lines of galvanized, corrugated and plain sheets, steel angles, tees and plates, hoops, pipes and pipe fittings.

Horne Co., Ltd. is the new name of F. W. Horne & Co., a Japanese corporation recently purchased from F. W. Horne by the American International Corporation. The business will be continued along its present lines.

A. & T. Burt, Ltd., Dunedin, N. Z., general importers and exporters, are particularly interested in machinery and fittings, engineering requisites, lighting fixtures and similar lines. Correspondence with a view to handling American goods is solicited.

Personals

GEORGE W. TRAUT, president and treasurer of the Traut & Hine Manufacturing Co., was presented with a silver loving cup in honor of his 50th birthday. The presentation was made by General Superintendent E. N. Humphrey.

R. G. AMES has joined the Black & Decker organization in the capacity of branch manager in charge of the Chicago office. Mr. Ames is well known in the automobile-accessory trade, having been associated for the past 10 years with the Edward A. Cassidy Co., New York.

A. F. STRAFER, recently with the Kemp Machinery Co., has organized the Strafer Machinery Co. in Baltimore, Md. Mr. Strafer has been identified with the machine-tool business for a number of years and was formerly with the Motch & Merryweather Machinery Co., Cleveland.

ROBERT S. ALTER, vice president and foreign manager of the American Tool Works Co., was given a dinner at the Business Men's Club, Cincinnati, Ohio, Jan. 31, 1919. The principal speaker was E. G. Todd of E. Isbecque & Co., New York, Brussels and Antwerp. Mr. Alter was presented with a gold watch.

L. M. BAKER is now special engineer of the Hyatt Roller Bearing Co., Detroit, Mich. Formerly Mr. Baker was sales manager of the United Motors Service, Inc., where he was chiefly engaged in organization and expansion work. Previous to this connection he was Western sales manager of the Standard Steel Spring Co., Detroit.

N. A. BOOZE, for a number of years secretary of the Machinists' Supply Co., has joined the Federal Machinery Sales Co., 12 North Jefferson St., Chicago, the change taking effect Feb. 17. Mr. Booze was one of the organizers of the Machinery Club of Chicago, served as its secretary and is among those responsible for its successful start.

THEODORE R. HUGO is the new superintendent of the Lisk Manufacturing Co., Bridgeport, Conn., according to an announcement issued by the company. Mr. Hugo comes from the Liberty ordnance plant of the American Can Co., Bridgeport, which he managed for the past year. Previous to that he was superintendent of the American Can Co.'s plant in Geneva.

Business Items

The Independent Pneumatic Tool Co. will move its New York office from 170 Broadway to larger quarters at 1463 Broadway in the near future.

The J. R. Stone Tool and Supply Co., Detroit, Mich., will represent the Advance Tool Co., Cincinnati, in Michigan. It will carry a full line of Advance tools in Detroit.

The National Twist Drill and Tool Co., Detroit, Mich., has opened a salesroom and office at 565 West Washington St., Chicago, Ill. E. J. Chamberlain is in charge.

The Chicago Pneumatic Tool Co. has removed its Cleveland office from room 813 to rooms 406-408, Engineers' Building. Ross Watson, district manager, will be in charge.

The Logansport Machine Co., Logansport, Ind., will in the future devote its factory entirely to the production of Logan air chucks, a line that contains many new features in air-chuck construction. George F. Hopkins, formerly superintendent of the Frost Gear and Forge Co., Jackson, Mich., has been appointed works manager. The Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., has been granted exclusive selling rights for the United States and for foreign countries.

Obituary

HOWARD P. EELLS of Cleveland, for 15 years prominently identified with the National Metal Trades' Association, of which he was president from 1909 to 1911, died at Pasadena, Calif., Feb. 11, at the age of 63. Mr. Eells was born in Cleveland and graduated from Hamilton College in 1876 and from Harvard University in 1877. For many years he was president of the Bucyrus Co., South Milwaukee, Wis., and at the time of his death was chairman of the board of that company. Previous to holding the presidency of the National Metal Trades' Association he served for some time as treasurer and as one of the councillors of the association. He was president of the Dolomite Co., Cleveland, director of the Sandusky Cement Co., Sandusky, Ohio, and director and member of the executive committee of the Superior Savings and Trust Co., Cleveland.

New Publications

Drafting Room Methods: Standards and Forms.—By Charles D. Collins. One hundred and forty-nine 5½ x 8¼-in. pages; numerous forms and tables; bound in red cloth boards. Published by D. Van Nostrand Company, 25 Park Pl., New York. Price $2.

This book has been written with the intention of giving those responsible for drafting-room organization something definite on which to found their system and make it as near standard as possible. Although a comparatively small book the information in it is in a very condensed form and to the point. The book is divided into four parts. Part I deals with the drafting room, and is subdivided into Location; Equipment; Personnel; Methods of Handling Work; Filing; General Instructions. Part II deals with Standards and Symbols, and the subdivisions are Safety Standards; Abbreviations; Aëronautical Terms; Cross-Sections; Definitions; Electrical Symbols; Lines; Patent Office Symbols; Pipe-Fitting Symbols; Rivet Symbols; Structural Materials—Breaks; Thread and Tapped Holes; Topographic Symbols. Part III is on Forms, and the subdivisions are Form Sizes; Drawing Sizes; Application Blank; Arrangement of Drawing; Building and Equipment Record; Print Record; Pattern Record; Index Cards; Material List; Specifications; Organization Chart; Rubber Stamps; Titles; Work Schedule; Work Orders. Part IV is devoted to Miscellaneous Tables listed as follows: Bolt Stresses; Bolts and Nuts; Bolt Threads; Washers; Weight Steel Bars; Studs; Pipe Threads—Briggs; Pipe Sizes; Boiler Tubes; Pipe Flanges; Pipe Fittings; Keyways; Shafting Horsepower; Gages—Sheet; Gages—Wire; Metric Conversion; Weights and Measures; Decimal Equivalents; Areas and Circumferences of Circles.

American Methods in Foreign Trade.—By George C. Vedder. First edition, 196 pages. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price, $2 net.

The aims of this volume are to familiarize American business men with export selling methods and are based on an experience and observation of the author's 14 years' connection with the export trade. Starting with the fundamentals he outlines the general practices now in existence and strongly advises the carrying out of the ideals which have built up American industry and discourages the imitation of European, especially German, trade practices.

The 33 chapters in this valuable work thoroughly outline the functions of the export manager, selling agent, manufacturer and commission house, also sales and advertising plans that are noteworthy for

their practicability. National questions, such as a viewpoint on the Webb-Pomerene bill and the working of the American merchant marine, are covered.

Cost Accounting.—By J. Lee Nicholson and John F. D. Rohrbach. Five hundred and seventy-six 5¾ x 8¼-in. pages; 102 forms; bound in black limp leather. Published by the Ronald Press Co., New York. Price, $6.

Cost accounting as a vital factor of successful business administration, has in the last few years been brought home in various ways to many manufacturers who before had never seriously appreciated its importance. The Federal Trade Commission, working for more stable conditions, has conducted a widespread campaign of education, explaining in detail what a cost accounting system is, how it is operated and the resulting business advantages. Various manufacturers' associations first paid skilled accountants to devise cost-finding methods suited to their special trade conditions, and then instituted a vigorous propaganda to induce all engaged in their own particular industry to adopt them. In this way they could obtain uniform methods in the trade and a uniformity of selling prices and the end of reckless and ignorant price cutting. The Government, in its need to levy heavy taxes with its consequent necessity for searching investigations into income and excess profits, requires that estimates and approximations as to production costs and profits shall give place to accounting systems giving actual figures obtained by uniform methods. As a result of this pressure and the attention given accounting in the better class of schools cost accounting has become the rule in all well-conducted businesses.

With the needs of those seeking authoritative cost-accounting data in mind the authors have compiled this book. Their efforts have been directed first to classifying the details of cost accounting so that the reader, whether accountant, manufacturer or student, is given a well-defined idea of the forms and records required for each separate operation, and an idea of how these forms and records fit into the general system used in the establishment with which the individual is associated. Secondly, they have endeavored to present additional and specially important data, such as a comprehensive table of depreciation rates and the classification of and distinction between assets and perishable tools. Definite information of this kind based on standard practice solves many problems which arise when such arbitrary matters as depreciation and classification are left to individual judgment with its tendency to be biased by the current statement of profit and loss. Similar problems have arisen in interpreting the terms of numerous Government contracts made during the war period and their subsequent cancellation. For this reason the book is brought up to date by a detailed discussion of what may be chargeable to such contract work and what compensation the contractor may be entitled to on the cancellation of a fixed price, a fixed profit or a cost-plus contract.

The various individual chapters deal with Cost Finding and Its Functions; Elements of Cost; General Methods of Cost Finding; Department and Product Classification; Factory Orders; Material and Material Reports; Wage Systems; Labor Reports; Departmental Application of Overhead; Depreciation and Maintenance; Distribution of Factory Overhead; Factory Overhead Reports; Methods of Reporting Production; Cost Sheets; Stock Records; Summarizing Records—Charging Factory Expenditures; Cost-Summarizing Records—Transfers Within the Factory; Cost-Summarizing Records—Sales, Cost of Sales and Journal Entries; General Ledger Control of Factory Accounts; Factory Ledger Controlling Accounts; Financial and Factory Statements; Method of Taking Inventory; Plant Asset Records; General Considerations; Installing a Cost System—Examination of Plant; Installing a Cost System—Method of Starting Operations; Elementary Cost Systems; Estimating Cost Systems; Uniform Cost Methods; Recommendations of Interdepartmental Cost Conference; Cost-Plus Contracts—Material, Labor and Equipment Items; Cost-Plus Contracts—Expense and Overhead Items; Suspension or Cancellation of Contracts.

The various forms and charts cover Elements of Cost; General Methods of Cost-Finding; Factory Orders; Material and Material Reports; Labor Reports; Factory Overhead Reports; Production Reports; Cost Sheets; Stock Records; Summarizing Records; Controlling Accounts; Financial and Factory Statements; Inventory Records; Estimating Costs; Cost-Plus Contracts.

Trade Catalogs

Loway Size Blocks. A. F. Way Co., Inc., Hartford, Conn. A single-sheet circular giving description and price of different sets of size blocks.

Loway Sine Bar. A. F. Way Co., Inc., Hartford, Conn. This four-page circular shows how the sine bar is used. The price and an illustration are given.

Leyner Oil Furnace, No. 3. Ingersoll-Rand Co., New York. Form 9120. Catalog. Pp. 4; 6 x 9 in. Giving advantages, construction and essential details of this furnace.

Dixon's Graphite Products. Joseph Dixon Crucible Co., Jersey City, N. J. Catalog. Pp. 20; 3¾ x 6¼ in. This describes the various products of the Joseph Dixon Crucible Company.

The Sergeant Ticket Cancelling Box. Ingersoll-Rand Co., New York. Form 9010. Catalog. Pp. 4; Giving particular advantages, diagram of the mechanism and a list of users of the Sergeant ticket-cancelling box.

Class F-P Steam Engine. Ingersoll-Rand Co., New York. Form 9026. Catalog. Pp. 12. On the Ingersoll-Rand high speed piston-valve steam engine. There are cross-sectional illustrations showing the machine in detail.

Imperial Tie Tamping Outfits. Ingersoll-Rand Co., New York. Form 9123. Catalog. Pp. 24; 6 x 9 in. It is profusely illustrated and shows the application of the tie-tamping outfit on many of the important railroads in the United States.

The Oliver Sawing, Filing and Lapping Machine. Oliver Instrument Co., Adrian, Mich. Catalog. Pp. 24. This combination sawing, filing and lapping machine is here described and illustrated. Details of the special features and specifications of its various types are also given.

Snyder Drilling Machine. J. E. Snyder & Son, Worcester, Mass. 1919 Catalog. Pp. 42; 6 x 9 in. This new catalog illustrates and describes high-grade upright drilling and tapping machines. General dimensions and details are given of the different types of machines manufactured by this company.

Tractor Service Book. Gurney Ball Bearing Co., Jamestown, N. Y. Booklet. Pp. 24; 4 x 9 in. The information presented herein will be found of interest in connection with the use of tractors. Useful engineering data are given, together with several blank service-account form records.

Geared Marine Steam Turbines. De Laval Steam Turbine Co., Trenton, N. J. Bulletin M. A 32-page catalog describing standardized geared turbine units for marine service. Details of construction of turbines and gears and also various turbine-driven auxiliaries, including lighting sets, circulating pumps, boiler feeders, etc., are given.

Erie Steam Hammers. Erie Foundry Co., Erie, Penn. Catalog F. Pp. 40; 8½ x 11 in. This is an illustrated catalog giving descriptions, specifications and instructions for erecting, operating and adjusting the various types of steam hammers. It also describes Erie trimming presses and sheet-galvanizing and shearing machinery.

Equipment for Sugar Factory and Refinery Service. Ingersoll-Rand Co., New York. Form 9028. Catalog. Pp. 18; 9½ x 11 in. Touching briefly on the various machines manufactured for this class of service. The catalog is offered in both English and Spanish, and can be had free on request at any of the Ingersoll-Rand Co.'s offices.

Small Power Drives, No. 16. Morse Chain Co., Ithaca, N. Y. Catalog. Pp. 24; 6 x 9 in. This is the fourth publication of the series, "A Chain of Evidence." It is composed largely of half-tone illustrations showing the installation of Morse silent chain drives in factories, mills, power plants, etc. On the inside back cover is a table of data to be used in the design of Morse silent chain drives.

Cubic-Foot Standard for Gas. Technologic Paper 114. Bureau of Standards, Department of Commerce, Washington, D. C. A paper treating of a new type of cubic-foot standard for measuring gas, which possesses decided advantage over the apparatus of this type commonly in use at present. The standard is especially well adapted to the needs of traveling inspectors of gas-meter testing apparatus. This paper is now ready for distribution, and those interested may obtain a copy by addressing a request to the bureau.

Catalog 7. Graton & Knight Manufacturing Co., Worcester, Mass. Pp. 124; 6 x 9 in. An illustrated catalog showing the different processes of belt making from the receiving of the hide to the finished belt. It not only illustrates and describes the different products made by Graton & Knight, but shows what can be accomplished in the manufacture of high-grade leather belting and leather specialties. The belting section fully explains the capabilities of the company's brands of belting, and embodies mechanical rules, tables and other information that should be of value in determining the most efficient belt for any drive or in assisting in other transmission problems. The last 20 pages are devoted to the leather-strap and sundries department and describe the miscellaneous products manufactured under this head.

Catalogs Wanted

Alexander Zelenko, American representative of the All-Russian Central Union of Coöperative Societies, Liebes Building, 167 Post St., San Francisco, Calif., would like to receive catalogs and price lists in duplicate from subscribers and advertisers who desire to establish commercial relations with the above societies.

Forthcoming Meetings

The annual aeronautical exposition of the Manufacturers' Aircraft Association, Inc., will be held Mar. 1 to 15 in New York.

The annual meeting of the National Foreign Trade Council will be held at Chicago, Apr. 24-26.

The annual convention of the United States Chamber of Commerce will be held at St. Louis, Apr. 28-May 3.

The National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

The Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, Mar. 18, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

The annual meeting of the American Association of Engineers has been scheduled for May 13 at Chicago.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed-Clipping Index of Equipment

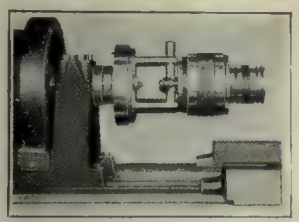
Clip, paste on 3 x 5-in. cards and file as desired

Jacks, Planing-Machine
Kent Machine Co., Kent, Ohio
"American Machinist," Feb. 13, 1919



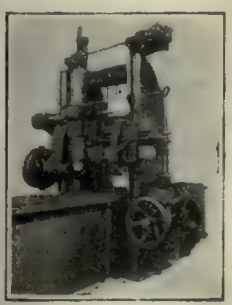
These jacks are made in three sizes, covering a range of from 2 to 6 in. The bases are made of cast iron, the adjustment being secured by means of a screw placed in the top of the casting, and prevented from turning while in use by means of a setscrew at the side bearing on a brass plug, which in turn bears on the raising screw and prevents mutilation of the thread. The screws for all sizes for both adjustment and for clamping have the same sized head, thereby entailing the use of but one wrench.

Piston Chuck
S. D. Hartog Manufacturing Co., St. Louis, Mo.
"American Machinist," Feb. 13, 1919



Intended for the use of garages, service stations or other places where it is desired to re-turn the piston-ring grooves in automobile or gas-engine pistons, which may be re-turned without the necessity of removing the connecting-rod. It is also claimed that the method of holding the piston avoids the liability of cracking. The chuck is clamped to a faceplate, after which the piston is put in place and a pin is put through the sides of the chuck and through the crankpin bearing of the rod. An outer sleeve on the chuck body is then screwed forward, carrying the faceplate up against the base of the piston, and thus holding it securely in place.

Keyseat Milling Machine, Heavy-Duty Horizontal
Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn.
"American Machinist," Feb. 13, 1919



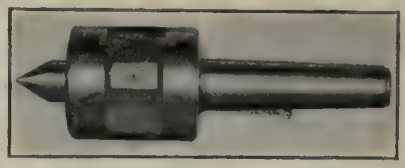
Diameter of horizontal spindle in bearing, 4⅜ in.; diameter of horizontal spindle through driving gear, 4 in.; side adjustment of horizontal spindle by hand, 4 in.; distance from center of horizontal spindle to under side of cross-rail, 2¾ in.; maximum cutter swing on horizontal spindle, where vertical spindle saddle does not interfere, 10 in.; maximum cutter swing under vertical spindle saddle, 6 in.; width of work table over working surface, 20 in.; length of table to mill, 10 ft.; width between uprights, 26 in.; maximum height from center of horizontal spindle to top of work table, 33 in.; maximum height from end of vertical spindle to top of work table, 35 in.; diameter of vertical spindle, 2 in.; independent hand elevation of vertical spindle sleeve, 6 in.; vertical spindle adjustable to maximum height of 2 in. above the center of the horizontal spindle; weight complete, 22,000 pounds.

Lamp Guard with Split Handle, "Flexco"
Flexible Steel Lacing Co., Chicago, Ill.
"American Machinist," Feb. 20, 1919



This device has been made to fill a demand for a substantial handle guard that does not have to be wired. The halves of the guard, including the handle itself, open wide from the hinge at the end of the guard and can be instantly closed and locked around any socket at the end of an extension cord, the cord itself running through grooves in the sections of the handle. The hinge pin is located in the end of the guard and can be equipped with a hook for hanging up the complete device if this is desired.

Centers, Ball-Bearing, "Alive"
Kell, Hock & Co., 354 Mulberry St., Newark, N. J.
"American Machinist," Feb. 20, 1919



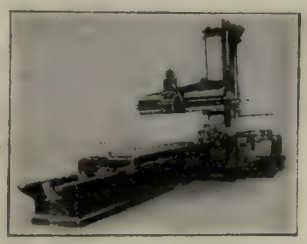
These centers are made in three sizes, with Nos. 2, 3 and 4 Morse taper shanks, and are regularly supplied with 60-deg. centers, but special centers of various types can be furnished if desired. Each center is mounted on two annular ball bearings, while end thrust is taken by a ball thrust bearing. The construction is such that no chips or dirt of any kind can enter the bearings. Two oil holes are provided, which are of such size as to contain an amount of lubricant sufficient for a month or more of use.

Table, All-Metal Shop
Kent Machine Co., Kent, Ohio
"American Machinist," Feb. 20, 1919



Useful for holding tools, fixtures, arbors, jigs, etc., in connection with machine work. The base consists of a three-footed casting, which insures steadiness on uneven floors. The base holds the central column, at the top of which is secured a fixed table 24 in. square and 33 in. from the floor. The lower table is adjustable on the column and may be placed at any height, as most convenient, and if desired a third table can be placed on the column as well. The weight of the device with two tables is approximately 175 pounds.

Planing Machine, 42-In., Open-Side
Simmons Machine Co., Inc., Albany, N. Y.
"American Machinist," Feb. 20, 1919



This machine will actually handle work 42 in. wide, 46 in. under the cross-rail and 13 ft. long. The bed is braced with box-girder ties placed at short intervals and inclosed to prevent chips falling through. The table is of hollow, double-deck section type with cross-ribs, and three T-slots are provided. Two heads are used, one on the cross-rail and one on the upright housing, both being fitted with adjustable gibs. The feeds are driven directly from the main driving shaft, the action not being dependent upon the close adjustment of friction surfaces. The feeds are regulated by an adjustment of a sliding block in a slotted faceplate. The drive is through spiral gearing, the takeup key for the end thrust being placed on the outside so that adjustments can be made while the machine is in operation. Motor drive, various bed lengths and two heads for the cross-rail can be furnished if desired.

Saw, Bench
J. D. Wallace & Co., 1401 West Jackson Blvd., Chicago, Ill.
"American Machinist," Feb. 27, 1919



Intended for light pattern, cabinet and carpenter work and is operated by a ½-hp. motor that is connected to the regular lighting circuit. The saw is geared directly to the motor, preventing belt slippage, and the whole assembly swings when the saw is tilted, the adjustment being by means of a handwheel at the left. This construction is said to be advantageous, as the table is always horizontal. The cross-cut fence is mounted on a rod located beneath the table and may be swung off the table when not needed. With both the cross-cut fence and the saw set at an angle it is possible to cut stock in both angular directions at one operation, the stock being guided by the rip fence. The tilting mechanism is provided with an indicator moving over a graduated scale to show the angle of inclination.

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34 60	$37 60
Northern Basic	31 80	34 80
Southern Ohio No. 2	32 80	35 80
NEW YORK, Tidewater delivery		
Penns. 2X	36 15	39 55
Southern No. 2 (silicon 2.25 to 2.75)	39 95	41 70
BIRMINGHAM		
No. 2 Foundry	31 00	34 00
PHILADELPHIA		
Eastern Pa. 2X	36 15*	39 15*
Virginia No. 2	35 10†	40 50†
Basic	33 90*	36 90*
Grey Forge	33 90*	36 90*
Bessemer	.....	39 10*
CHICAGO		
No. 2 Foundry Local	31 00	34 50
No. 2 Foundry Southern	37 25	39 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31 00	35 40
Basic	30 00	34 40
Bessemer	33 60	36 60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4 07	$4 07	$4 20	$3 97	$4–4 04	$4 07	$4 20
Soft steel bars	3 97	3 97	4 10	4 07	4–4 04	3 97	4 10
Soft steel bar shapes	3 97	3 97	4 10	4 07	4 14	3 97	4 10
Soft steel bands	4 57	4 57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4 27	4 27	4 45	4 47*	4 39	4 27	4 45

* For ¼-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$2 90	$3 50
Warehouse, New York	4 17	4 70
Warehouse, Cleveland	3 90	3 98½
Warehouse, Chicago	4 10	4 10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4 70	6 22	6 22	6 445	5 75	6 45	6 22	6 445
*No. 26 black	4 60	6 12	6 12	6 35	5 65	6 35	6 12	6 35
*Nos. 22 and 24 black	4 55	6 07	6 07	6 295	5 60	6 30	6 07	6 295
Nos. 18 and 20 black	4 50	6 02	6 02	6 245	5 50	6 25	6 02	6 245
No. 16 blue annealed	4 10	5 37	5 37	5 645	4 95	5 65	5 37	5 645
No. 14 blue annealed	4 00	5 27	5 27	5 545	4 85	5 55	5 27	5 545
No. 10 blue annealed	3 90	5 17	5 17	5 445	4 75	5 45	5 17	5 445
*No. 28 galvanized	6 05	7 57	7 57	7 695	7 15	7 70	7 57	7 695
*No. 26 galvanized	5 75	7 27	7 27	7 395	6 85	7 40	7 27	7 395
No. 24 galvanized	5 60	7 12	7 12	7 245	6 70	7 25	7 12	7 245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25 50–30	$15 00
Cleveland	20 00	15 00
Chicago	16 50	15 00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL SWEDISH—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 1/8, 5/32, 3/16, 7/32 No. 8, 1/4 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14 00
		1/4 by 19 in. long	12 00
		5/16 by 19 in. long	10 00
No. 12		3/8 by 21 in. long	10 00
5/32, No. 14 and 1/16		**Special Welding Wire, Coated**	
No. 18		1/16	35 00
No. 20		3/32	30 00
Domestic 20c. for 1/16, 15c. for 1/8 to 1/4.		1/8	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7 50	8 00	7 50
Spring steel (light)	10 00	11 25	11 75
Coppered bessemer rods	8 00	8 00	7 07
Hoop steel	4 57	4 75	4 77
Cold-rolled strip steel	8 02	8 25	8 57
Floor plates	6 27	6 00	6 25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛, ¼, and ⅜	47%	20½%	⅛ to 1½	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			
LAP WELD					
2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	43%	25½%	½ to 1½	36%	21%
½	48%	35½%			
¾ to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	43%	27%	43%	26%	44 9%	29 9%
3½ to 6 in. steel lap welded	38%	23%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16 00	20 00	23 50
Tin in 5-ton lots	72 50	71 50	85 00
Lead	5 25	5 30	7 25
Spelter	6 75	7 10	8 00
ST. LOUIS			
Lead	5 00	5 00	7 10
Spelter	6 40	6 75	7 75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	24.50–27	29.00	31.50–33	26.50	32.50	32.00	36.02
Copper wire (carload lots)	25.00–28	28.00	32.00	25.00	28.50	28.50	34.50
Brass sheets	23.75–28	29.00	30.75	28.00	32.50	29.00	35.50
Brass pipe	34.00–37	37.00	36.50	34.00	39.00	37.00	41.50
Solder (half and half) (case lots)	38.00–41	41.00	62.00	41.50	48.50	39.00	48.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$20 50	$25 25
New York	21 50	26 25
Cleveland	26 00	30 00
Chicago	28 50	37 00

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Motor Drive as Viewed by Machine Builders and Motor Manufacturers

BY C. E. CLEWELL

The viewpoints of manufacturers of motors, machine-tool builders and plants who have used the combined product in the form of motor-driven machine tools are given in this article. As motor manufacturers look favorably upon motor-driven machinery greater stress is placed upon the attitude of machine-tool builders to the problem than upon motor manufacturers. Some practical aspects of the electric-power situation based on some actual opinions from various machine-shop industries are included.

ARTICLES containing more or less conflicting statements in regard to the advantages and disadvantages of the electric motor for machine-tool driving have appeared in the technical press from time to time during the past few years. It is believed, however, that a better grasp of the situation can be gained by a study of the present attitude of machine-tool builders toward motor-equipped machine tools than from articles based on a single viewpoint, since this attitude reflects to some extent at least the demand for such a method of drive by the manufacturers who purchase machine-tool equipment.

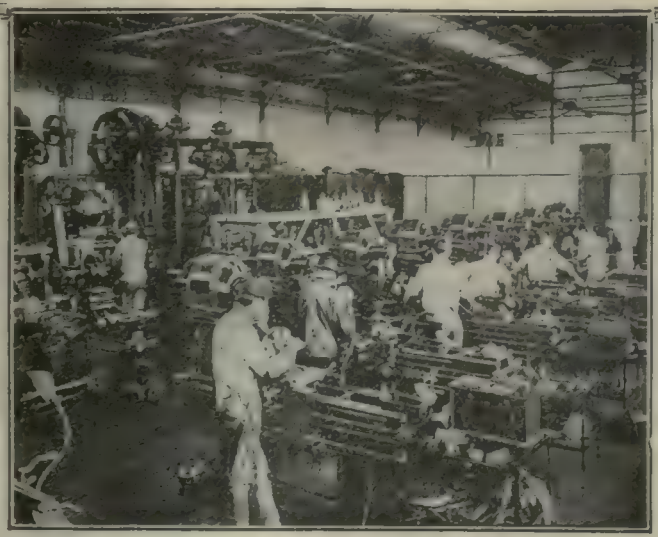


FIG. 1. INDIVIDUAL-MOTOR-DRIVEN MACHINE TOOLS

For the purpose of obtaining views of this kind I gathered opinions from representative machine-tool builders in 1914 and again during the past months, so that this article is based on actual opinions from various industries in this field. The opinions gathered in 1914 were at the instance of the *American Machinist;* those gathered recently were for the *Electrical World* and were used to illustrate a modern viewpoint of motor applications. This article coördinates the older and more recent opinions, giving an indication of the changing attitude in favor of the motor after an interval of three to four years.

THREE VIEWPOINTS

The question of the motor and its usefulness to the shop is one that must always rest upon actual rather than imagined advantages, and the answer to the question of which method of drive is best depends on the judgment of those plants where motor-driven machinery is subject to the test of everyday service.

It is perhaps apparent to the reader that the manufacturers who build motors naturally view the situation in a way favorable to their own commercial interests, but it is only fair to add that probably more high-grade engineering investigations and attention to the accumulation of exact data on the real advantages of the motor under shop conditions have been due to the motor manufacturers than to any other branch of the industrial field. Another viewpoint is that of the users of machine tools. The user of such equipment is naturally and logically the very one to decide finally which of the various methods of drive is best suited to shop conditions and the most economical from all standpoints. It is probably safe to assume that the demand for an adjustable-speed motor with a wide range of speeds and close gradations in speed adjustment was dictated largely by the needs originally felt for such driving mechanism by users of machine tools after the appearance of high-speed tool steel. The policy of the motor manufacturers has been to observe and search out just such needs in the shop field and then to design motors that can supply those needs.

Still another viewpoint is that of the machine-tool builders. They stand in a certain sense between the motor manufacturers and the user of machine tools, and in this light their opinion, so far as it indicates the tendencies of supply and demand, may be taken as a valuable basis for a general decision as to how motor-driven machinery is meeting the needs of users of their product.

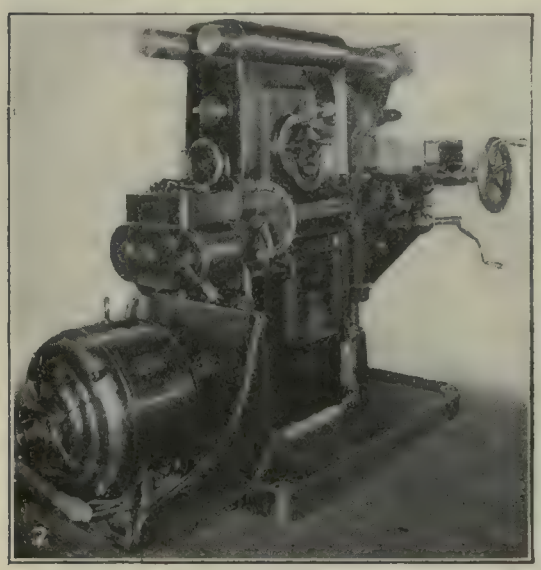
OLDER AND MORE RECENT OPINIONS COMPARED

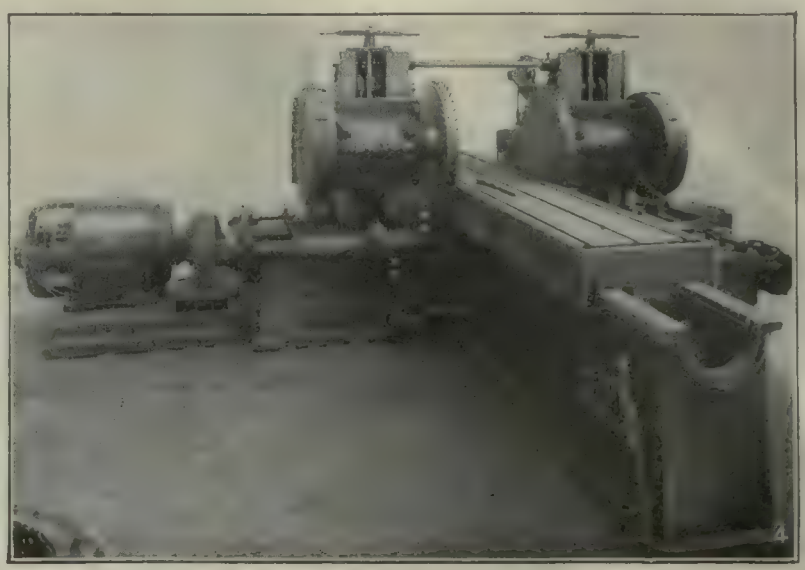
The general impression given by a comparison of opinions gathered in 1914 with those collected more recently is that a change has taken place within the past three or four years in the attitude of machine-tool builders toward the use of the motor. In the earlier canvass there appeared to be some hesitation in admitting the superiority of the motor-driven machine tool. More recently the views of 10 of the leading

machine-tool builders indicate a practical uniformity in favor of the motor drive.

The opinions obtained in the more recent canvass of the field possess unusual value because they relate to four fundamentally important aspects of the motor-drive problem; that is to say, (a) to the general attitude of the various machine-tool plants to the question, (b) to the points in which motor drive is considered superior to other methods of drive, (c) to the approximate percentages of machine-tool output supplied for individual motor drive, for group motor drive and for straight lineshaft drive, and (d) to the more recent changes in the design of modern machine tools in order to adapt them more conveniently to the motor drive.

The following opinions of machine-tool builders toward motor-driven tools relate to the equipment of new machine tools, which is an entirely different proposition from where a shop modifies its equipment so as to change old machine tools from belt to individual motor drive:





FIGS. 2 AND 4. TWO TYPES OF MOTOR DRIVE

Fig. 2—Polyphase induction motor driving a milling machine. Fig. 4—Individual-motor-driven machine with geared connection

General Opinions

Individual-motor drive, according to a recent canvass of 10 leading machine-tool builders, is preferred on large machine tools in practically all cases and for smaller machines where feasible. In one case the individual-motor method of driving is preferred to all other methods; in another about 80 per cent. of the machine tools are individual-motor driven, this being an index of the way the question is viewed in their own shops. In one case both belt drive and motor drive have their legitimate field of operation. In the main the tone of all 10 opinions is highly favorable to the use of the motor.

Points of Advantage

Following up the general attitude of the various manufacturers with reasons why the motor is considered superior we find a number of interesting comments which may be summarized somewhat as follows: By mounting the motor on top of the machine the driving mechanism is protected from dirt and other injury and is out of the way; flexible equipment, shop lighter and cleaner and the problem of upkeep reduced; number of working parts in the transmission reduced and speeds changed readily; economy in energy, space and material. In several cases, however, emphasis is placed upon the importance of scientifically adapting the machine tool in its design to motor drive.

An example of the last-named point is advanced by one firm in which a disadvantage of motor drive is given, such as the complex mechanical attachments in direct-motor driving when the machine tool has not been adapted to it, and along this same line another firm advances the point that in all special cases as those of single-pulley drive for screw machines or turret lathes, for heavy planing machines and also for boring machines the first cost of the machines is less, but only for such tools as have been designed for either method of driving. One of the statements in this connection is that of a tool builder in which the superiority of motor drive is given in terms of such points as constancy of power input, no belt slipping, adaptability of the machine tool to overtime work, freedom from dependency on the rest of the shop, and, in some cases, greater convenience of control. The choice, according to this builder, should be governed by the circumstances under which the machines are to be operated.

Various Types of Drives in Percentages

It is difficult to derive exact figures on the output of machine-tool plants even on a basis of such data, since there is no easy way for a machine-tool plant to know whether its machines are for use on line-shaft drive or for group drive. However, the figures on individual-motor-driven tools are more readily obtained, and hence the figures to follow relate mainly to them. It should be remembered that the nature of the product of a machine-tool plant, that is, whether the machines are large or small and dependent also upon the class of machines, will govern the greater or lesser use of the motor to some extent, and allowance for this should be made.

The percentages of the output of the 10 plants

equipped for motor drive range from about 5 per cent. in one or two exceptional cases up to 95 per cent. in others. Actual examples may be cited as follows: In one case about 36 per cent. motor driven; in another very few machines furnished for belt drive; in another about 50 per cent. at least for individual-motor drive, practically all the rest for group motor drive; in another

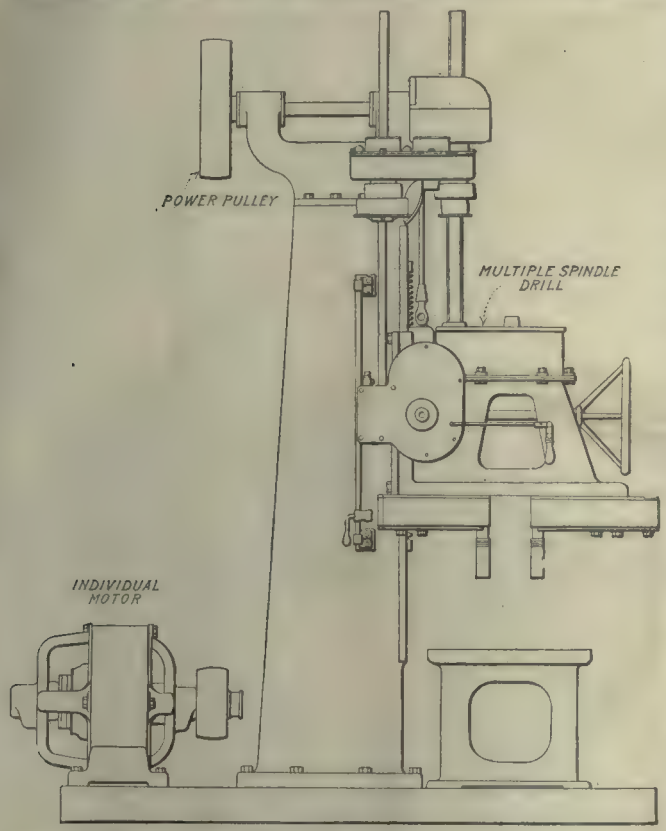


FIG. 3. DIAGRAM SHOWING ARRANGEMENT OF A MACHINE FOR INDIVIDUAL-BELTED MOTOR DRIVE

about 95 per cent. motor driven; in another about 40 per cent. of planing machines are individual-motor driven and about 85 per cent. of boring machines are for individual-motor drive.

Other figures might be added to the foregoing, but those given show increased use of the motor as an integral part of machine tools, and this use is resulting in more attention to the design of motor mounting and its adaptability to the machine tool in size and shape, power-transmission apparatus, location of control levers and items of this kind.

The foregoing points may be summarized in the form of a list of advantages of individual-motor drive based on a very complete table of such advantages as prepared and submitted to me recently by E. E. George, plant engineer of Lodge & Shipley. The points are abridged from a list first published in extended form in the *Electrical World*, Vol. 70, No. 21, p. 997.

Advantages of the Individual Motor

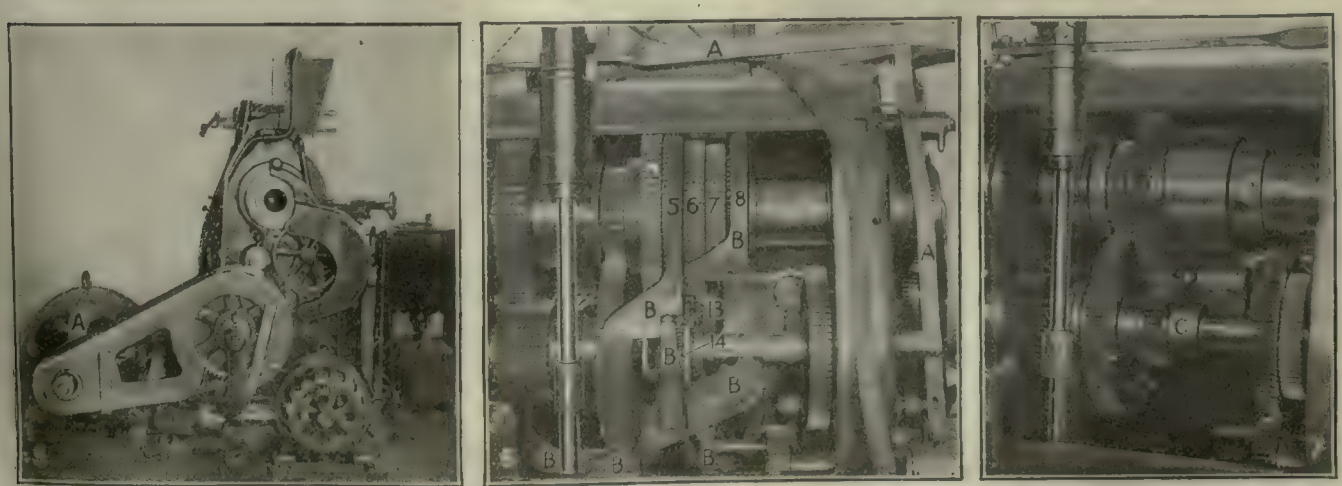
The advantages of the motor as here given indicate the machine-tool builders' attitude partly from the engineering standpoint and partly from that of actual experience under shop conditions. The individual motor may be said to possess advantages over lineshaft or even group drive because of low maintenance, low initial cost and low power losses, greater flexibility in being moved about the shop, ease in starting and stopping, closer speed control, more simple for reversing, special control available, clearance overhead for cranes, better lighting, machines readily set at any angle, easily adaptable to space requirements, avoidance of side pull by belts, special features for grinding machinery, each machine may have its own speed, overload protection by fuses or circuit-breakers and safety devices readily applied.

A Practical Example

Fig. 1 shows the clearness of the space over motor-driven machine tools[1]. Fig. 2 shows special bracket for mounting the motor rigidly to a machine tool. In Fig. 3 the extension of the main baseplate of a multiple-spindle drilling machine is shown for accommodating an individual motor. This view illustrates a case of belted connection with the motor. Fig. 4 indicates a method of mounting the motor to a machine where a geared connection is employed for the power transmission.

Some of the foregoing points will perhaps be clearer from the following practical example of the efficiency

[1]Figs. 1, 5, 6 and 7 are due to the Westinghouse Electric and Manufacturing Co.; Fig. 2 to the Wagner Electric Manufacturing Co.; Fig. 3 to the Bausch Machine Tool Co., and Fig. 4 to the Newton Machine Tool Works.



FIGS. 5 TO 7. CHANGES IN A BELT-DRIVEN MACHINE TO ADAPT IT TO MOTOR DRIVE

Fig. 5—Turret lathe changed from belt to constant-speed motor drive and later to adjustable-speed motor drive. Fig. 6—Starting and stopping lever and internal mechanism of the headstock when used with either belt or constant-speed motor drive. Fig. 7—Internal mechanism of the headstock for adjustable-speed motor drive

of motor drive[2]. This refers to some work done on a 24-in. turret lathe in changing from constant-speed belt drive, first to constant speed and later to adjustable-speed motor drive.

Through the medium of gears and levers 30 changes in speed were obtainable, the gear ratios giving ample driving power to the spindle, and the spindle speeds ranging from 6 to 180 r.p.m. The rapid traverse for the turret and carriage was gear connected to the constant-speed driving mechanism. When the spindle was stationary all driven parts were also stationary, not permitting the rapid traverse to be operated under such conditions.

The machine was changed to a constant-speed motor drive using a 975-r.p.m., 220-volt, direct-current motor, with a chain connection from the motor to the driving pulley, the motor being located at *A* in Fig. 5. By using the mechanical speed changes and levers the same spindle speeds were available as before. The motor was started gradually by a regular starting rheostat, and the spindle was started and stopped by a lever arranged to engage with the friction pulley. The rheostat served also as a safety device for the motor and the machine since it automatically released the lever if anything went wrong or if the motor was subject to an overload from any cause.

Starting and Stopping Lever

The starting and stopping lever connecting with the friction pulley on all of the drives of this lathe is shown at *A*, Fig. 6. This same figure also shows the mechanical speed changes and devices that were used when the lathe was belt driven, there being no change in this design for the constant-speed motor drive.

Later on the same lathe was changed over to adjustable-speed motor drive, a 220-volt direct-current motor, with a speed range from 450 to 1800 r.p.m., being used. Fig. 7 shows the mechanism of the head-stock used with the adjustable-speed motor drive.

Comparing Fig. 7 with Fig. 6 it will be noticed that the gears numbered 5, 6, 7, 8, 13 and 14 have been eliminated, together with all parts marked *B*, and that the hub gear marked *C*, Fig. 7, replaces all the gears and parts eliminated. With the adjustable-speed motor drive the same chain connection between the motor and the friction pulley was employed and the lever *A*, Fig. 6, was used to start and stop the spindle.

With the adjustable-speed motor drive there are 96 spindle speeds available on the modified machine, with three mechanical gear shifts, that is, 32 direct speeds, 32 back gear speeds and 32 triple gear speeds, and the proper cutting speeds can be obtained for practically all cases ranging from boring a hole 1½ in. in diameter up to turning work 24 in. in diameter.

As the rapid traverse for the turret and carriage could still not be driven when the spindle was stationary a 3-hp. 700-r.p.m. 220-volt constant-speed motor was used as shown at *B*, Fig. 5. This auxiliary motor operates the rapid traverse and enables the operator to stop the spindle and take the piece of work out of the chuck while the carriage and turret are being run back to the starting point for the next piece.

[2]The writer is indebted to E. C. Brandt of the Works Dept., Westinghouse Electric & Mfg. Co., for the report on which this explanation is based.

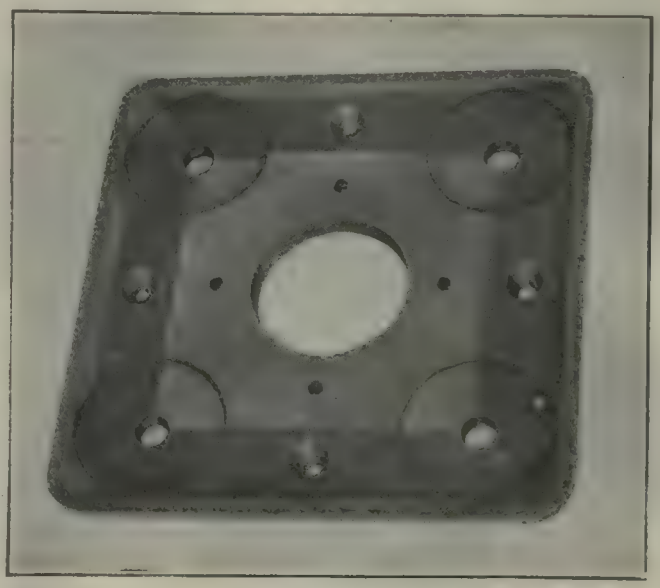
A Composite Seaming Die

By J. A. Lucas

The illustration shows a seaming die that is used on can-making machinery for setting the bottoms and tops of cans in place. Seaming dies are of many sizes and shapes, as each size and shape of can formed by the machine requires a die which conforms exactly to it. The die here shown is about 12 in. square and ½ in. thick.

A piece of tool steel of these dimensions would be somewhat difficult to harden without warping so badly as to render it valueless for the purpose intended, and even if it were possible to produce satisfactorily it would be comparatively short lived, as the wear is rapid, particularly at the corners.

To reduce the first cost, and particularly the maintenance cost, these tools in the larger size are built



A BUILT-UP SEAMING DIE

up with a mild-steel core and tool-steel wearing strips which form the periphery of the die. The edges of the center piece are rabbeted to a depth of 1¼ in., the rabbeted portion being about ¼ in. thick. The tool-steel strips are rabbeted to match and are doweled to place with taper pins passing through both parts.

The large counterbored places to be seen near the corners of the die fit over locating plugs on the spindle of the machine on which the die is used. The die is used in conjunction with a pair of seaming rollers, one of which locks the bead on the edge of the can cover or bottom, while the other roller presses down the seam thus formed, making a tight joint.

When seaming a bottom in place on a new can, the seaming die revolves, while the position of the rollers, though the rollers themselves are rotating, is stationary with reference to the die. When setting a top in a filled can it is obviously necessary that the can, and consequently the die, should remain stationary, and in this case the head carrying the rollers revolves around the die. Though the making of large seaming dies in this way involves some rather nice fitting it is still far less expensive than making an entire new die of tool steel when the chances of the latter in the hardening operation are taken into consideration.



Thermit Rail Welding for Electric Systems

Rail welding is an interesting proposition, mechanically and otherwise. The directions given in this article are detailed, and taken with those which have been previously published they should furnish a clear idea of the process and facilitate its use in many fields.

PROBABLY no problem in recent years has received more consideration at the hand of traction companies than the subject of track construction and maintenance. Progress along this line has been continuous and expense has not been spared to obtain the best roadbed possible; heavier rails are being used and particular attention is paid to the foundation, ties and drainage; everything is of the best material and workmanship until it comes to joining the rails together, and here there usually develops the weak point of the entire system. This refers to the mechanical joints in common use. No matter how much care is taken in applying splice bars mechanical discrepancies and disadvantages cannot be overcome; the rail sections are seldom uniform and the American Society for Testing Materials has adopted specifications which limits a maximum difference in height to $\frac{3}{64}$ inch. Variable height in new rails is often unavoidable, as joint plates fitting one rail perfectly may not fit its neighbor.

There are many reasons why the mechanical joint fails to fulfill its function, which are not necessary to enumerate here. On the other hand the advantages of a welded rail joint, where circumstances will permit, are plain. While there are several systems by which rail joints may be welded, at the present time the Thermit method is the only one that absolutely eliminates the joint. It also has advantages in the modified joint-welding work. These advantages will become clear as our description of the actual processes develops. Briefly, the weld is accomplished by pouring the superheated steel obtained from the Thermit reaction into a mold surrounding the rail ends at the joint. This fuses with the base and web of the rail as well as with the lip and one side of the head. An insert cut from a rolled section of similar analysis to that of the rail itself is placed between the heads at the running face, and the lower part of this insert is melted into the Thermit steel. The mold is so constructed, however, that the head of the rail and the top part of the insert are not melted but are merely heated to a welding temperature, so that when the Thermit metal begins to cool and contract, thus drawing the rail ends together with tremendous force, the squeezing action on each side of the insert thoroughly



FIG. 53. ADJUSTING INSERT BETWEEN RAILS

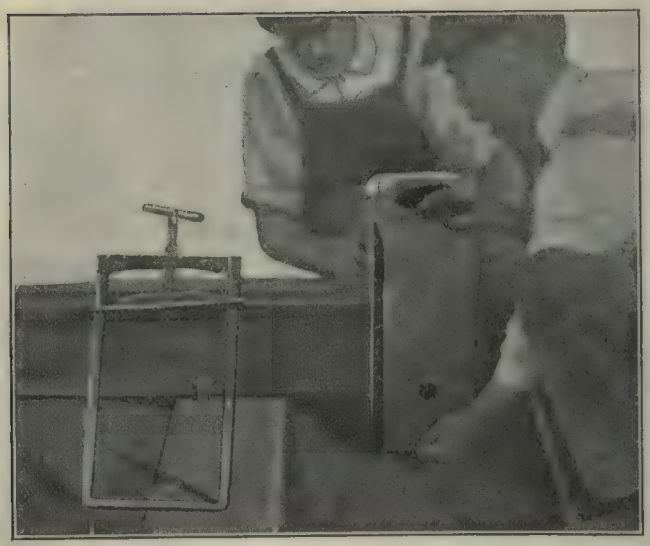


FIG. 54. ADJUSTING TWO-PART MOLD TO RAILS

butt welds it into the head. When this has been accomplished the running face is ground to a true surface and the surplus metal ground out of the groove. The weld obtained in this way is so perfect that it is practically impossible to detect its location after the rails have been paved in.

In practice the welding is best done after the ties have been concreted. If the welding is done before the concreting it is somewhat difficult to keep the rails in perfect alignment and to proper surface after the temporary splice bars have been moved. The rails are spaced $\frac{3}{4}$ in. apart and must be thoroughly cleaned for a distance of 4 in. from each end. This can be accomplished by using a small steel-wire brush. The ends of the rail heads must next be cleaned and where necessary filed smooth so that when the insert is fitted the maximum amount of contact surface will be obtained. In other words the insert must be made to fit accurately. Following this the rails are brought to proper surface and alignment, care being taken to keep the rail ends a trifle high, so that when a straightedge about 30 in. long is centered over a joint there will be a space of about $\frac{1}{32}$ in. between the ends of the straightedge and the surface of the rail directly under it. This slight raising of the rail ends has been found necessary in practice, as it assures proper alignment and surface after grinding.



FIG. 55. RAMMING MOLDS ON A SQUEEZING MACHINE. WOODEN PATTERNS AND SHEET-IRON MOLD BOX IN FOREGROUND



FIG. 56. CUTTING HEATING GATE IN MOLD. FINISHED MOLD AND WOODEN PATTERN SHOWN IN FOREGROUND

The joint is now ready for the placing of the insert, as shown in Fig. 53. Various thicknesses of inserts must be kept on hand to fit the variation in gap brought about by temperature changes and other causes. With the inserts in position two part sand molds are applied, as shown in Fig. 54. These are rammed in advance on a foundry squeezing machine over a wooden pattern, the dividing line of the molds being in the center of the web. A squeezing machine being used for this purpose is shown in Figs. 55 and 56.

The pattern is so constructed as to form an opening around the rail ends in the shape of a collar into which the Thermit steel is poured. This collar is usually about 3 in. wide and varies from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in thickness, depending on the rail section to be welded. Pouring gates and risers are also provided for in the mold in a similar manner to those already described.

Recent improvements in the construction of the molds

used have been perfected to guard against runouts. A bead protrudes around certain parts, so that when the two halves are clamped together it is compressed between them and forms a safeguard against the liquid steel running out.

Before clamping the molds to the rails two cords of asbestos soaked in molasses are applied around the contour of the rail, one on each side of the joint, as shown in Fig. 57, and placed in such a position that they will come just inside the outer edge of the mold box. The molasses is sufficiently sticky to make these cords adhere tightly to the rail and form a very efficient luting all around the outside edge between the mold and the rail. As an additional precaution a small amount of fireclay is blown into the mold through the pouring gate by means of compressed air, as shown in Fig. 58, while the other openings are closed temporarily by inserting wooden plugs. Should there be



FIG. 57. APPLYING ASBESTOS AND MOLASSES STRIPS TO RAILS PREVIOUS TO PLACING MOLD

any opening around the edges of the mold the fire clay escaping through that opening will be caught by the molasses on the asbestos cords and the opening automatically sealed. When the air-pressure gage indicates that the mold is tight the wooden plugs are removed and all surplus fire clay blown out through a small blowout gate provided in the lower part of the mold.

Preheating

The rails are now ready for preheating, and must be brought to a bright-red heat. For this purpose a special portable heater is used.

The opening in the mold through which the rails are heated is situated about two-thirds from the top, so that the flame strikes the lower portion of the web of the rail and has the effect of heating the entire rail section uniformly. This preheating also accomplishes two other objects, as it bakes the mold and at the same time heats up a can of additions which are added to the Thermit in the crucible to improve the quality of the steel produced. This can of additions is placed on top of the mold in a special receptacle provided for the purpose in the riser opening, as shown in Fig. 59. As soon as the rails are red hot, the mold thoroughly dried and the can of additions heated to the proper temperature the burner is withdrawn and

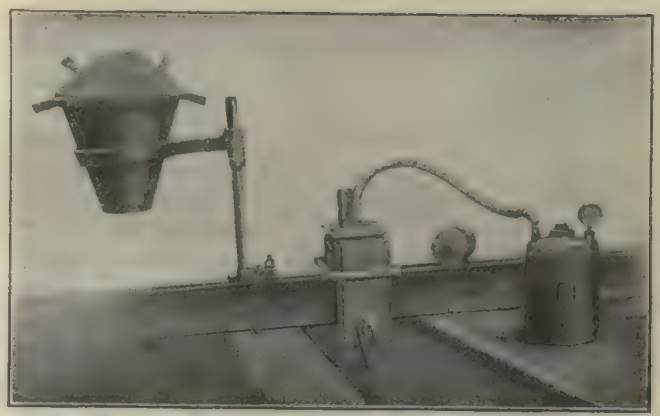


FIG. 58. FINAL LUTING PROCESS, BLOWING POWDERED FIRE CLAY INTO THE MOLD

the heating gate plugged with a sand core. The burner is then directed down the pouring gate in order to restore any heat that may have been lost during the plugging operation.

The mold is now ready for pouring, and the crucible is placed in position, the reaction started and the melt tapped, just as described for other work of this character.

The steel enters the mold on the lip side of the rail and thoroughly melts and amalgamates with the lip as well as with the web, base and one side of the head. No Thermit steel is allowed to touch the running surface of the rail, as the steel insert closes up the space between the rail ends except for a small opening of about $\frac{1}{4}$ in. from the outside of the head. The under part of the insert is thoroughly fused with the liquid steel and becomes a part of the fusion weld, as shown in Fig. 60.

As explained previously, when the metal in the weld begins to cool it produces sufficient pressure on each side of the insert, due to contraction, to thoroughly butt weld it in position so that at the end of the operation the entire rail is welded into one homogeneous mass. A finished weld is shown in Fig. 61 and in Fig. 62 is shown a number of operations going on at once.

One of the principal advantages of this type of weld is that it depends on a predetermined chemical reaction which is always uniform. The success of the reaction

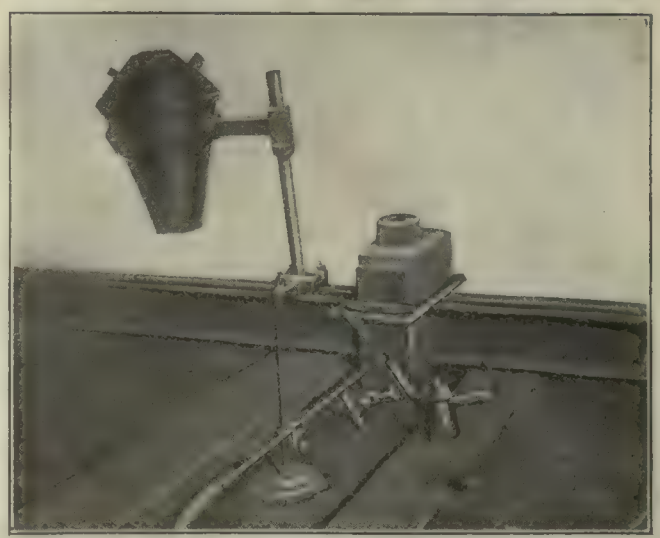


FIG. 59. MOLD AND CRUCIBLE CLAMPED IN POSITION READY FOR PREHEATING. BOX CONTAINING ADDITIONS SET IN RISER OF MOLD

is assured by the fact that every Thermit-welding portion is weighed out separately for each rail section to be welded and in just the proper quantity to obtain a perfect weld on that section.

The placing of the additions in a sheet-iron container is a fairly recent improvement and has resulted in not only obtaining a higher grade of steel in the weld than was possible formerly but also permits of obtaining a greater quantity of steel from the Thermit used. This in turn permits a weld to be made with less Thermit than formerly and has considerably reduced the expense of the welded joints.

The scheme of employing the additions as outlined is to use plain Thermit, and instead of mixing the additions of manganese, nickel and other materials for improving the quality of the Thermit steel throughout

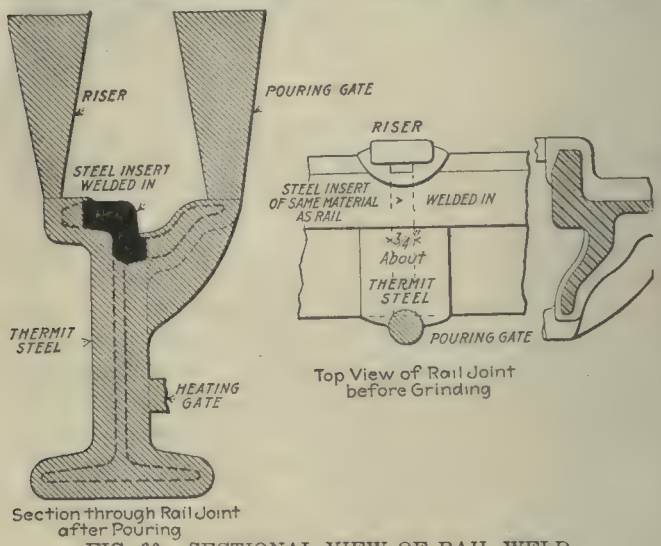


FIG. 60. SECTIONAL VIEW OF RAIL WELD

the Thermit itself these additions are now put up in the sheet-iron container which is placed on top of the mold during the preheating and is heated red hot by the waste gases. It is then placed in the center of the crucible and is melted down by the heat of the Thermit reaction.

This method enables the production of more steel from a given amount of Thermit without any sacrifice of heat, with the result that the cost of the welding portion of Thermit is considerably reduced.

After the weld has been poured *the mold should be left undisturbed for a few hours;* in fact, the longer it is allowed to cool the better, as the metal in the weld has time to become properly annealed. The mold boxes can then be removed, the metal left in the risers and pouring gates cut off by nicking with a hammer and chisel and knocking off. All sand, etc., is cleaned from the rail in the vicinity of the mold and the joint is ready for grinding.

As the steel insert is left a trifle higher than the rail section this excess metal must be ground off together with the excess metal left in the groove and on the outside of the head where the riser is removed.

This grinding can best be accomplished by means of the machine shown in Fig. 63. It possesses the advantage that the weight is concentrated over the grinding wheels so that a deeper cut can be taken. It also has attachments permitting of grinding in the groove of the rail and on the gage. If only a very few joints are being welded, however, the grinding can be very satisfactorily accomplished with a flexible-shaft grinding machine. In fact one of the great advantages of the Thermit process of rail welding is that a few joints can be welded almost as economically as a large number, and traction companies can do the work themselves wherever they please, and when the work is properly organized a gang of nine men can weld from 35 to 40 joints in a nine-hour day.

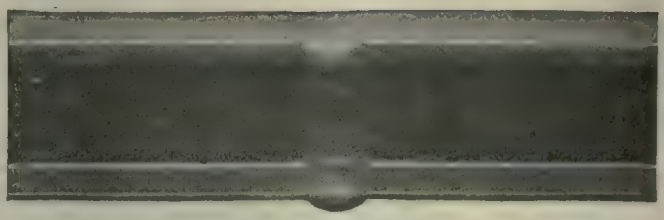


FIG. 61. FINISHED THERMIT FULLY WELDED INSERT JOINT

The simple and portable character of the welding outfit, including the grinding machine, is a strong point of merit, as one service car will carry all the equipment or it can be hauled on its own wheels.

The rail-grinding machine referred to was originally designed by the Thermit company for grinding Thermit-welded rail joints, but has proved very efficient for grinding out corrugations, pounded joints, and in fact anything that is required of a rail-grinding machine on an electric-railway system. An important feature is the derailing device which permits the removal of the machine from the path of traffic very quickly. The concentration of the weight over the grinding wheels has already been mentioned. By this arrangement deep or light cuts may be taken without danger of the grinding wheels chattering. The truck frame carries two axles. One axle is fitted with ordinary 22-in. car wheels and the other has eccentrically mounted 13-in. wheels. By means of sliding adjustments the wheels may be spaced on their axles to fit road gages of from 4 ft. 8½ in. to 5 ft. 2½ in. The grinding-wheel brackets have both vertical and horizontal movement to allow for adjustment to the work. The bracket also may be rotated so that the face of the grinding wheel may be adjusted to the surface to be ground. By a special arrangement of the motors used the machine



FIG. 62. PREHEATING RAILS, DRYING MOLDS AND HEATING THERMIT ADDITIONS, ALL IN ONE OPERATION. FOUR JOINTS BEING HEATED AT ONCE

can be driven forward at a rate of 2 or 4 ft. per minute and 6 to 12 ft. per minute on the return. A reversing switch permits speeds to be used in either direction.

Where it is desired to grind out a depression a special arrangement is used by which an accurate curve is obtained. The grinding wheels run about 1833 r.p.m., which corresponds to a peripheral speed of 6719 ft. per minute on a new 14-in. wheel. The grinding-wheel motors are rated at 3½ hp. and the propelling motor at 1¾ hp., and they are designed to operate on 500 to 550 volts. The derailing device operates by power and is quickly brought into use. The complete machine weighs about 6000 pounds.

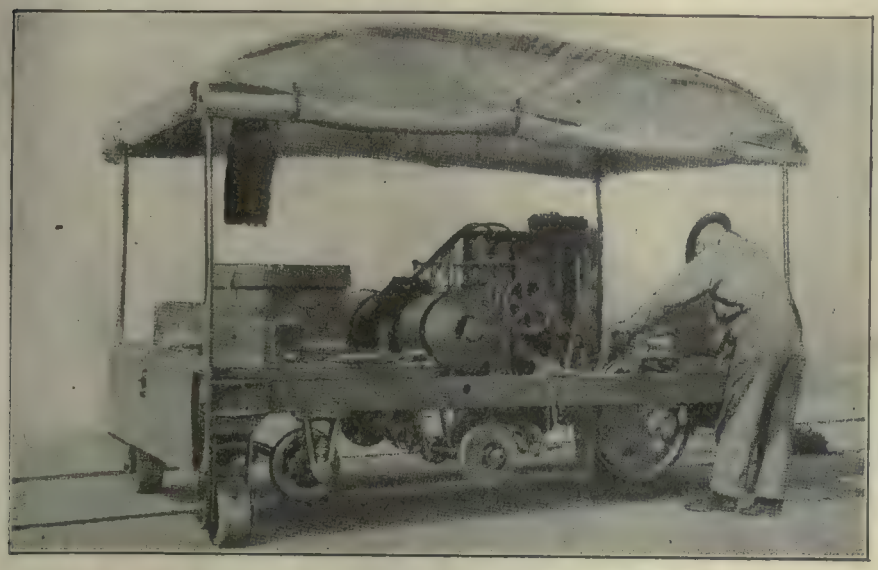


FIG. 63. RAIL-GRINDING MACHINE DERAILED UNDER ITS OWN POWER

The Jottings of a Journeyman

By F. L. Ess

While walking along the other day in that sort of a trance that often comes to men of a mechanical turn of mind when they are thinking out some problem I suddenly bumped violently into a man who was presumably similarly preoccupied. Looking up with some degree of impatience I met the solemn gaze of my old friend Joe Huse, who was a foreman in a large concern manufacturing valves.

"Better look where you are going," said Joe.

"Look yourself," I retorted, holding out my hand.

After the exchange of badinage usual between friends who have not met in years I suddenly recalled that I had recently seen Joe's name in the papers in connection with some patent matters.

"By the way Joe," I said, "how did you come out in your deal? I heard you had recently been allowed a patent on a valve and had sold it to your company."

"Well," replied Joe, "I was allowed a patent all right, but when it comes to selling it to the company I guess it was I that got sold."

"How's that?" I queried. "Your firm has the name of being pretty square sort of people to deal with. Did they try to put something over on you?"

"Oh, I suppose they are square enough. They are pretty good people to work for, but they seem to think that any ideas that their employees may happen to have ought to be turned over to them free of charge in consideration of their giving the employee a steady job."

"That may be all right with minor ideas or suggestions, but it doesn't seem quite fair with reference to things which they consider to be worth patenting."

"Now this thing I got up," continued Joe, "was something that they wanted pretty badly. It was an improved type of valve which they wanted to replace one that they had been obliged to abandon to avoid action in infringement. They had nothing to fill the gap except a valve that had been invented and patented by their former superintendent and on which they were obliged to pay a generous royalty; besides it was expensive to make. They knew I had got up something along that line and had the sketches at home, and they wanted me to bring them in, but I held back because I was afraid they would try to get it away from me.

"I was persuaded, however, to submit my sketches, and they seemed to like them very much. but when they got down to brass tacks the president of the concern, who conducted the transaction, did not seem inclined to give any more than he had to.

"I did not want to risk my job by holding out for a good figure and I finally let it go. Now, I suppose, the president thinks he has made a good bargain for the company, but I think that in the future I will keep my ideas to myself."

"But," said I, "they paid the old superintendent a good royalty."

"Yes," he replied, "and I think that was the reason that they let him go."

Now I don't know whether Joe's resentment against the president was justified or not. Perhaps the latter was the kind of person who likes to see a man stand his ground and would have had more respect for Joe if he had put up a little better front in the matter provided he did not carry it too far or get too exaggerated an opinion of the value of his invention.

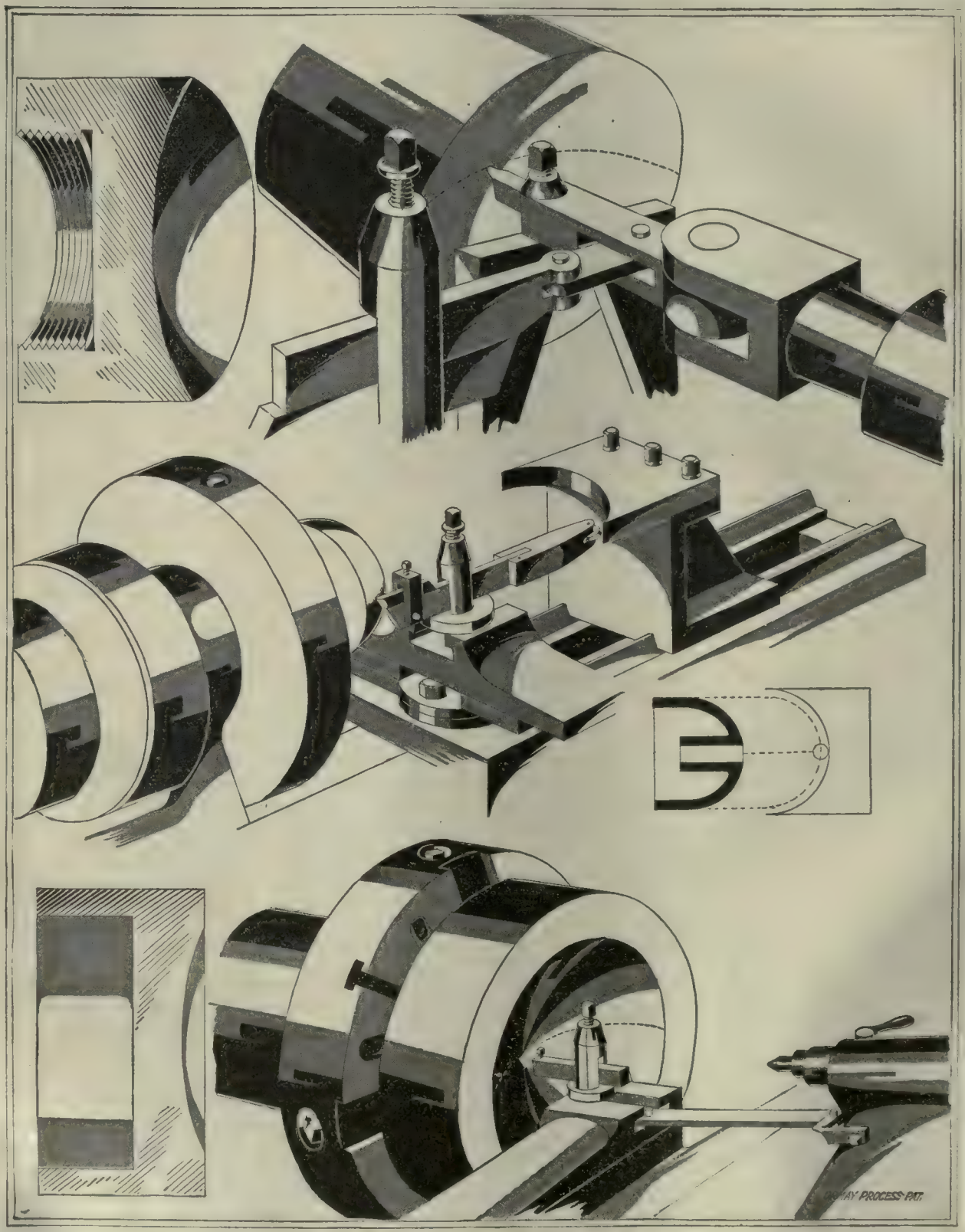
My own impression of the man, and I had worked for his concern, was just that, and I think he failed properly to appreciate Joe's viewpoint as a subordinate dependent upon his daily work for a living, yet wishing to show due respect for his superior without sacrificing his own interests.

Huse's experience makes me wonder just what course should be pursued by the workman who gets up patentable improvements on his employer's products. His employer would naturally resent anything that looked like an attempt on the part of the employee to use his knowledge of the product to "put one over" on the firm.

There are a good many angles to this puzzling question as to what is right and proper in such cases. It is not unnatural or uncommon—indeed it is quite the usual thing for the suggestions that result in improvement of the product of any firm to come from those who are in daily personal contact with them—and any information tending to enlighten the poor workman who naturally wants to get all he can for his ideas without endangering his job would be acceptable.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



SPHERICAL TURNING METHODS

Optical Projection for the Inspection of Screw Threads—II

By JAMES HARTNESS
President Jones & Lamson Machine Co., Vice Chairman National Screw-Thread Commission

In this installment of the article by Mr. Hartness reprinted from "Mechanical Engineering" (formerly the "Journal of the American Society of Mechanical Engineers") a description and illustrations are given of a new and improved optical method for the accurate inspection of screw threads.

THE projection lantern has been developed to a point where it now gives at a glance the diameter, lead, form and a fair indication of the roundness and smoothness of the surfaces. In order to get all of these results it is necessary to use in connection with the projection apparatus a stage and tolerance chart laid out on a large scale to conform to the desired characteristics of the screw to be inspected.

The chart is so located that the profile of one or more threads of the screw may be projected on to the chart and a comparison made between the enlarged shadow thus cast by the thread and the form of thread and tolerances outlined on the chart. (A more detailed description of the projection apparatus and chart is given later.) The advantage of the projection method is that it is possible to see at a glance how a screw will fit in its threaded hole as represented by the tolerance chart on the screen. If only one thread is projected on the screen, this is raised or lowered by variation in diameter and displaced laterally by variation in lead. The combination of these two things must be known in order to know how the screw will fit into the threaded hole. If two threads are projected we have a knowledge of the parallelism or taper of a screw.

In the Progress Report of the Committee on Limits and Tolerances in Screw Thread Fits presented at the spring meeting of the American Society of Mechanical Engineers in 1918 tables will be found showing what reduction in pitch diameter must be made to offset certain errors in lead. For instance, the basic pitch diameter of the ¾-in. 10-pitch screw is 0.6851 in., and if the lead of the screw is true the pitch diameter may be made up to this full diameter; but if the error in lead is plus or minus 0.002 in. in the length of engagement then the pitch diameter must be reduced 0.0026 inch.

Even in the best work, however, such allowances for difference in lead are seldom calculated. We merely know that if the lead is off we must reduce the effective diameter.

By the use of the projection apparatus and the tolerance chart all elements excepting the density of surface may be seen at a glance. The resultant effect of the displacement in lead, diameter and angle to the boundaries established on the tolerance chart indicates the fit with a definiteness that will be beneficial alike to the producer and the purchaser, for it will make it possible for the purchaser to express in words and by diagram the exact boundaries within which the product must come. In addition to providing a measure for the lead and diameter the tolerance chart and projection apparatus provide a way by which it is possible to indicate the extent of variation in the form of the thread that will be tolerated. As the art of machine building advances and our methods for producing and gaging screw threads advance we shall doubtless soon arrive at a point at which we will find it desirable to indicate the difference in lead between the two component parts of a screw-thread fit. For instance, stress of work

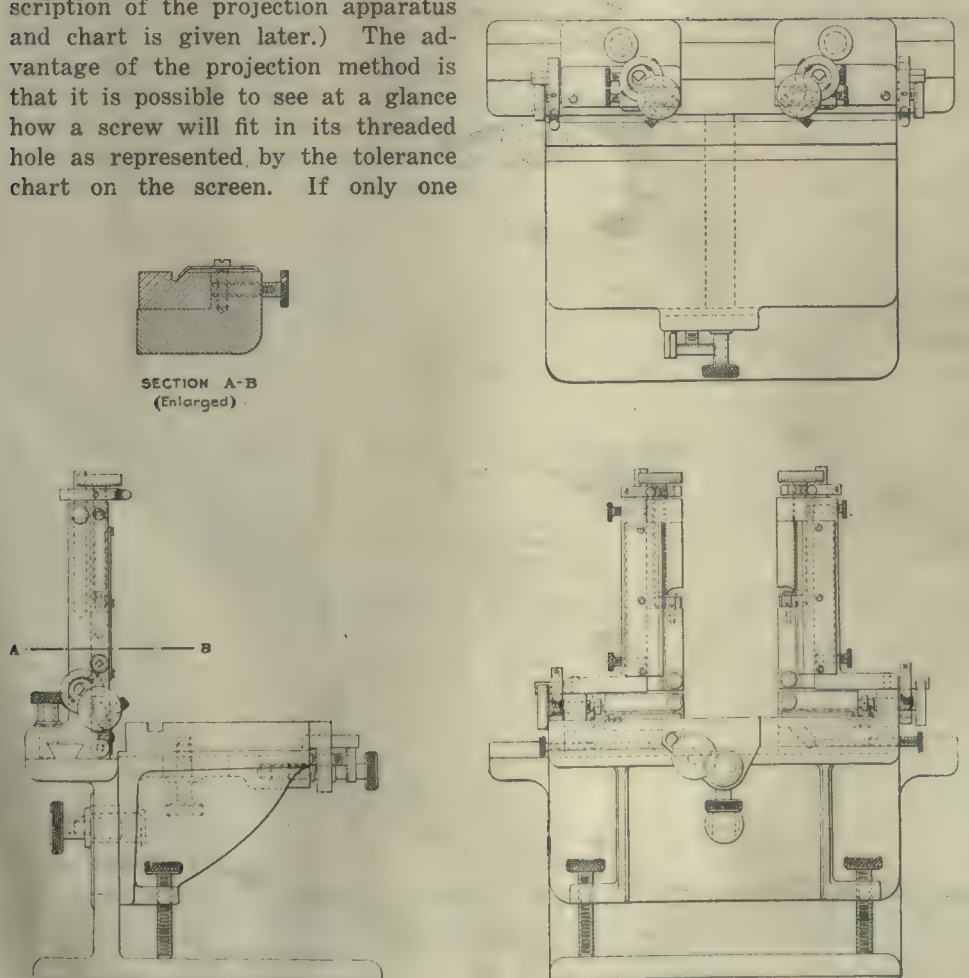


FIG. 1. PROJECTION MACHINE FOR INSPECTING SCREW THREADS

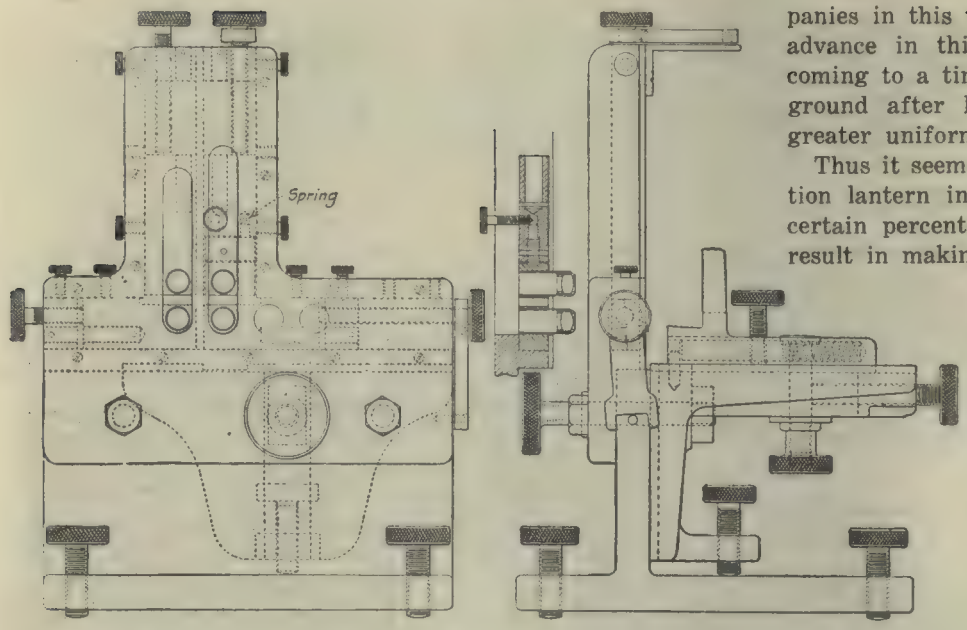


FIG. 2. MACHINE DESIGNED FOR SMALLER WORK THAN THE ONE IN FIG. 1

panies in this work have shown a remarkable advance in this respect we are undoubtedly coming to a time when taps will be lapped or ground after hardening to bring them into greater uniformity.

Thus it seems that the advent of the projection lantern into the workshop for testing a certain percentage of the work produced will result in making our airplanes and other machines which operate under great tension for given dimensions more dependable and more efficient and at the same time get a greater return for the energy that is put forth in the workshop in producing these things, for no one thing has been a greater barrier to our progress, especially in our recent war activities, than the uncertainty in our methods of specifying, producing and testing screw threads.

on a bolt or nut tends to lengthen the screw and compress the nut, so that if the leads of the thread in the screw and the nut were equal when free from stress there would be an unequal distribution of the load on the various threads engaged when the two members were under a heavy stress.

The stress on a setscrew compresses the screw, and to get equal distribution of load on each thread the setscrew should be long in lead when free from stress, and the lead of the bolt and nut should be longer in the nut than in the bolt.

To meet such demands the projection-lantern scheme furnishes a solution of one-half of the problem, for gaging is half of producing the work. If we have a practical and ready method of gaging it is much easier to produce the work. By the use of the projection apparatus the specifications may call for capscrews showing the displacement due to lead in one direction and setscrews in the opposite direction.

While the projection apparatus does not provide a solution for the measurement of the internal thread it does provide means for measuring the tap which is used for producing the internal thread, and although it is well known that the usual way of measuring a tap does not indicate the exact nature of the threaded hole that will be produced by that tap it is probable that a complete inspection of the tap by the projection methods will bring a closer harmony between the measurements of the tap and the threaded hole produced by it. Furthermore the advance of machine construction has demanded for a number of years a greater refinement in tap making, and although the most progressive com-

Fig. 1 represents a machine in use at present, excepting as it has been modified from time to time with various forms of work supports. Fig. 2 indicates a machine designed to take a smaller range of work.

Fig. 3 gives a side elevation and plan of the general scheme, although not true to proportions. The lamp house, for example, is shown too close to the object. The apparatus consists of three principal elements; the machine, which holds the work and lens; the lamp house; and the chart holder, which serves as a screen on which the profile of the thread is projected. The chart holder slides on rails to and from the work in order to get the desired number of magnifications.

The general plan of operation starts with positioning the work and adjusting the light, work, lens and chart so that the image of a perfect screw thread will fall on the chart along certain lines.

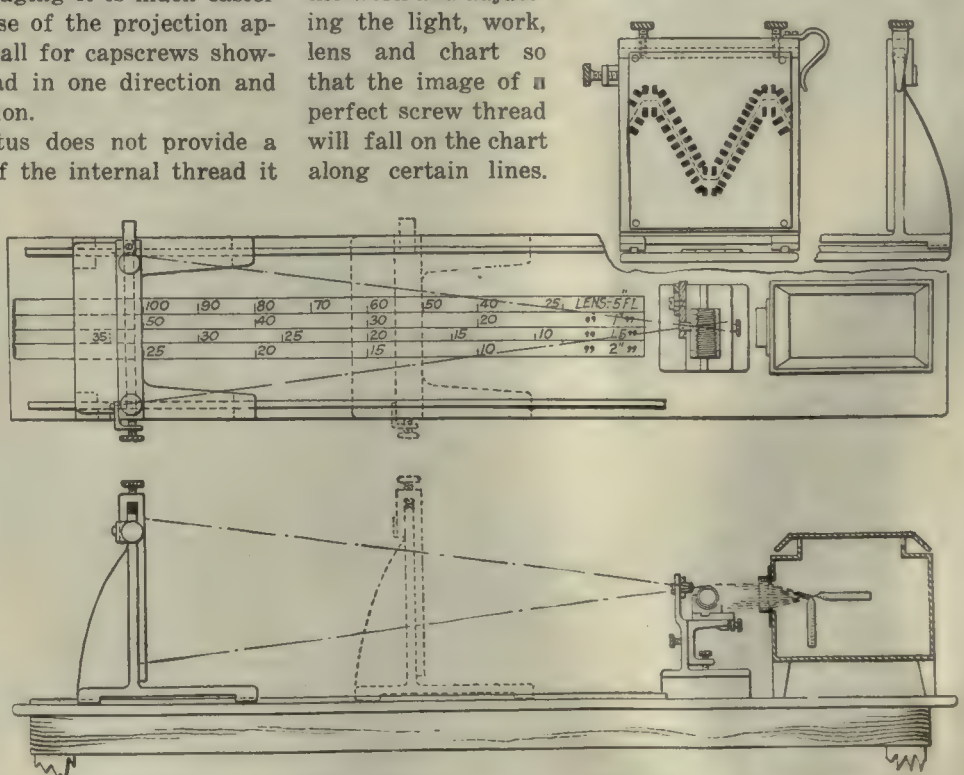


FIG. 3. DIAGRAM SHOWING THE ESSENTIAL PARTS OF THE APPARATUS

When we have no sample of work on which the thread is known to be satisfactory a standard screw-thread plug may be put in the work holder and used for setting the chart. After that the work may be placed in the machine, one piece after another, and instantly its shadow will reveal its diameter, lead error

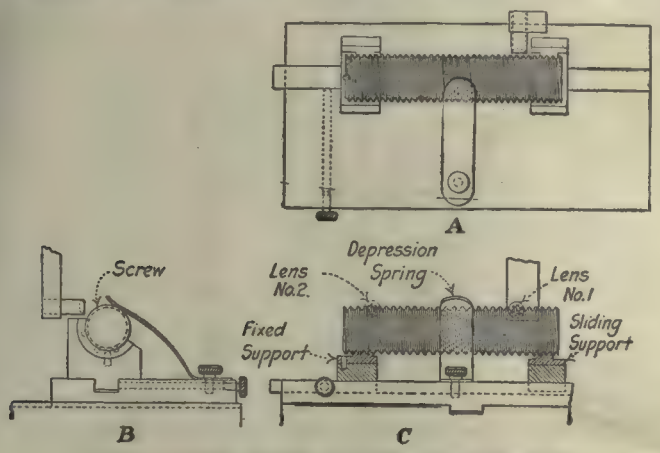


FIG. 4. THE WORK HOLDER OR CRADLE

and profile. If these fall within a certain range of tolerance on the chart the work is acceptable.

The simplest method of screw inspection projects the profile of one thread on a chart that has a maximum and minimum boundary. The maximum boundary represents the outline of the thread of the hole into which the screw must fit and the minimum represents the smallest acceptable diameter.

It has been found necessary, in order to meet the usual run of work, to mount the screw in one or two cradles consisting of nearly a half circle of a nut and embracing from one to three threads of the screw, according to the character of the work. With this form of mounting it is possible when projecting one of the

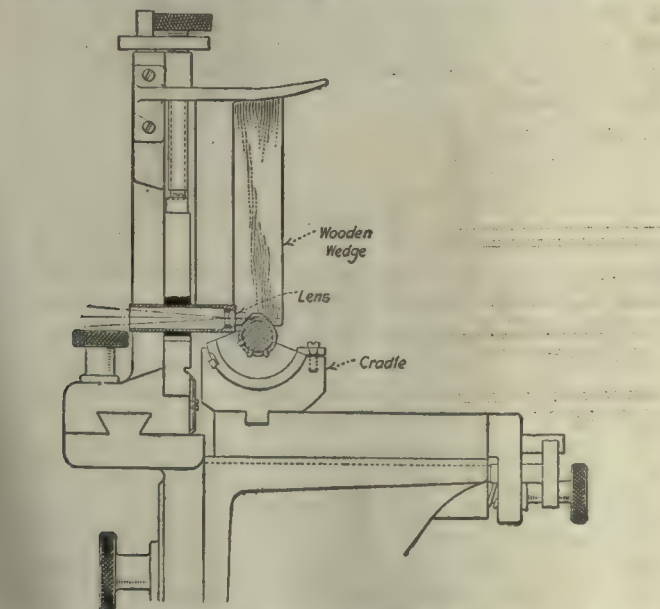


FIG. 5. METHOD OF HOLDING THE SCREW IN PLACE WHILE TESTING

threads to a tolerance chart to get some indication of the roundness and roughness by merely turning the screw in its cradle.

Three views of supports of this type are shown in Fig. 4 at *A*, *B* and *C*. The threads of the supports are interrupted with notches so that turning the screw in the thread will tend to carry out chips or other foreign particles that otherwise might be lodged in the thread. A spring is indicated for the purpose of giving the screw a downward pressure to hold the work firmly into its seat when it is being rotated by hand, the extent of this contact and pressure being different for different grades of work. On a ¾-in. rough screw I have used a wooden wedge which slipped readily into place and enabled me to get uniform results, as shown in Fig. 1. Fig. 5 shows the method of holding the screw in place for testing.

If the thread to be tested is very short and on a shaft or bolt of considerable length one of the cradles may be threaded to fit the screw and the other may fit the cylindrical body of the bolt or shaft.

Although this method is subject to the uncertainties due to fine chips or other particles becoming lodged in the cradles these things are more easily detected because the cradle is open and can be frequently inspected. Since a standard plug thread gage is the check on the

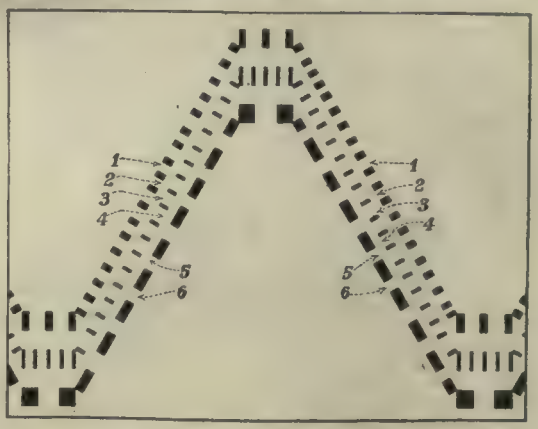


FIG. 6. A TOLERANCE CHART

adjustment of the projection apparatus it may be dropped into the cradle at frequent intervals.

The object of using a cradle instead of single points, such as center points or single-point contacts on the flanks or other parts of the screw, is to get a truer knowledge of the fit of the screw in the nut. The extent of area of contact of the cradle should be proportioned to the roughness of the work. Threads produced by the best methods of chasing on centers could use cradles with simple contact points.

Cradles are better than center points because 0.001 in. variation in diameter is fully shown on the chart, whereas by the use of center points with the projection of a single thread 0.001 in. would show a variation on the chart of only half that amount, and although by confining the projection to one thread with parts of two valleys a high magnification of 200 will give a displacement of 0.2 for each 0.001 in. of variation the fact remains that it is desirable to get the best result with the minimum handicap. For instance, a small chip on a center point, when one is looking for an error of 0.0005 in., is more serious than if the chip were imbedded in a cradle.

The condenser lens may be a simple planoconvex or it may be a combination of lenses to gather rays at a wide angle and condense them into a very small bundle of parallel rays. The essential thing of course is to have the rays travel in a parallel direction when they

reach the screw thread, striking the screw thread at the angle of the helix in order to present the sharpest profile for the lens.

In order to bring the screen as close as possible to the operator I prefer to use a lens of very short focal length. For instance, for ½-in. size I am using 0.43 in. focal length, and this could be conveniently used for $\frac{9}{16}$-in., but for ¾-in. screws and larger the outside diameter of this lens would conflict with the sides of the screw, making it necessary to cut away part of each thread.

The exact form of the tolerance chart will vary with different requirements, but I prefer a chart on which the boundaries indicated have stated gradations. For instance, for a screw thread of 10 pitch at 200 magnifications the outline of the thread form measures 20 in. between centers of crests of thread, and I produce a chart by drawing these forms in light pencil marks in steps spaced at 0.8 in., which amounts to 0.004 in. variation of screw thread, for at 200 magnifications we have 0.2 in. per thousandth of an inch. Such a chart is shown in miniature in Fig. 6.

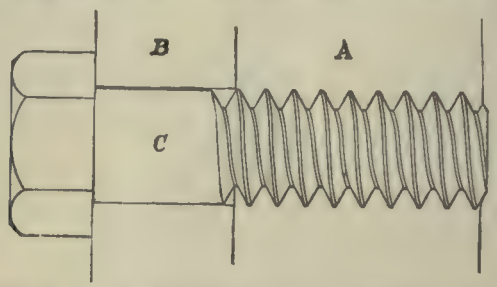


FIG. 7. AN IDEAL SCREW-THREAD FIT

Inasmuch as it is not easy to locate the shadow in relation to straight lines I use black dots having a vertical width of 0.8 in., which amounts to approximately a width of $\frac{3}{32}$ in. on the flanks of the thread. These dots are made of different lengths so they may be readily recognized in the partial light of the projection room. The light of the projection room should be adjusted to see the black dots even in the shadow and yet not too light to dim the shadow.

By numbering the lines of the charts from 1 to 6, beginning at the upper and running to the lower side, we have means for recording if necessary the measurements of a screw. For this purpose we would set up the instrument with a standard plug gage or other perfect thread so that the shadow of this perfect thread would fall on line 5, and this would constitute the largest size that would be tolerated for free fits, the plug being the basic diameter.

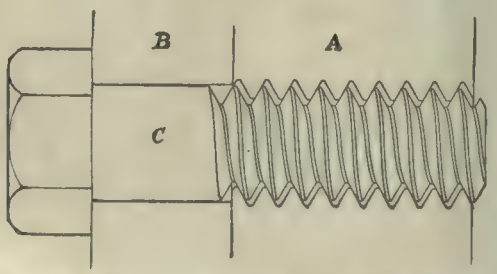


FIG. 8. SCREW SMALLER THAN THE THREADED HOLE

Let us assume that the allowable tolerance at the pitch diameter of a 10-pitch screw is 0.008 in.; that is, that the screw may be up to the full basic standard line 5 or it may be 0.008 in. smaller, in which case the shadow should not proceed farther than line 3. Then by placing one piece of work after another in the holder if the shadow falls within these boundaries of 3 to 5 we know its size is acceptable. If its shadow falls below line 5 toward No. 6 we know it is too large for that grade of fit.

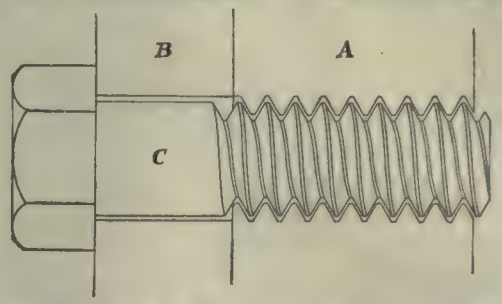


FIG. 9. SCREW OF FIG. 8 PLACED IN CENTRAL POSITION

The distance of the chart holder from the focal center of the lens must be as many times the distance from the focal center of the lens to the profile of the thread as the number of magnifications required. If the focal length of the lens were 1 in. the screen would have to stand away 200 in. to get a magnification of 200 diameters. With a 0.43-in. focal length we get 100 magnifications at 43 in. and 200 magnifications at 86 in. At a distance of 86 in. the shadow can be seen by the operator.

I am aware that in astronomy and other sciences using lenses, it is the novice that goes to the higher magnifications, and that the magnifications should not be greater than required, as the best result is obtained by the lowest magnification that will give the proper definition. And while I am aware that those who have been in this art for some time in testing gaging devices advise the low magnifications it would seem to me that there may be a special reason for using large magnifications in this scheme for testing the work itself.

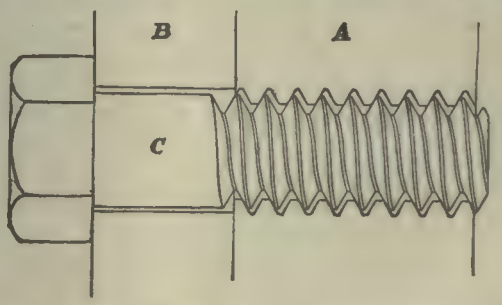


FIG. 10. STANDARD SCREW IN HOLE THREADED TOO LARGE

In this plan we have little or no occasion for projecting more than a single profile, or if we project more than one of the threads we superimpose the shadows so that the dimensions of the chart may be kept down to about 25 in. square for the run of work of standard threads up to 8 pitch with magnification up to 200.

Figs. 7, 8, 9, 10, 11 and 12 illustrate three elements of an ordinary screw-thread fastening. *A* and *B* are pieces to be forcibly held together by a cap-screw or bolt *C*. A hole is drilled in *B* large enough for the whole of the screw to pass through it, excepting the head, and *A* has a tapped hole into which the screw is turned.

Fig. 7 represents an ideal screw-thread fit in which the flanks of the thread of the screw and the threaded hole closely fit the entire length of the screw.

Fig. 8 illustrates an extreme example in which the screw is smaller than the threaded hole so that the threads engage only three-quarters of the entire depth of the full engagement.

Fig. 10 illustrates a fit in which the thread diameters are the same when measured on the pitch line, but

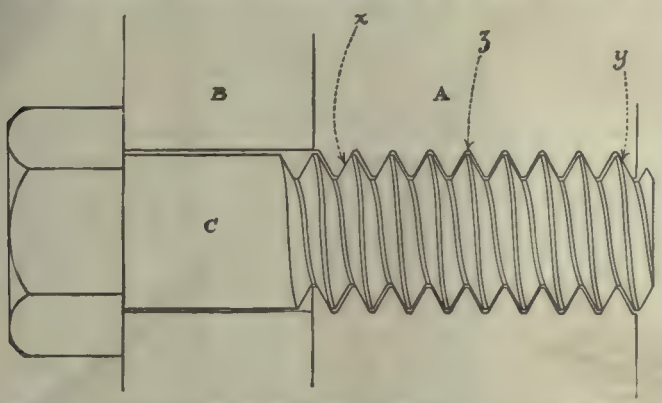


FIG. 11. LEAD OF THE SCREW GREATER THAN THAT OF THE THREADED HOLE

shows an example of a threaded hole in which the crests of the thread are not up to the full size owing to the hole having been drilled larger than the root diameter of the tap which produced it.

Fig. 11 shows a screw-thread fit in which the diameter of the screw is a trifle smaller than the diameter of the threaded hole, but the threads are not equally spaced, so that it is just barely possible to turn the screw into the threaded hole, for it will be seen that the flank of the thread at x and y bears in opposite directions, while the flanks of the thread at z stand clear.

Figs. 8 and 10 show the flanks of the thread properly engaged; that is, each thread bears its proportionate part of the load; whereas in Fig. 11 the whole load comes first on a single thread at x. In practice of course ordinary differences that appear in lead result in the stress crushing down the first thread at x and gradually working back until they may be distributed the entire length, but not equally.

A reversal of the difference in lead, that is, making the thread of the bolt shorter than the thread in the threaded hole, puts the burden of the work first on the thread at y, and then gradually, either through crushing down of the first threads engaged or by stretching out of the length of the bolt, brings a distribution over the other threads.

In making screw-thread fits we have not only the element of difference in diameter with true leads, but we have combinations of lead errors and diameter variations. It is obvious that with perfect lead the diameters must correspond to insure a depth of engagement that will prevent stripping under its working stress, and in addition to this if the screw is one that is frequently adjusted and must have good wearing qualities the depth of engagement must be great enough to provide ample wearing surface.

In addition to the foregoing elements we have to consider the form of the thread. In Fig. 12 is shown a threaded hole in which the thread is of a blunter angle than the thread of the screw, and while this is not as serious a matter as may seem at first glance, for it has been found perfectly practicable for ordinary fastenings to use a 55-deg. Whitworth thread in a 60-deg. U. S. Standard, the fact remains that it is one of the elements that we must consider in determining the dependability of a screw-thread fastening, for the thread under stress must be squeezed into a shape that will produce a uniformity of contact over a fair amount of the flank surface. Our system of screw-thread gaging should take into consideration form as well as diameter and lead.

The foregoing figures illustrate the three elements A, B and C as they would appear when screwed together under a light stress. No attempt has been made to show the various degrees of change that take place under the enormous stresses of the work, although we are coming to a state of machine construction which demands a consideration of the form of thread when under stress. For the purpose of illustration and comparison of the optical gaging system with the tactile gaging system, that is, the system in which we see the condition of a screw as against the system in which we try to determine it by the sense of feeling, we will for the present ignore such stresses.

If we substitute Fig. 9 for Fig. 8, in which a small screw is shown in the threaded hole, but instead of being pulled to one side it stands clear, showing the amount of clearance there would be around each side of each thread—if we will take this for Fig. 8 we will find that the various fit conditions can be found by glancing at the thread at the end of the engagement; for instance, at point y or point x.

Since the error in lead is equally divided between the opposite ends of the length of engagement it is the end threads that tell us the story.

In the optical-projection method we so locate the screw before the lens that the shadow is thrown on the

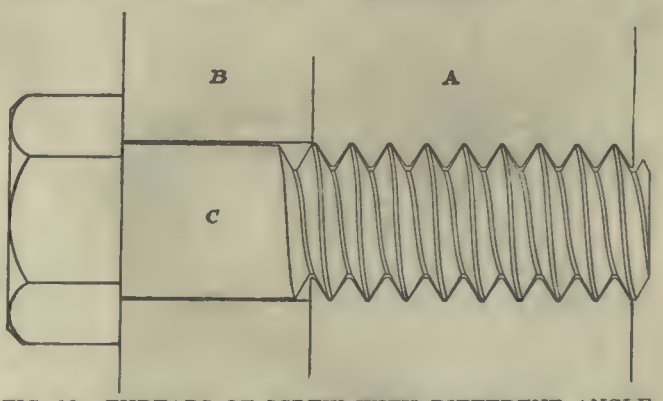


FIG. 12. THREADS OF SCREW WITH DIFFERENT ANGLE FROM THREADS OF HOLE

screen. A lateral displacement of the shadow will clearly indicate the lead error, and a vertical displacement a variation in diameter. The combination of the two will locate the shadow of a single profile on the chart in a way to indicate the condition at the end of a thread engagement of a given length. This tells the whole story of the resultant effect of diameter, lead and form of thread, for one of the boundaries of the chart may be considered as the interior profile of the threaded hole.

The average run of work with the projection lantern will present some new thoughts to the inspector's mind.

He will see that the lead is not uniform. In the length of a 3-in. screw the lead at one end of the screw may be shorter than at the other end. He will find that many screws are not round and some are very irregular and mountainous on the surface; not that these elements have been created by the projection apparatus, but merely that they have been brought clearly to view and should be recognized by any system of gaging that has for its ultimate purpose determining the dependability of the screw.

Rotating the Work

Rotating the work in its holder brings out irregularities. If the screw is of good form its shadow will remain stationary on the chart. If the thread is drunken, out of round or very irregular the shadow will move. A ragged surface also appears in the unevenness of the line, and frequently the inspector is confronted with the necessity of determining what part of the line he is to designate as indicating the real working diameter of the screw. It is not unusual to find one of the flanks of the thread instead of presenting a straight profile shows for instance a ridge near where the crest of the thread is rotated.

This condition has always existed in screw threads, and it is for us to recognize that the projection method merely shows how deceptive has been the gaging system which depended on the tactile sense or sense of feel of the gage.

In gaging this ridge would play an important part in eliminating shake, and yet the screw might be under size so far as its holding capacity is concerned.

When we see the displacement of the thread laterally, that is, if we assume that the profile of the thread on one side (Fig. 6) is on No. 4 boundary and the opposite side on No. 5, we will know that its lead is off to that extent, and that when turned into a nut the full length of the nut it will feel the same as a perfect thread. But as a matter of fact the slack will be taken up by opposite sides of the flank at opposite ends of the nut, while the middle may not be in contact.

Let us understand that line 5 represents the inside of the nut or at least the upper boundary for the screw. In order to get a perfect indication of the fit of an inaccurate rate lead in a perfect nut it is necessary for us to see that our holder which positions the work is adjusted in relation to the length of the engagement of the thread in the nut or in the threaded hole. For instance, if the lead is long or short we know that as it screws into the nut or threaded hole the difference in lead will cause the screw to fit in the nut as shown in Fig. 10, if the screw is longer than that of the nut, and on the opposite sides of the threads if the screw is shorter.

Now we must adjust our holding means so as to get a view of the thread at the end of the nut, which of course determines the closeness of its fit.

In Fig. 4, previously referred to, are three views, *A*, *B* and *C*, of a screw located in the cradle of a projection machine. In order to make the view projected on the chart duplicate the conditions in the nut it is only necessary to see that the longitudinal distance between the distance of the fixed support and the lens (position 1) is equal to the length of engagement of the thread in the threaded hole. (If the screw were held on center points instead of on a cradle this fixed support would be one-half the length of engagement.)

It will be understood that the fixed support locates the screw in its longitudinal position as well as laterally; that the sliding support, although holding the screw in the right focal distance from the lens, adapts itself to the position of the thread which, if the lead is true, will be the same as a standard thread, and if the thread is short or long will move endwise without changing the vertical gage of the screw. The projection through the lens will then be displaced vertically if there is a difference in diameter, and laterally if there is a change in length of lead.

The combination of these two when the distance to the fixed support is equal to the length of engagement gives a definite knowledge of the fit, and while it may be disturbing to know that the fit is not a fit in the true sense of the word, that it is a misfit in 99½ per cent. of our work, it is best to know the truth if we are to make our machines dependable.

A lens located in position 2 can be adjusted to throw its shadow simultaneously with lens 1; or a shutter may be used to alternate these two. The object of lens 2 would be to check the parallelism of the screw. If the vertical position of the thread projected by lens 2 corresponded to the vertical position of the thread projected by lens 1 we would know that the thread was parallel.

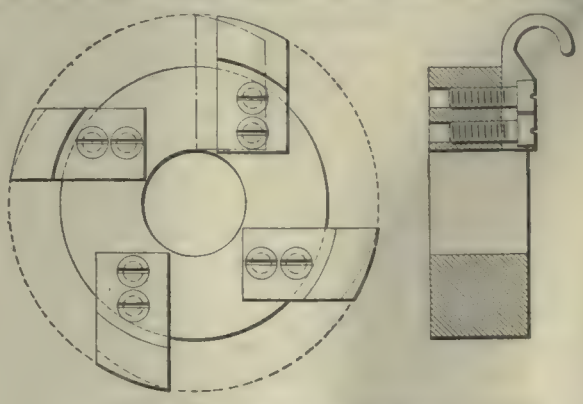
If it were desirable to have this test for each screw that went through the instrument its shadow could be so located as to fall two numbers lower than the shadow from lens 1, so that the range of its position would be from line 1 to line 3 on the chart, Fig. 6, while the range of the other position would be from 3 to 5, and the uniformity of the average distance between these would constitute an indication of parallelism.

The essential thing in gaging the rougher screws is to see that the screw is held down in its supports with sufficient pressure to insure good contact.

Relieving Wood-Working Cutters

By G. James Carr

The sketch shows a fixture for holding wood-working cutters when forming and relieving them in an engine



THE RELIEVING FIXTURE

lathe which has no relieving attachment. The desired amount of clearance can be obtained by setting the cutters back from the center more or less as may be required. This also gives a more uniform clearance curve and eliminates danger of the tool digging in.

Routing Machine of Special Design

SPECIAL CORRESPONDENCE

The bow drill used for making holes and cutting recesses in such materials as come within its scope represents one of the most primitive stages of tool design, and, despite the developments of later periods, it still remains a wonderfully efficient tool for operations to which it is adapted. This article describes a machine constructed along modern lines in which advantage is taken of the principle embodied in the bow drill.

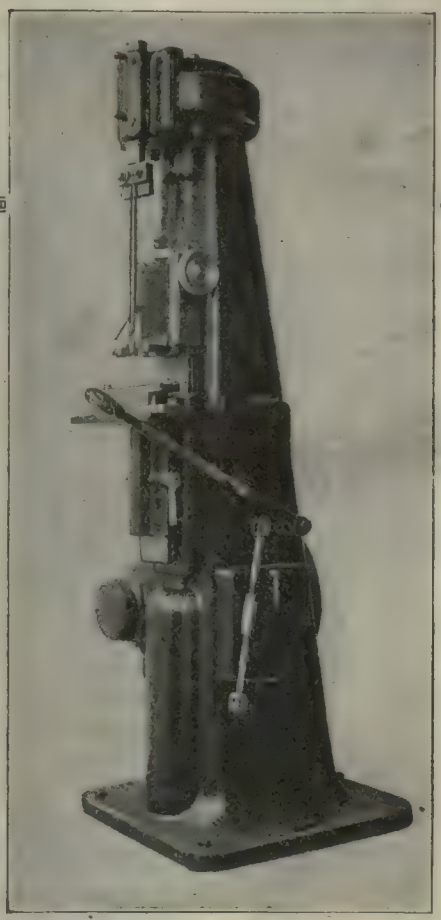


FIG. 1. SPECIAL ROUTING MACHINE

AN INTERESTING machine designed for routing out narrow channels, grooves, irregular openings and other forms in small parts is the one shown in the cuts in this article. Fig. 1 shows the completed machine and the drawing, Fig. 2, illustrates important features of construction.

This machine makes use of a special form of cutting tool, which will later be more fully described. For the moment it may merely be stated that the tool is rapidly rotated through several turns in one direction, then reversed and rotated as rapidly and for an equal number of turns in the opposite direction, this cycle of movement being continued so long as may be necessary to complete the operation. The tool during its operation first one way then the other is guided in a form plate containing the outline of the opening to be cut in the work, and the work itself is fed upward to the cutter by means of a vertically adjustable slide on the machine column, this slide and the work table which it carries being actuated by a hand lever operating a gear train which engages with a rack at the rear of the work slide. The cutting tool, the work slide and the operating lever for the latter are shown clearly in Fig. 1.

The mechanism for actuating the spindle will be best understood upon examination of the line drawing, Fig. 2. This spindle is a short member journaled in suitable boxes which are fitted into the head attached at the top of the column, which here develops into a cylindrical shell to house in the combined driving gear and clutch for operating the spindle.

Pinion teeth on the spindle at *A* engage the driving gear *B*, which is bored to form an internal cone to receive the clutch member *C*. The part *C* is fitted onto the taper end of the vertical shaft *D* and secured by a key and nut. The shaft passes down through the long sleeve hub on gear *B*, which runs in two sets of ball bearings as shown. The shaft is a running fit in the gear sleeve and is provided at the top with oil channels for lubrication of the bearing surfaces. When the shaft is lifted to release the clutch from its seat in the gear the latter is allowed to come to rest and the clutch shaft then runs in its own bearings until the gear is again set in motion by dropping the clutch into engagement. The gear and spindle may thus be rotated intermittently and in either direction by suitable control of the clutch shaft.

A pinion *E* is keyed to the lower end of shaft *D*, and a rack *F* at the rear meshes with this pinion. The rack is secured to a horizontal slide that is actuated by a crankshaft and connecting-rod. At each revolution of the crankshaft the rack causes the pinion *E* and the vertical shaft to make a half turn and back to its original position so that the cone *C* at the top of the shaft constantly turns back and forth through this arc. The proportions of the gear *B* and the pinion *A* are such that each movement of gear *B* gives the spindle three complete revolutions in each direction; that is, for every revolution of the crankshaft the spindle is driven three turns one way and then three turns in the opposite direction.

By reason of the changing angularity of the connecting-rod the tendency is to start the rack slowly and impart to it a gradually accelerating rate of movement until the center of the travel is reached, when the movement is gradually retarded to the end of the stroke. This results in an easy reversal of the driving gear on shaft *D* and the cutter spindle itself, correspondingly lessening the stresses on the driven parts.

The lower end of the driving shaft *D* is carried in a ball bearing *J* mounted in a vertically sliding member *K*, the latter having a limited amount of up-and-down movement in its guide in the supporting sleeve *L*. The gear *E* is keyed fast to its shaft, as indicated, and travels up and down when the shaft is lifted and lowered, therefore the face of the gear is made somewhat wider than the face of the rack with which it engages. The object of the vertical movement for the shaft *D* is of course to operate the cone clutch at the top. In either position of the shaft the rack *F* has a full bearing upon the wide face of the pinion *E*.

The hand lever shown at the side of the machine in Fig. 1 operates a rock shaft that is connected through the medium of a series of suitably adjustable links

and levers with the sliding support *K*, Fig. 2, so that movement of the hand lever results directly in vertical movement of the driving shaft *D*. When the lever is pressed down the clutch is engaged and at the same time an upward movement of the work table is effected. When the lever is raised to lower the work from contact with the cutting tool it at the same time causes the spindle shaft *D* to be raised, thus releasing the clutch and stopping the spindle.

The work table proper may be adjusted for height independently of its slide by releasing the binder handle

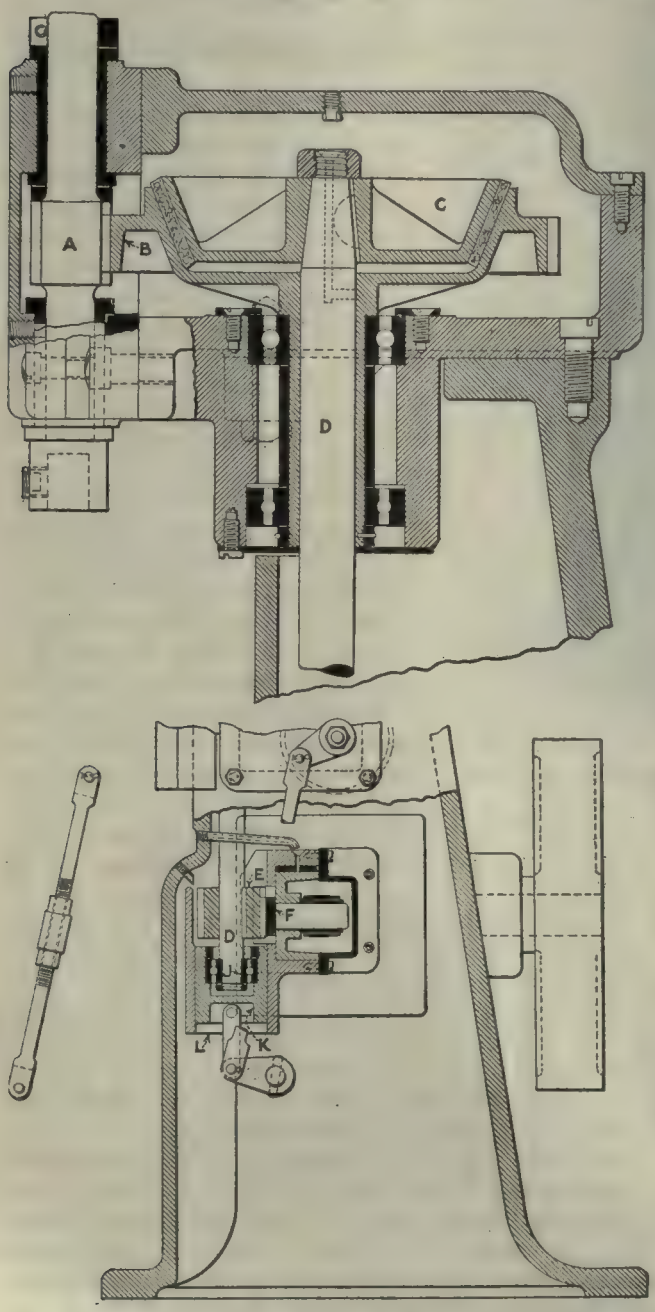


FIG. 2. DETAILS OF MACHINE

and setting the table at any position required. This provision for adjustment is shown distinctly in Fig. 1. The table is here represented with a fixture in place for holding the piece to be operated upon.

The cutting tool used with this machine is in the form of a spring tool or wabble device that is intentionally made so that its working end swings well out of center and thus bears always against a guide plate by which its path of cutting is controlled. The tool is shown by the sketch Fig. 3, which represents the long, slender shank made somewhat to resemble the curve of a violin bow. The upper end of the device is enlarged to fit the chuck, while the lower end is formed to provide a holder for the cutter. This enlarged lower end is of rectangular cross-section, and the portion of the shank immediately above is of small circular section to permit it to follow closely the contour of any pattern that may be used in the guide or form. The cutting tool itself may be triangular, as in the sketch, or it may be diamond shaped or of other form to suit the character of the cut to be made in the work.

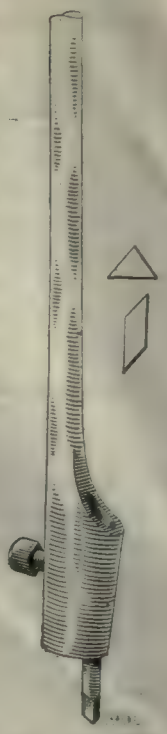


FIG. 3. THE TOOL

The guide or form for controlling the contour produced by the cutter is attached to a support on the face of the column and is adjustable up and down by means of knurled head screws which may be seen in Fig. 1.

This machine is used for such work as cutting in the openings in knife handles, etc., for shields, or "shielding" cuts as they are called, and is the design of Arthur J. Briggs of Syracuse, N. Y. An elementary method of doing such work is shown in Fig. 4, which illustrates a workman using a bow drill with a split tool for the cut. The drill is supported at the outer end by a center which runs in a countersunk opening in a plate attached to a belt around the operator's chest. The work to be cut out is shown attached to a block

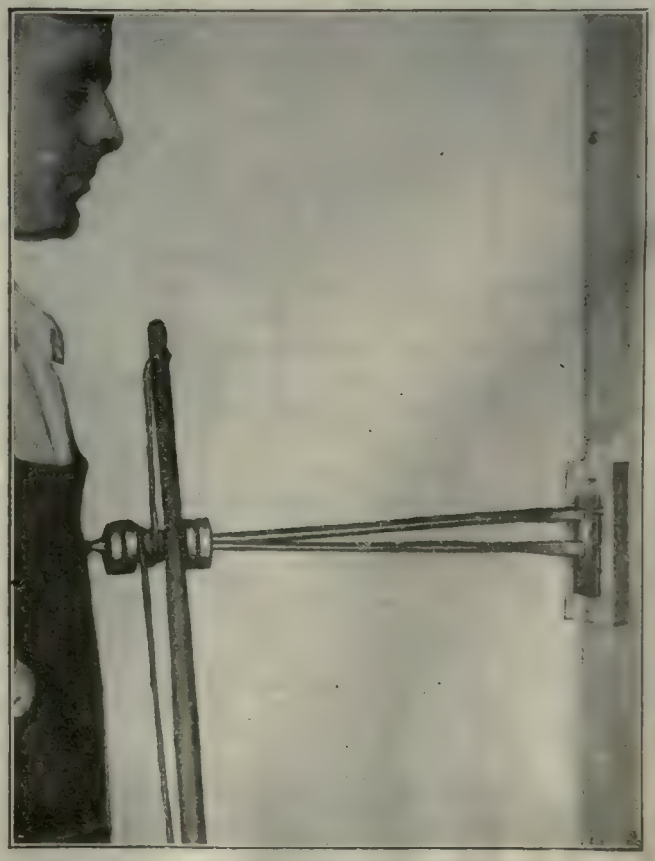


FIG. 4. OLD WAY OF DOING THE WORK

which is fastened to the wall. In operation the split, or divided, cutters on the ends of the two rods or spindles tend to spring apart and are therefore held by their spring action against the guide plate while revolved by the bow drill, so that the form of the opening in the guide is reproduced in the work.

The Next Move—Human Interest

By Harry Senior

There was an article in a recent issue of the *American Machinist*, page 213, that was so surprising that it left me fairly gasping for breath. A Mr. Godfrey—John R. Godfrey his name is—has apparently made the astounding discovery that intelligent workmen who have followed a certain line of business for years know at least as much about that business as the highly trained efficiency expert who until last month or so didn't know there was such a business.

There have been intelligent workmen (most all skilled workmen are intelligent, Mr. Godfrey, only the intellect of the expert being on a so much more superior plane the latter has never stumbled on this fact)—there have been, I say, such workmen who have suspected this to be the case ever since the days when everybody knew it—the day when Frederick W. Taylor turned all preconceived notions of intellectuality inside out by discovering that a trained gorilla could carry more pig-iron in 47½ sec. than a man could—but they have in later years carefully concealed their suspicions lest the fierce white light of popular belief should find them out and show them up for ignoramuses or ignoramii, whichever it is.

Mr. Godfrey does not write like a recalcitrant workman whose resentment of some real or fancied wrong has forced him into a position of defiance of public opinion, but rather like some member of the business world whom the stresses of the last four years has brought to the realization of a great truth.

Mr. Godfrey says: "We have made time studies and motion studies to try and save seconds when we might have saved minutes and hours by getting the coöperation of the men," and "We have assumed that all the brains of the establishment were tied up in the craniums of a few men, some of whom knew almost nothing of our shops, or for that matter of any shops, and have failed to avail ourselves of the intelligence that lay within our grasp in the brains of our workers."

Travesties Upon Real Taylor System

This is all too true. I did not know Mr. Taylor and never came in contact with his system as installed under his personal supervision, but it has been my disgusting privilege to visit shop after shop that was in the iron-bound grip of what I hope (for the sake of Mr. Taylor's memory) was a travesty upon the Taylor system, where on one occasion I might have seen three or four men striving laboriously under the guidance of a white-shirted and becollared youth to do in a given time what any one of them alone could have accomplished in less if they wanted to, or again an expert screw-machine hand would be making the fur—and oil—fly around his machine in a strenuous effort to beat the stop watch, and beating it beyond the wildest imaginings of the guy who held it, only the stop-watcher did not know the direction in which it was being beaten.

There have been during the past year or so of feverish industrial activity exhibitions of marvelous skill in some lines of work, and wonderful records for production have been established, and though many of them have been accorded due recognition in the newspapers doubtless a large majority will never be known beyond the immediate vicinity of their accomplishment; but there have been also many cases of mismanagement due to incompetence, crass ignorance or misapplied effort in which so-called scientific management should bear its full share of odium.

The theory of scientific management as evolved by Mr. Taylor was far from being altogether wrong, notwithstanding his unfortunate reference to a gorilla. It was, as I understand it, merely the application of mechanical principles to human endeavor, each member of the working unit having a definite duty to perform and a definite time allotted to its performance, so that the work of each would be done in proper relation to that of other units.

It was no more a part of his scheme that men should work to beat a stop watch than it is the intent of a good machine designer to make a certain cam perform its cycle of duty in the smallest fraction of time. Both cam and man must fit into the general design and work in harmony with what comes before as well as what follows after.

Scientific Managers Required

Scientific management presupposes a scientific manager, and it is right at this point that the system got its black eye. A machine designer must be thoroughly familiar with the materials and forces with which he seeks to accomplish a desired end. The scientific manager must be equally familiar with his materials and forces, and as these are human his is by far the more intricate study.

Now there are many would-be disciples of Mr. Taylor who, lacking his mental ability and analytical vision, see only the stop watch and the multiplicity of card records, charts, etc., as the whole conception, when as a matter of fact these are but the paraphernalia, the tools by which the more intangible human forces are correlated. In too many cases he is neither scientific nor a manager. He sees the human element as so many tools that according to previous records are capable of performing certain tasks, and he remains indifferent to, because ignorant of, the thousand-and-one conditions that affect its productive capacity.

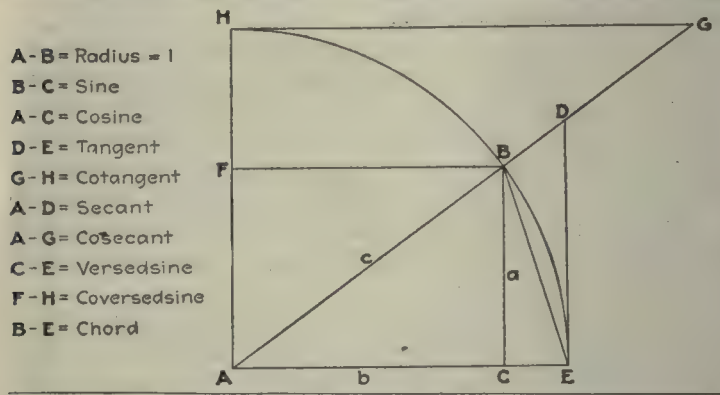
The manager who treats his "help" with the consideration due to fellow beings; who appeals to their sympathies and enlists their coöperation; who by virtue of common sense, fair and just dealing and knowledge of his business is able to *lead* a body of men who admire and respect him, will be the scientific manager of the future, while the fellow who, knowing a great deal about plotting and figuring percentages, a little (sometimes very little) about shops and shop methods, and nothing at all of human nature, seeks to *drive* with the lash of "scientific management" a body of men who despise and ridicule him, will take a much-needed vacation —much needed by those whose efforts he sought vainly to direct.

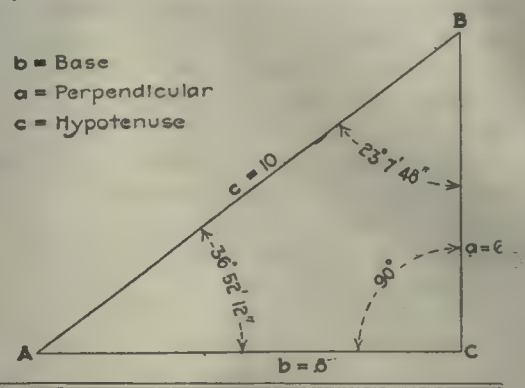
Simple Solution of Right-Angle-Triangle Problems for Mechanics

By S. A. Hand
Associate Editor American Machinist

Time was when trigonometry in the machine shop was unknown, but in recent years, and especially since the sine bar has come into almost universal use, it has become necessary for toolmakers and machinists to know how to figure problems involving the right-angle triangle.

While the formulas given in the handbooks seem simple enough to those who have studied trigonometry,





To Find	Knowing	Rule	Formula	Example
Angle A	Angles B and C	Subtract angle B from angle C	C — B = A	90° — 53° 7′ 48″ = 36° 52′ 12″
Angle B	Angles A and C	Subtract angle A from angle C	C — A = B	90° — 36° 52′ 12″ = 53° 7′ 48″
Angle C	Angles A and B	Add angle A to angle B	A + B = C	36° 52′ 12″ + 53° 7′ 48″ = 90°
Sine A	Sides a and c	Divide side a by side c	$\frac{a}{c}$ = sin A	$\frac{6}{10}$ = 0.60000 = sin 36° 52′ 12″
	Cosecant A	Divide 1 by cosecant A	$\frac{1}{\text{cosec A}}$ = sin A	$\frac{1}{1.66666}$ = 0.60000 = sin 36° 52′ 12″
	Tangent A and cosine A	Multiply tangent A by cosine A	Tan A × cos A = sin A	0.75000 × 0.80000 = 0.60000 = sin 36° 52′ 12″
	Tangent A and secant A	Divide tangent A by secant A	$\frac{\text{Tan A}}{\text{sec A}}$ = sin A	$\frac{0.75000}{1.25000}$ = 0.60000 = sin 36° 52′ 12″
	Cosine A and cotangent A	Divide cosine A by cotangent A	$\frac{\text{Cos A}}{\text{cot A}}$ = sin A	$\frac{0.80000}{1.33333}$ = 0.60000 = sin 36° 52′ 12″
	Cosine A	Subtract the square of cosine A from 1 and extract the square root of the remainder	$\sqrt{1 - \cos A^2}$ = sin A	$\sqrt{0.36}$ = 0.60000 = sin 36° 52′ 12″
Cosine A	Sides b and c	Divide side b by side c	$\frac{b}{c}$ = cos A	$\frac{8}{10}$ = 0.80000 = cos 36° 52′ 12″
	Secant A	Divide 1 by secant A	$\frac{1}{\text{sec A}}$ = cos A	$\frac{1}{1.25000}$ = 0.80000 = cos 36° 52′ 12″
	Cotangent A and sine A	Multiply cotangent A by sine A	Cot A × sin A = cos A	1.33333 × 0.60000 = 0.80000 = cos 36° 52′ 12″
	Sine A and tangent A	Divide sine A by tangent A	$\frac{\text{Sin A}}{\text{tan A}}$ = cos A	$\frac{0.60000}{0.75000}$ = 0.80000 = cos 36° 52′ 12″
	Cotangent A and cosecant A	Divide cotangent A by cosecant A	$\frac{\text{Cot A}}{\text{cosec A}}$ = cos A	$\frac{1.33333}{1.66666}$ = 0.80000 = cos 36° 52′ 12″
	Sine A	Subtract the square of sine A from 1 and extract the square root of the remainder	$\sqrt{1 - \sin A^2}$ = cos A	$\sqrt{0.64}$ = 0.80000 = cos 36° 52′ 12″
Tangent A	Sides a and b	Divide side a by side b	$\frac{a}{b}$ = tan A	$\frac{6}{8}$ = 0.75000 = tan 36° 52′ 12″
	Cotangent A	Divide 1 by cotangent A	$\frac{1}{\text{cot A}}$ = tan A	$\frac{1}{1.33333}$ = 0.75000 = tan 36° 52′ 12″
	Secant A and sine A	Multiply secant A by sine A	Sec A × sin A = tan A	1.25000 × 0.60000 = 0.75000 = tan 36° 52′ 12″
	Sine A and cosine A	Divide sine A by cosine A	$\frac{\text{Sin A}}{\text{cos A}}$ = tan A	$\frac{0.60000}{0.80000}$ = 0.75000 = tan 36° 52′ 12″
	Secant A and cosecant A	Divide secant A by cosecant A	$\frac{\text{Sec A}}{\text{cosec A}}$ = tan A	$\frac{1.25000}{1.66666}$ = 0.75000 = tan 36° 52′ 12″
	Secant A	Subtract 1 from the square of secant A and extract the square root of the remainder	$\sqrt{\text{Sec A}^2 - 1}$ = tan A	$\sqrt{0.5625}$ = 0.75000 = tan 36° 52′ 12″
Cotangent A	Sides b and a	Divide side b by side a	$\frac{b}{a}$ = cot A	$\frac{8}{6}$ = 1.33333 = cot 36° 52′ 12″

To Find	Knowing	Rule	Formula	Example
Cotangent A	Tangent A	Divide 1 by tangent A	$\frac{1}{\tan A} = \cot A$	$\frac{1}{0.75000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A and cosine A	Multiply cosecant A by cosine A	$\text{Cosec } A \times \cos A = \cot A$	$1.66666 \times 0.80000 = 1.33333 = \cot 36° 52' 12''$
	Cosine A and sine A	Divide cosine A by sine A	$\frac{\text{Cos } A}{\sin A} = \cot A$	$\frac{0.80000}{0.60000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A and secant A	Divide cosecant A by secant A	$\frac{\text{Cosec } A}{\sec A} = \cot A$	$\frac{1.66666}{1.25000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A	Subtract 1 from the square of cosecant A and extract the square root of the remainder	$\sqrt{\text{Cosec } A^2 - 1} = \cot A$	$\sqrt{1.77777} = 1.33333 = \cot 36° 52' 12''$
Secant A	Sides c and b	Divide side c by side b	$\frac{c}{b} = \sec A$	$\frac{10}{8} = 1.25000 = \sec 36° 52' 12''$
	Cosine A	Divide 1 by cosine A	$\frac{1}{\cos A} = \sec A$	$\frac{1}{0.80000} = 1.25000 = \sec 36° 52' 12''$
	Cosecant A and tangent A	Multiply cosecant A by tangent A	$\text{Cosecant } A \times \tan A = \sec A$	$1.66666 \times 0.75000 = 1.25000 = \sec 36° 52' 12''$
	Tangent A and sine A	Divide tangent A by sine A	$\frac{\text{Tan } A}{\sin A} = \sec A$	$\frac{0.75000}{0.60000} = 1.25000 = \sec 36° 52' 12''$
	Cosecant A and cotangent A	Divide cosecant A by cotangent A	$\frac{\text{Cosec } A}{\cot A} = \sec A$	$\frac{1.66666}{1.33333} = 1.25000 = \sec 36° 52' 12''$
	Tangent A	Add 1 to the square of tangent A and extract the square root of the sum	$\sqrt{\text{Tan } A^2 + 1} = \sec A$	$\sqrt{1.5625} = 1.25000 = \sec 36° 52' 12''$
Cosecant A	Sides c and a	Divide side c by side a	$\frac{c}{a} = \text{cosec } A$	$\frac{10}{6} = 1.66666 = \text{cosec } 36° 52' 12''$
	Sine A	Divide 1 by sine A	$\frac{1}{0.60000} = \text{cosec } A$	$\frac{1}{0.60000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Secant A and cotangent A	Multiply secant A by cotangent A	$\text{Sec } A \times \cot A = \text{cosec } A$	$1.25000 \times 1.33333 = 1.66666 = \text{cosec } 36° 52' 12''$
	Secant A and tangent A	Divide secant A by tangent A	$\frac{\text{Sec } A}{\tan A} = \text{cosec } A$	$\frac{1.25000}{0.75000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Cotangent A and cosine A	Divide cotangent A by cosine A	$\frac{\text{Cot } A}{\cos A} = \text{cosec } A$	$\frac{1.33333}{0.80000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Cotangent A	Add 1 to the square of cotangent A and extract the square root of the sum	$\sqrt{\text{Cot } A^2 + 1} = \text{cosec } A$	$\sqrt{2.77777} = 1.66666 = \text{cosec } 36° 52' 12''$
Versed sine A	Sides c and b	Subtract side b from side c and divide the remainder by side c	$\frac{c - b}{c} = \text{versin } A$	$\frac{2}{10} = 0.20000 = \text{versin } 36° 52' 12''$
	Cosine A	Subtract cosine A from 1	$1 - \cos A = \text{versin } A$	$1 - 0.80000 = 0.20000 = \text{versin } 36° 52' 12''$
Coversed sine A	Sides c and a	Subtract side a from side c and divide the remainder by side c	$\frac{c - a}{c} = \text{covers } A$	$\frac{4}{10} = 0.40000 = \text{covers } 36° 52' 12''$
	Sine A	Subtract sin A from 1	$1 - \sin A$	$1 - 0.60000 = 0.40000 = \text{covers } 36° 52' 12''$
Chord A	Sine ½ A	Multiply the sine of half the angle A by 2 and by the radius or side c	$2c \sin \frac{A}{2} = \text{chord } A$	$\text{Sin } 18° 26' 6'' = 0.31623$ $0.31623 \times 2 \times 10 = 6.3246 = \text{chord } 36° 52' 12''$
Side a	Sides c and b	Subtract the square of side b from the square of side c and extract the square root of the remainder	$\sqrt{c^2 - b^2} = \text{side a}$	$\sqrt{36} = 6 = \text{side a}$
	Side c and sine A	Multiply side c by sine A	$c \times \sin A = \text{side a}$	$10 \times 0.60000 = 6 = \text{side a}$
	Side b and tangent A	Multiply side b by tangent A	$b \times \tan A = \text{side a}$	$8 \times 0.75000 = 6 = \text{side a}$
	Side b and cotangent A	Divide side b by cotangent A	$\frac{b}{\cot A} = \text{side a}$	$\frac{8}{0.13333} = 6 = \text{side a}$
	Side c and cosecant A	Divide side c by cosecant A	$\frac{c}{\text{cosec } A} = \text{side A}$	$\frac{10}{1.66666} = 6 = \text{side a}$
Side b	Sides c and a	Subtract the square of side a from the square c and extract the square root of the remainder	$\sqrt{c^2 - a^2} = \text{side b}$	$\sqrt{64} = 8 = \text{side b}$
	Side c and cosine A	Multiply side c by cosine A	$c \times \cos A = \text{side b}$	$10 \times 0.80000 = 8 = \text{side b}$
	Side a and cotangent A	Multiply side a by cotangent A	$a \times \cot A = \text{side b}$	$6 \times 1.33333 = 8 = \text{side b}$
	Side a and tangent A	Divide side a by tangent A	$\frac{a}{\tan A} = \text{side b}$	$\frac{6}{0.7500} = 8 = \text{side b}$
	Side c and secant A	Divide side c by secant A	$\frac{c}{\sec A} = \text{side b}$	$\frac{10}{1.25000} = 8 = \text{side b}$
Side c	Sides a and b	Add the square of side a to the square of side b and extract the square root of the sum	$\sqrt{a^2 + b^2} = \text{side c}$	$\sqrt{100} = 10 = \text{side c}$
	Side b and secant A	Multiply side b by secant A	$b \times \sec A = \text{side c}$	$8 \times 1.25000 = 10 = \text{side c}$
	Side a and cosecant A	Multiply side a by cosecant A	$a \times \text{cosec } A = \text{side c}$	$6 \times 1.66666 = 10 = \text{side c}$
	Side a and sine A	Divide side a by sine A	$\frac{a}{\sin A} = \text{side c}$	$\frac{6}{0.60000} = 10 = \text{side c}$
	Side b and cosine A	Divide side b by cosine A	$\frac{b}{\cos A} = \text{side c}$	$\frac{8}{0.80000} = 10 = \text{side c}$
	Sides c and b and versed sine A	Subtract side b from side c and divide the remainder by versed sine A	$\frac{c - b}{\text{vers } A} = \text{side c}$	$\frac{2}{0.20000} = 10 = \text{side c}$
	Sides c and a and coversed sine A	Subtract side a from side c and divide the remainder by coversed sine A	$\frac{c - a}{\text{covers } A} = \text{side c}$	$\frac{4}{0.40000} = 10 = \text{side c}$

many mechanics do not seem to understand them readily. To enable those who have a knowledge of arithmetic only to easily find the different dimensions of the right-angle triangle this table has been prepared.

The particular angle chosen for illustration was selected on account of the ease in which the dimensions of the sides could be found by simple arithmetic.

The beginner will of course understand that dimensions of the sides of the triangle can be any other than those given in the illustration but their proportions will remain constant for the same angle.

Outside Aid in Developing Ideas

By C. E. Shaffner

We often hear the remark that a man is too near his work to get proper mental perspective. This article discusses the value to the mechanic of the views of the outsider, and intimates where a source of such co-operation may be found.

Not long ago I heard a conversation between an oil salesman and the master mechanic of one of the largest paper mills of its kind in the country, which strikingly indicates just what coöperation from the outside may accomplish in solving mechanical problems. The master mechanic was protesting vigorously against any inquiry into the lubricating requirements of the factory because he said it was an interference into the affairs of the company which resulted only in waste of time. In the end the salesman with a little persistence learned that the factory was really having trouble with machine lubrication because through oversight an oil of insufficient consistency had been recommended.

I believe this to be but an isolated illustration of an antagonistic and unreasonable attitude which does not generally prevail among shopmen; nevertheless it points out a tendency to which all of us are liable. Thorough familiarity with certain methods of machining and constant work in manufacturing the same products cause machinists in some cases to ignore outside assistance just as manufacturers are often unwilling to have advertising men take up their merchandising problems because they feel these outsiders have but an inadequate knowledge of their business.

Most of us have learned that a new point of view usually results in helpful suggestions and not infrequently in a solution of mechanical problems which from within the shop are looked at too frequently from a limited range. There are some interesting sidelights on this matter of outside coöperation which indicate possibilities not thought of by machinists.

I have in mind a young foreman in a Detroit factory who is somewhat of a genius along certain lines of motor construction. By a rather unfortunate coincidence he is connected with a company engaged in an entirely different line of work, and is practically bound to this organization by family ties which mean a great deal for his financial future. One afternoon he was introduced by his superintendent to a sales engineer from a machinery firm, and as a result of a conversation that ensued he received guidance in the construction of an appliance for a tractor on which he had been working for a long time. This particular engineer happened to be in a position to give him specialized information because he had himself worked out the particular phase of the problem by the application of theories of which the young foreman had no knowledge.

Another mechanic I know of in a Philadelphia factory has obtained the help he needs in perfecting an electrical advertising machine through a chance meeting with a service man in his shop who was so interested in the idea that he readily got the assistance of electrical experts from his company. And I have just been told recently about a lathe hand who developed a particular interest in milling machines through an acquaintance with a service man sent out by the manufacturers, and because of knowledge gained in this way he was able to suggest an improvement, which has been adopted.

I appreciate the fact that hundreds of machinists never come in contact with engineers and service experts from outside companies, but I believe they can secure the assistance of such men in working out mechanical ideas. I have known men in the shop who have good ideas, yet take no steps toward their development simply because they believe they lack the necessary means. In the majority of these cases what they really need is information which easily becomes available when the proper sources are located.

The successful machine shop or factory has become too much of a clearing house for ideas to permit any of them to be idly passed by for the want of a little well directed coöperation. Engineers, salesmen and service men can do considerable missionary work in this respect in their contact with shop men, but their efforts are necessarily limited. There are channels of information open for all requirements, and they can be located with little difficulty by taking the matter up with any foreman or superintendent who is in a position to establish a point of contact with the proper parties.

Ancient Rustless Iron

According to a Dutch technical paper a smith who lived in the sixteenth century in the town of Edam, in North Holland, where the cheese comes from, knew a process of making iron rustless, and some of his handiwork is to be found in the town to this day, but he took the secret of the process of manufacture to his grave. The piece of rustless ironwork made by him which still survives consists of part of the iron railing of a bridge in Edam which was originally erected in the year 1569. In 1625 the old wooden bridge, of which the railing formed part, was replaced by a stone structure, and the railing was taken down. It was reërected, but some of the lengths were lost, and the others, which bore the date of their manufacture, were not replaced in their proper order, but mixed with lengths of ordinary iron, which is not rust free. The peculiarity of part of the railing being impervious to rust used to be pointed out as a curiosity to visitors; but about 20 years ago the town architect, who failed to appreciate the importance of the matter, had the whole railing painted green. Recently Edam was visited by two members of the Commission for the Preservation of National Monuments, who ordered that the railing is not to be repainted, and in due course it is expected that the iron will be restored to its original condition. It is surmised that the sixteenth-century smith, whose name has not been handed down, was himself ignorant of his "invention."—*Brass World.*

Labor Turnover and a Remedy

By W. H. WEINGAR

Labor turnover, always too great, has during the past few years reached the point where its magnitude, together with its cost and disorganizing effects, has driven employers almost frantic in their efforts to keep production up to the maximum. This article tells in detail how one large munition plant has successfully handled the problem.

THE unprecedented demand upon manufacturers of munitions and general war supplies up to the present time has meant nothing short of maximum production per man and per machine. No shop is working at 100 per cent. efficiency unless every machine is turning out work to its capacity, and there may be instances where shops may have each machine working full time and still not reach the 100 per cent. mark.

At first glance it would appear that the responsibility for maximum production lies with the employment department in that were there a sufficient number of men to keep the machines running there would be no cessation of production. In point of fact this is not true. In many plants there is a steady stream of employees pouring out at the same time the employment department is straining every effort to send others in to take their places.

The question of getting men is a comparatively easy one, but the real trouble—the one that comes closest to solving the problem of maximum production—is keeping them after getting them.

A careful analysis, by a large war-contract concern, covering many months' intensive study, shows the major causes for departures to be susceptible to correction. Friction aroused through the ill temper and intolerance of foremen, transportation difficulties and dissatisfaction over wages are a few of the matters that can be remedied within the shop. Dealing with an irate foreman requires firmness and tact. A foreman naturally is incapable of acting as judge and jury on his own case and the division superintendent will generally support his foreman's decisions. It is essential, therefore, to obtain the mediation of a totally disinterested third party to act as mediator between the employee and the executive.

To meet this situation, which was one of common occurrence, a dismissal interviewer was appointed, before whom every dismissal comes immediately, and no dismissed employee can get his pay unless his pay check is initialed by the dismissal interviewer. Good judgment, impartiality and patience are requisites for this work as its success depends more upon personality than almost any other work in the employment department. If the interviewer decides that the employee has been wronged he may send him back to his old department as a disciplinary measure. This has been so successful that at least in one case the foreman has called up the employment manager to express his appreciation in the face of his own bad judgment. Ordinarily it has been found advisable to place the employee in another department from the one he left.

RAB-169-B

DEPARTURE RECORD DATE_____

NAME	DEPARTMENT	RATE	LENGTH OF SERVICE

1 2 3 4 5 6 7 8 9 10 11 12 13

RESIGNED ☐ DISMISSED ☐ LAID OFF ☐ OCCUPATION | REASON FOR DISMISSAL

GENERAL FOREMAN

TRANSFER TO

DEPARTMENT_____

RATE_____

DATE_____

NEW FOREMAN

GENERAL FOREMAN

FOREMAN

INVESTIGATION BY

_____ E. O.

ABOVE FOUND_____ CORRECT

____ PAID OFF____ REINSTATED

FIG. 1. RECORD OF DEPARTURE

CLEARANCE SLIP

Employee's No._____ Date_____

Name_____

ARTICLE	CLEARED	CHARGE	
a) Tool Checks			
b) Tools			
c) Keys			
d) Spoiled Work			
e) Broken Gages			
f) Real Estate Dept.			
g) Meal Books			
h) Barracks Acc't			
i) Uniform "			
j) Badges			

INSTRUCTIONS FOR THIS FORM

Use for all departures, quit, laid off, discharged or transferred.
All spaces *above* the line on other side *must* be filled in by Foremen and approved by General Foreman.
White Copy to remain in Foreman's File.
In cases Discharged Yellow and Blue Copies to Employment Office.
In cases Transferred, Yellow to Paymaster, Blue to Emp. Office.

FIG. 2. CLEARANCE SLIP (ON BACK OF FIG. 1.)

A complete detailed report of the work done has been kept by the dismissal interviewer. The forms here shown were designed with respect to clarity and simplicity, so that the various summaries or resignations and dismissals, whether of skilled or unskilled, male or female, could be gained at a glance. Dismissals and resignations were listed under different heads, such as irregularity, incompetence, insubordination, dishonesty, sickness, better position, etc. This record form has been of inestimable value.

It is difficult to measure the results of so intangible a thing as morale, but besides retaining hundreds of valuable employees this method of dealing with departing employees has spread a feeling of loyalty and has reinforced the contact between the men and the management.

When we become satisfied that the turnover had been lowered as far as it could be our next task was to

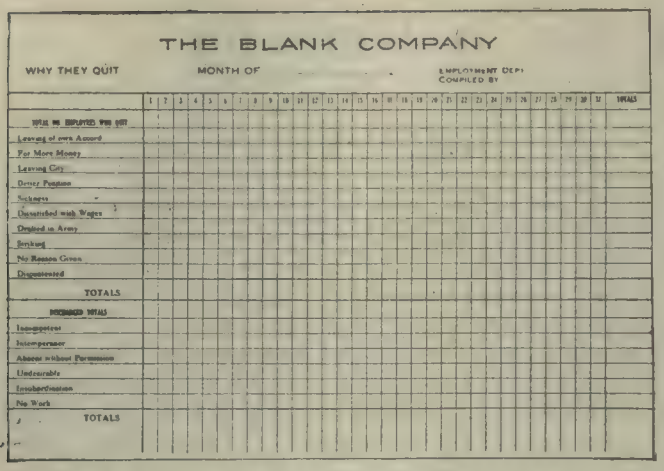


FIG. 3. DETAILED REPORT OF TURNOVER

improve the quality of the raw labor entering the plant. The standard of labor had depreciated greatly since the beginning of the war, and on account of the scarcity it was necessary to utilize men without training and of a type not generally used in factories—elderly men and dry-goods clerks, ministers and musicians and people of both sexes from every walk in life.

Formerly new employees were sent direct to the various production departments where they received the necessary instruction from the foremen and machine set-up men, but with the kind of labor we were receiving this practice could no longer be continued. The average inexperienced person has no conception of the dangers in operating machine tools; they do not realize the need of cleanliness in the event of receiving cuts and scratches, and the importance of one or two thousandths of an inch in the functioning of a machine gun, a fuse or other mechanical device means nothing to them. To instruct them thoroughly along these lines is beyond the capability of the ordinary foreman, so to help the new employee to obtain the best instruction that could be given, which was equally to the interest of the employer, an operators' training school was established.

This school was centrally located, readily permitting employees to be sent to the production shops, and it was also a convenience to superintendents and foremen who desired to be benefited from any practical suggestions it could impart.

The equipment of the training school is more ex-

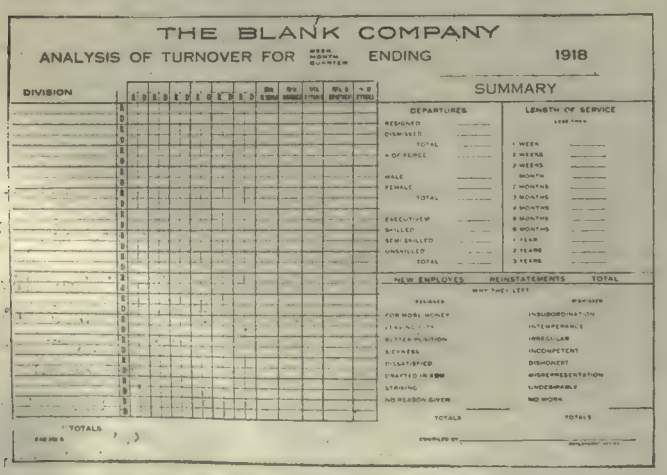


FIG. 4. ANALYSIS OF TURNOVER

tensive than that of almost any other school of its kind. This is largely due to the wide variety of machines used in the manufacture of machine guns and other small arms being produced in the plant of the Remington Arms Union Metallic Cartridge Co. Each type of machine set up in the factory is represented in the school, and only the most modern machinery is installed. There are cylindrical grinding, milling, screw, profiling and drilling machines, lathes and so on, and the pupils

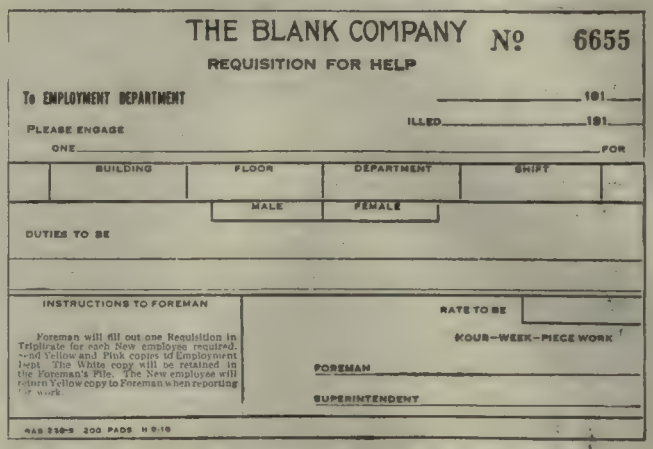


FIG. 5. REQUISITION FOR HELP

are instructed on these types with specialized training on one before they are sent into the shops.

At the head of the school is a man of wide experience and education. He is in charge of the apprentice school as well, and under him is a large and carefully chosen corps of assistants. These men have not only mechanical ability but the power of imparting the knowledge they possess.

Before the new employees are put on machines they are gathered into the lecture room where they are given a talk on cleanliness, safety, opportunity and responsibility. An attempt is made to bring home to every newcomer a realization of his obligation to himself, his company and his country. The students are impressed that each one of them is vital to the organization and their patriotism is stimulated to the utmost.

Cost of Hiring and Training

The cost of hiring and training a new employee is shown to the students; their attention is called to their slowness in production and to the rapid progress they can make through intelligent and conscientious observance of their instructions. They are shown the small value of rapid, spasmodic production in comparison with continuous, average-speed work. In brief, every advantage that the school offers is seized upon to create the proper mental attitude toward the firm as well as to hammer home the truths that will be of incalculable advantage to the employee.

After leaving the school the progress of the student is followed up carefully, and weekly records of his work is kept in the school for months after his departure. In this way check can be kept on the results of the school's methods and any change for improvement offered.

The attention given to the progress of the student and the frequent visits he receives from members of the school faculty after he enters on production work in the plant impress upon him that he is more than a

number or a name on the payroll. We try to convince each member of the organization that his efforts are appreciated, and when representatives of the school or of the executive offices stop to say good morning to him at his machine he realizes that we are watching him and trying to keep in touch with him for his own benefit. This particular method has resulted in a better feeling toward the company on the part of beginners than if the man were let alone after starting work and allowed to drift back into the usual apathetic frame of mind so common in factories.

We have tried to convey to the employees that if discharged they will be given a sympathetic hearing by the dismissal man at the employment office. Unfortunately foremen are not always 100 per cent. loyal or efficient, and if an employee feels that his foreman is a little bit rough on him he can tell his story to the dismissal interviewer even though he may not have been discharged. If several apparently unreasonable discharges have occurred in one department the dismissal interviewer conducts a little quiet investigation, and where conditions appear to be radically wrong steps are taken to correct them.

The spread of the feeling throughout the shop that every employee is sure of an absolutely square deal creates an ease of mind on the part of the men that is beneficial. The knowledge of this same fact is also advantageous to the company because of its effect upon the conduct of the foremen. The foremen realize that the petty squabbles and imaginary injustices they have heretofore had to iron out themselves will be taken care of by the dismissal interviewer, and when they know that a summary discharge for little or no reason will be promptly voided at the employment office they think twice before releasing an employee.

A large number of the discharges in the average plant are due to the impatience or personal feelings of the foremen, but since installing this method of investigating discharges there has been a marked decrease in the labor-turnover figures attributed to discharges. The method has also had a good effect in reducing the percentage of resignations.

Disability Under the Compensation Acts—II

BY CHESLA C. SHERLOCK

Under the laws of some states partial loss of vision or hearing is not compensable and the workman can only collect for temporary disability which ends when he returns to work. In many cases this is manifestly unfair and a moral liability should direct the employer where the legal liability is nonexistent. In making awards the courts usually rule that loss of earning power is not the controlling factor in cases of permanent partial or total disability.

PARTIAL disability as it is known under the compensation acts is more properly designated as permanent partial disability. These injuries are most generally specifically enumerated by the statute itself, which also allows a specific recovery for the particular disability.

Under the discussion concerning temporary disability we found that if a man is injured so that he is unable to carry on his work for a short time he is suffering from technical temporary disability. He is totally incapacitated, being unable to work for a temporary period.

If his injuries are such that he can never be restored, although he may in fact recover his former earning power in his particular employment, he is said to have suffered a permanent partial disability. An example of such an injury is the loss of a finger, a hand or an arm. The workman's earning power may be restored to him within a short time, but the character of his injuries is permanent in nature. It is this class of injuries which is designated by the compensation acts as partial disability.

Inasmuch as many of the statutes classify these injuries under a schedule showing the amount of compensation payable for each specific injury they are often called "schedule injuries," although this term is confusing and improper.

The statute itself is the authority under which settlements are made for partial-disability cases. It is not expedient to treat of those common partial-disability cases which are plainly treated in the respective statutes, as there is no room for argument or doubt where the legislative intent has been clearly expressed. If the statute allows 40 weeks' compensation for the loss of a thumb there is no alternative for the employer but to pay that amount.

It is well to observe, however, that a workman suffering from a disability of this nature, the loss of a member or of any other schedule injury, is entitled to the full amount of the compensation awarded by the statute regardless of whether his actual earning power has been affected or not. If the workman returns to work within two weeks the employer cannot pay him two weeks' compensation and call it square. He must continue the payments for the full statutory period regardless of the status of the workman's present earning power. The law deems that the workman's efficiency has been impaired to the extent mentioned, and there is no showing on the part of the employer which will overcome this presumption.

Cases Where the Law Is Silent

The room for real doubt arises in cases where the law is silent and does not mention the amount of compensation which is to be paid for a given injury. A good example may be cited from many of the states, particularly Connecticut, Iowa and others, where no allowance is made for the partial loss of vision. Most of the statutes contain provisions compensating a workman for the loss of one or both eyes, but they have overlooked instances where only a partial loss of vision is sustained.

Naturally the question arises as to the right of these unfortunate workmen to have more compensation than

they would receive if they suffered merely from temporary disability. Temporary disability, as we have noted before, ends when the workman returns to work.

If these men return to work when they have recovered from the shock of the accident they can no longer draw compensation for temporary disability. They have not lost an eye or both eyes; therefore can they receive such compensation when they have not suffered the loss compensated by the statute?

Legislation Intent

It is contended with very good reason that it was the legislative intent to award compensation to all who have suffered partial disability without reference to their loss of earning power, and for authority the workman points out the fact that the man who loses a finger is compensated as well as the man who loses a hand. regardless of whether such loss affected his earning power or not.

Unfortunate as it may seem there is no legal duty devolving upon employers to pay compensation for a partial loss of vision where the statute is silent upon the subject. Where the legislature has not expressed an intent, although there is every reason to believe that such an intent existed, there is no recourse but for the workman to accept the compensation which the law has specifically conferred upon him, namely, compensation for temporary disability.

These instances have come up in many of the states where the laws were the "product of the shears rather than of the pen," but it is safe to say that as soon as the respective legislatures have the opportunity they will remedy the situation by fixing a schedule of compensation for those who lose a portion of their normal vision.

The same thing can be said of a partial loss of hearing. A workman suffers the loss of hearing completely and he is compensated, but if he suffers only a partial loss he can receive only the compensation granted for his temporary disability.

Loss of Teeth

It is a praiseworthy act on the part of the majority of employers when they pay the workman so injured a percentage of the compensation based on total loss of sight or hearing, as the case may be, without regard to their legal liability to do so. I am familiar with many instances of this nature, and it cannot reflect too highly to the credit of these public-spirited employers. Whether the legal liability is present or not the moral liability is there, and they are allowed to escape legally only because of an oversight on the part of the legislative authority.

The loss of teeth is a common instance where the legislature has been entirely silent on partial-disability cases. The number of instances in which workmen have some or all of their teeth knocked out is by no means a freak occurrence at the present time. It is especially noticeable in cases where workmen are employed on machinery or in the transportation of raw materials.

I do not recall a single original compensation act which allowed compensation for the loss of teeth. The law imposes on the employer the duty of providing medical, surgical and hospital aid within certain limitation to all employees who are in need of them, in addition to the compensation benefits mentioned under the acts, but seldom, if ever, is reference made to dental benefits.

The workman who suffers a loss of teeth is entitled to aid just as much as the man who loses a finger or a toe. In fact it would seem that he is more entitled to aid in this case because there is nothing that so completely disables a man or impairs his health and efficiency as does the loss of his teeth. It is worth noting that the states are quickly amending their acts in this respect. In Iowa the matter will be before the legislature this spring, and it will also come up in other states.

Graduated Compensation

Many of the states have a provision in the compensation acts which stipulates that in case a workman suffers a partial disability and no scheduled amount of compensation is mentioned in the act for such disability the compensation shall be based upon the amount allowed for permanent disability.

Thus in Minnesota a workman sustained a 10 per cent. loss of vision. The statute allowed 100 weeks' compensation for the loss of an eye, so the court held that the compensation should be based on the amount allowed for the loss of the whole vision, to be determined by medical opinion.

But if in the permanent disability schedule no mention is made of the specific injury the workman can recover nothing but compensation for his temporary disability.

If a workman draws compensation on an injury and later the injury causes total loss of the member the question arises as to whether he is entitled to full compensation for his complete loss of member or whether the compensation already paid must be deducted from the amount allowed for the full loss.

A case of this nature might be illustrated as follows: A workman suffers a partial loss of vision, which is determined by medical experts to be 40 per cent. loss of vision. The law allows the workman 50 per cent. of his average wages for 100 weeks for the total loss of vision. The award is accordingly made for 40 weeks' compensation. Subsequently the injury causes the workman to sustain a complete loss of vision. The question arises, Is he entitled to 100 weeks' additional compensation or the difference between 100 and 40, the amount already paid, which is 60 weeks? The courts and commissions are almost unanimous in holding to the latter view that the workman can recover no more than the schedule amount regardless of how long his injury was prolonged.

This same situation arises between temporary and partial disability and between temporary and permanent disability as was shown above between partial and permanent disability. If the workman has been paid compensation for a period covering his temporary disability he cannot recover the full amount awarded for his partial disability or permanent disability, as the case may be, unless the law specifically grants it to him. Some of the states have expressly declared that if a workman sustains such an injury as entitles him to relief under the schedules such compensation paid for temporary disability shall not be deducted from the schedule amount.

Other states accomplish the same result in the end by increasing the percentage of the workman's wages which the employer shall pay for injuries, but allowing the law to stand as it was before, so far as deducting the compensation paid for temporary disability is concerned.

In determining the amount of compensation which is due for a partial disability it should be kept in mind that the court, where given authority by the statute, must fix the compensation on the amount awarded in such case if a permanent total loss had been sustained. Suppose, for instance, that a workman loses a hand, the law remaining silent so far as the loss of a hand is concerned, but allowing 250 weeks' compensation for the loss of an arm and 175 weeks for the loss of the arm at the elbow.

The workman may show that the loss of his hand was worth in proportion to him, so far as the loss of the whole arm was concerned, 200 weks' compensation. But such an award cannot legally be made, because the law specifically limits his compensation to 175 weeks for the loss of the arm at the elbow. He cannot have greater compensation for a lesser injury.

Loss of Little Finger

This principle holds true all through the subject of partial disability. The compensation awarded for a lesser injury than that mentioned by the statutes cannot be out of proportion to the compensation granted for the greater injury. If a workman loses a little finger and the law allows 50 weeks for the thumb he cannot receive 50 weeks' compensation for the loss of the little finger.

Some of the states arrive at the amount of compensation due the workman for partial disability in an entirely different manner. They proceed on what is known as the system of proportional, or estimated, awards. This is a much more scientific way of taking care of workmen than the arbitrary schedule system.

The system might be roughly illustrated by saying that each workman is given an efficiency standard and his earning capacity based according to the standard to which he belongs. If he loses a hand that loss impairs his efficiency just so much and he is compensated according to his loss. In the instance of one man the loss to the workman may be slight. Such a system is correspondingly beneficial to the employer. If the man was of a high standard and his injury played a great figure in his ability to do future work his percentage of loss was determined and payment made accordingly. His compensation might be several times that granted to another man for the same injury. This is the theory of the system, but it has not been applied in just this manner.

Ordinarily, workmen are said to have a certain standard and their partial disability bears a certain percentage to their full earning power. It then follows that in the average application of the system sooner or later the tendency is to fall back into cut-and-dried schedules granting so much compensation for such and such injury, so that in the end the system has slight advantage over statutory schedules.

The schedules granting compensation for partial disability are not the arbitrary word of the legislature as to the value of certain specific losses, as so many employers and workmen are prone to believe. These schedules have been arrived at only after the most exhaustive research of actuarial statistics and are for the most part entirely adequate and fair. The great difficulty is that so far as individual workmen are concerned they often work hardship. They overcompensate some and undercompensate others. But no system of jurisprudence has yet been devised which is perfect in its application to humanity at large and to individuals in particular. The hope and the purpose of the law is to perform the ends of justice at all times.

Two Typical Cases

Some of the statutes contain no schedules for partial disability cases, but provide compensation on a certain percentage of the wages extending over a period of years. A noteworthy example is Kansas, where the period of years is eight, no reference being made to the actual wage loss. This system is in effect nothing short of a pension system, for no reference is made to the workman's value in industry, but upon injury he becomes entitled to full benefits, regardless of whether it over or under compensates him.

In this state it was found that a certain workman had suffered a partial disability, but that he had resumed his employment at his former wages. The employer contended that there was no necessity for the continuance of the compensation as the earning power had been restored. The court, however, held that such was not the case; that the employer must continue the payment of compensation and that his liability under the law did not end with the return of the workman to his employment unless such employment was to continue for the period of eight years.

The court further pointed out that at some later date before the expiration of the statutory period the workman might want to leave the old employment and seek work elsewhere, at which time the permanent partial disability might seriously affect his earning power. The ruling here is in line with the ruling elsewhere to the effect that loss of earning power is not the controlling factor in permanent partial or permanent total disability cases.

Where a workman suffers a permanent partial disability it is not necessary that he suffer the complete severance of the member in order to recover his compensation. The acts were enacted in a "spirit of true helpfulness" and they are generally construed in that manner. For all general purposes the loss of use of the members will suffice, amounting to the same thing as amputation or total loss.

If a workman loses several members, which in turn cause him to lose the use of a greater member, the courts will generally award him compensation for the loss of the greater member. This is particularly true in cases involving injuries to the hands. It is commonly acknowledged that the hand is useless without the fingers. If the fingers have been severed, or enough of them to render the hand useless, even though the palm remains, it is generally held that the workman is entitled to compensation for the loss of a hand.

An Illinois case is frequently cited as an example of this view. A workman lost all of his fingers with the exception of the thumb. He was awarded compensation for the loss of the hand because the court declared that

for all practical purposes he might just as well have had the hand severed at the wrist as to have lost all four fingers.

Loss of use is the controlling factor in these partial-disability cases. All of the fingers may be intact on the hand, but they may be so badly used up that they are useless to the workman. In that case, if he has lost the use of his hand, he will be compensated accordingly, even though he still has his hand.

However, there is this caution to observe. The loss of use must be permanent, at least is the opinion of competent medical testimony. No such reward will obtain or should obtain where there is a probability that there will ever be a recovery of the use. In the case of amputation such a recovery is of course removed, but it is always more or less present where the members are still attached to the body. But cases are plentiful where this reasoning is applied, provided it is sustained by the most competent medical testimony at hand.

It has been held in both New York and Vermont that where a partial disability is sustained and compensation awarded according to the schedule contained in the law that that is all the compensation allowable and that the workman cannot later receive more compensation from his employer for subsequent loss of earning power due to the injury.

One injury may in its nature so affect other portions of the workman's body or member as to render them practically useless. This is shown in a case where the loss of one joint of a finger so stiffened the other joints of the finger that the finger was worthless. The reward will generally be for the loss of the finger, but in no instance will it extend further.

Employment of Medical Treatment

Where proper medical treatment will, under ordinary circumstances, cure a case of partial disability and practically restore the workman to his normal usefulness it is the opinion of the authorities that the workman must submit to such treatment. The same can be said if the treatment will lessen the employer's liability under the law for compensation, provided it does not endanger the workman's life.

The law will not compel any man to undergo an operation or treatment which endangers his life or penalize him if he fails to take advantage of it, but in cases where there is no reasonable danger the workman must submit or suffer his compensation payments being reduced.

Suppose that a workman has sustained an injury to his knee so that it is stiff and he is unable to use his leg to any great extent. His injury may even be so pronounced that he has practically lost the entire usefulness of the leg. But under competent and skilled medical attention the leg might be restored to its normal usefulness.

If the workman refuses to accept such treatment or operation his compensation will be fixed at the period of time up to the probable operation and the length of time which it would ordinarily take thereafter for him to normally recover from the operation. The employer is of course liable for the payment of such medical treatment or operation if it is undertaken with the view of lessening his own compensation liability.

If the workman accepts the treatment and undergoes the operation, but it is unsuccessful and leaves him in worse shape than before, then he is entitled to compensation for full loss of the member. If the operation is succesful he has really gained a great deal because he has his leg back at no cost to him and he is paid compensation until he has had time to recover from the effects of the operation. This is one of the really beneficial things of the compensation practice.

I have known of instances where an agreement was entered into between the workman and the employer that the operation was to be made, but if the surgeon found that after cutting open the leg there would be practically no chance of restoring its usefulness he was to go ahead and amputate the leg and thus save the workman the inconvenience of its pain in the future. In this instance the employer took a chance of reducing his compensation liability, and that failing, removed the leg for the workman, doing the same without additional cost to himself and performing a lasting service to the workman.

The real difficulty in partial-disability cases is in determining the extent of the disability and in arriving at the measure of liability in instances where through the sins of omission the legislature has failed to provide protection for the workman. In either instance it is hoped that this discussion has served to clear up the matter of partial disability in the minds of employers, for it is a subject which is often very much misunderstood.

Daylight Saving

By Matthew Harris

The time table for daylight saving published on page 364 of the *American Machinist* reminds me that Chordal told us of such a table in one of his early letters published in the *American Machinist* on Nov. 29, 1879.

The table is here given, and according to Chordal was calculated by the late Charles A. Bauer, who was at the time superintendent of the Champion Bar and Knife Works, Springfield, Ohio.

TIME TABLE. AVERAGE 10 HOURS

Date	Go to Work A.M.	Be Gone to Dinner	Go Home
Jan. 1	7.15	1 hour	5.00
Jan. 8	7.15	1 hour	5.15
Jan. 29	7.00	1 hour	5.30
Feb. 12	7.00	1 hour	5.45
Feb. 19	6.45	1 hour	6.00
Mar. 18	6.45	1 hour	6.15
Sept. 16	6.45	1 hour	6.00
Oct. 7	6.45	1 hour	5.45
Oct. 14	6.45	1 hour	5.30
Nov. 11	7.00	1 hour	5.15
Dec. 2	7.00	1 hour	5.00
Dec. 9	7.15	1 hour	5.00
Dec. 16	7.15	1 hour	4.50

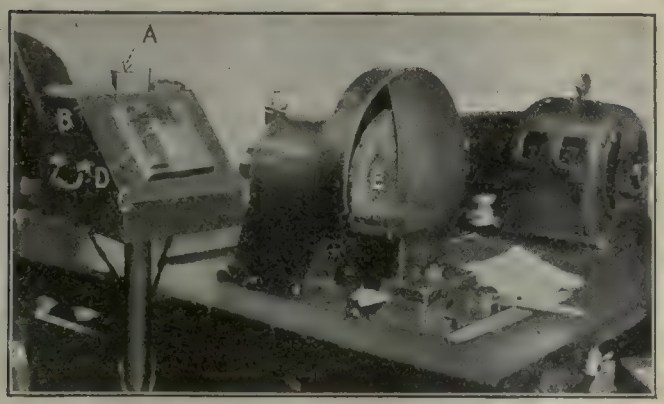
Commenting on the subject Chordal said: "The pay of the men is never changed. They get 10 hours pay every day. There are vicious sides to this time-table plan when taken advantage of by unscrupulous men, both owners and workmen. I have heard workmen kicking against the plan because some roguish owner had paid them wages during the summer and then put them on starvation piece work in the winter, and I have seen owners the victims of sharp workmen who drew wages during the winter and went to other shops in the summer. This table is a good gage for morals. In smooth-working shops I have seen men growling in summer over the long hours. These men were invariably big fools who knew nothing of the laws of compensation or the rules of average."



Device for Gaging Chaser Blanks

By J. B. Smith

It is necessary that the blanks for chasers used in quick-opening die heads be square to within very close limits, especially with reference to the base and the end upon which the threads are to be cut. The method



GRINDING WHEEL AND GAGING DIVICE FOR CHASER BLANKS

here illustrated is that employed in the plant of the Modern Tool Co., Erie, Penn.

A chaser blank is shown at *A* and the gaging device at *B*. This device is mounted on a box *C*, which incloses an incandescent lamp, the light from which shines through a narrow slot *D*.

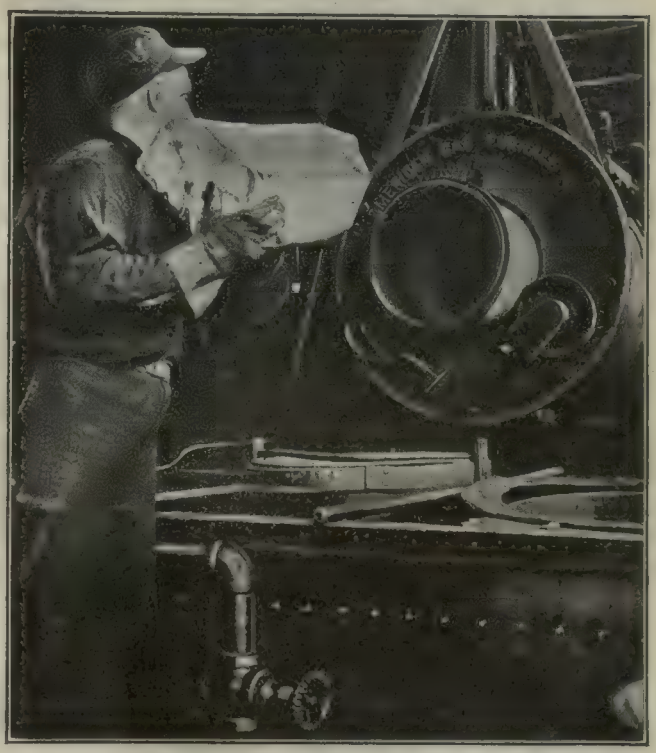
When the operator holds a blank against the gage the light shining through this slot shows very plainly any discrepancy in squareness of the two most essential edges, and the work may be more rapidly passed than by holding a standard square on the piece every time it was checked up.

The grinding of these is done on the small motor-driven disk grinding wheel *E*. Seated on a stool before this wheel the operator can rapidly grind the parts and check them on the gage until they have been finished correctly.

Carbonizing in a Rotary Furnace

By W. H. Addis

No, the man in the picture is not loading a giant trench mortar. He is a rotary-furnace operator snapped at his regular job of charging his furnace "somewhere in America," and he is loading his furnace with a large 50-lb.-sized paper bag containing 30 lb. of high-grade carbonizing compound. One 30-lb. bag of compound is sufficient to treat 130 lb. of work, which is loaded in like manner by placing in two bags of equal capacity. This ratio of work to compound is correct for the best commercial carbonizers, which are generally of uniform quality. The paper bag containers burn up in the retort, releasing their contents which are mixed by the tumbling action of the rotating retort.



A ROTARY CARBONIZING FURNACE

The change from the packed-pot, oven-fired type of furnace to the bag-loaded rotary made itself first felt in our packing room where a large force of girls who once packed pots were released for other work. A few hours each day is sufficient time for one man to fill and weigh enough paper bags for a battery of rotary furnaces. Then there is the advantage of knowing with certainty the correct ratio of work to compound and to be able to control it.

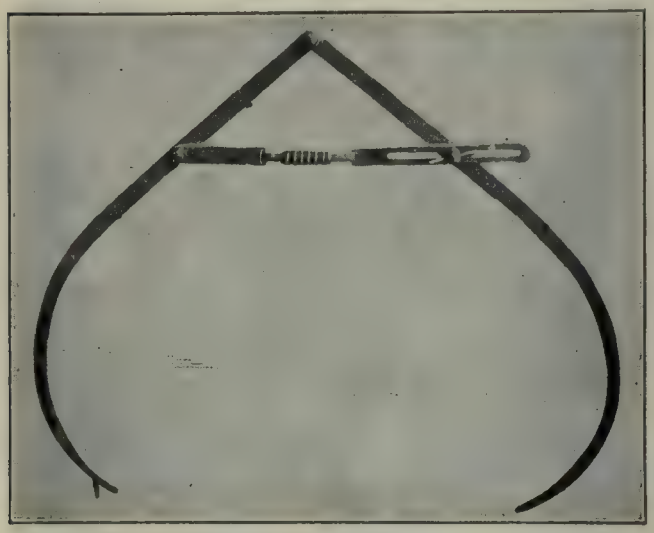
Production is greatly increased over the oven type of furnace. This may be attributed to the fact that the rotary retort does not have to be raised to carbonizing heat, as do the pots, for it is right at that temperature when the paper bags are put in. It is also true that there is immediate contact of the work with the retort just as soon as the bags burn. There is for

this reason a big reduction of heating time over the best type of oven furnace. In other methods each pound of work took its pound of compound, but here a remarkable saving is made due to the fact that there is very little loss of gases through the sealing of the rotary retort, while with other methods there is always the loss of gases from each pot in the furnace. This loss has been computed by well-informed men to be at least 20 per cent.

A Large-Sized Caliper With Turnbuckle Adjustment

By J. Wright

A large-sized outside caliper with a capacity of about 60 in. span has been made in the Wilson Ave. shops of the Northwestern Elevated Railway System of Chicago.



LARGE OUTSIDE CALIPER

The unique feature of this caliper is that for accurate adjustment it is provided with a turnbuckle in the center of its clamping bar, the details being plainly shown in the illustration.

Bees' Wax Vise for the Miller

By E. A. Dixie

Vises have been shown in the *American Machinist* for holding a number of pieces at a time. Many of them employ levers, most of them are somewhat complicated and liable to get out of order, and all of them are somewhat expensive to make. Where levers are employed the mechanism is greatly simplified by having the numbers of pieces to be gripped a power of 2, as 2, 4, 8, 16, so that by a series of simple levers pivoted at their centers the reaction on the lever arms will be equal, as shown in Figs. 1 and 2. Where the number of pieces to be gripped is either odd or divisible by 3, as 3, 6, 9, 12, the levers must be of two kinds, some with equal arms and some with unequal arms, as shown in Fig. 3, to equalize the pressures on the work. This complicates the mechanism and multiplies the difficulties of producing an efficient vise.

Multiple-cylinder hydraulic vises using water, oil or alcohol are efficient for this work, but as a usual thing expensive to make. The work on them must be fairly accurate and the packing on the hydraulic rams in good order or the fluid will leak and render them inoperative. In Figs. 4 and 5 is shown a hydraulic vise devised by Mr. Emrick of the Eastern Tube and Tool Co.,

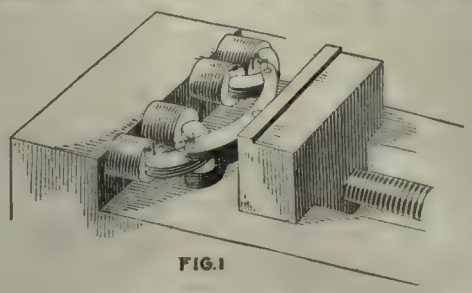


FIG. 1

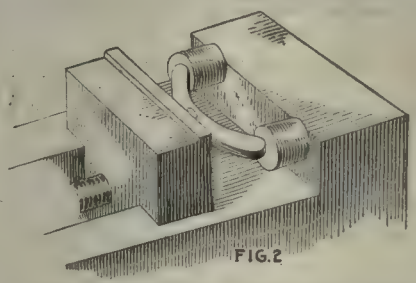


FIG. 2

FIGS. 1 AND 2. LEVER VISES FOR GRIPPING TWO AND FOUR PIECES OF WORK

Brooklyn, for holding any number of pieces, either odd or even. The parts are simple to make and no great accuracy is necessary. The plungers *A* are without packing, as none is necessary, because the medium used in place of water, oil or alcohol is ordinary bees' wax;

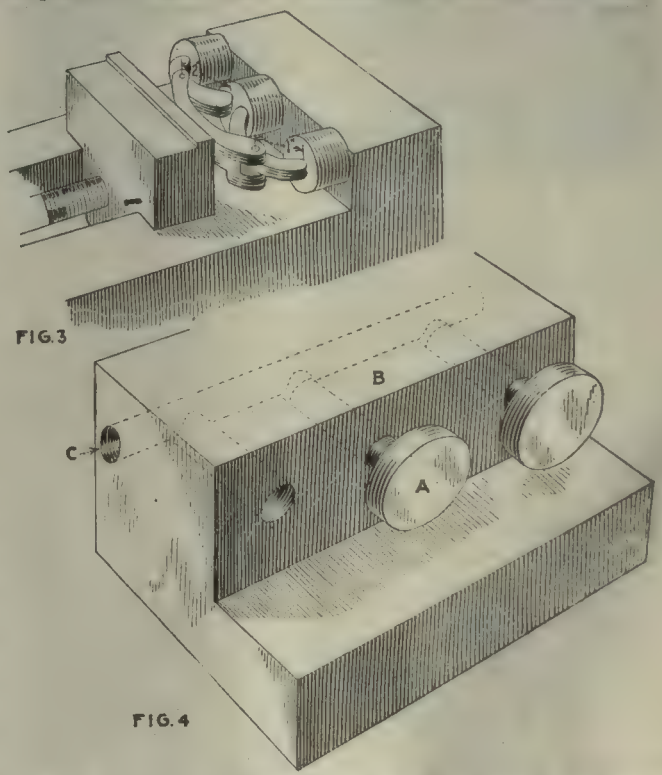


FIG. 3

FIG. 4

FIGS. 3. AND 4. LEVER VISE FOR GRIPPING THREE PIECES AND WAX VISE FOR GRIPPING ANY NUMBER OF PIECES

the member *B* is cast iron; the holes for the plungers *A* are drilled and reamed. A cross-hole that breaks into the rear ends of the holes for the plungers is drilled at *C*, but it does not go through the opposite side. The hole *C* need not be reamed, as it is merely a duct through which the wax passes as it equalizes the pressure on the various plungers.

With the parts *A* fitted to *B* and the hole *C* drilled the parts are assembled and the whole warmed so that it will not chill the wax.

When ready to pour the melted wax the plungers are pulled part way out, and with the hole *C* on top and the assembly tilted so no air pockets are formed the

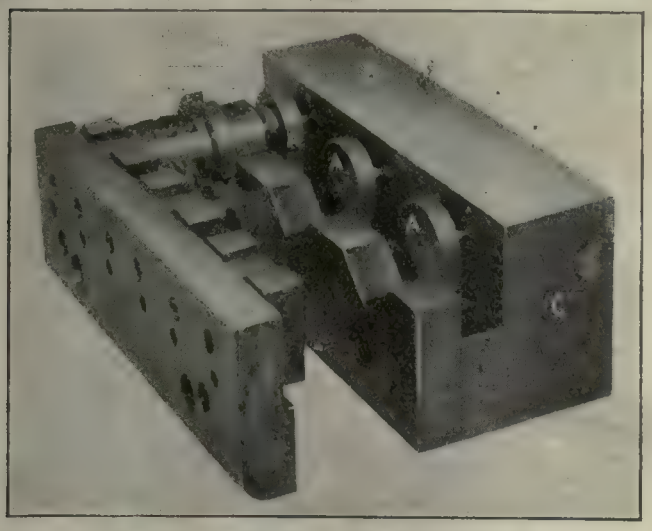


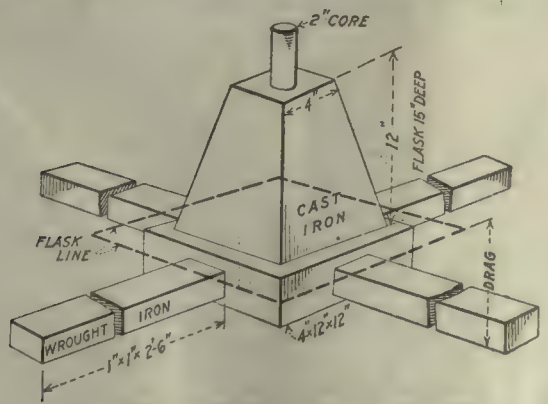
FIG. 5. THE WAX VISE COMPLETE

hot wax is run in clear to the top of the hole. When the wax is cold an ordinary pipe plug is screwed into the threaded end of the hole *C*. Under working conditions it will be found that the wax in time decreases in bulk and more will have to be added from time to time. When this becomes necessary the jaw assembly is warmed, the plug removed and more wax poured in.

Molding a Large Casting in a Small Flask

By M. E. Duggan

A machine part the center of which was of cast iron with four wrought-iron arms cast in it was wanted in a hurry. The molder asked for the over-all dimensions of the patterns so that he might get out a flask suitable for the job, and the patternmaker, thinking that the



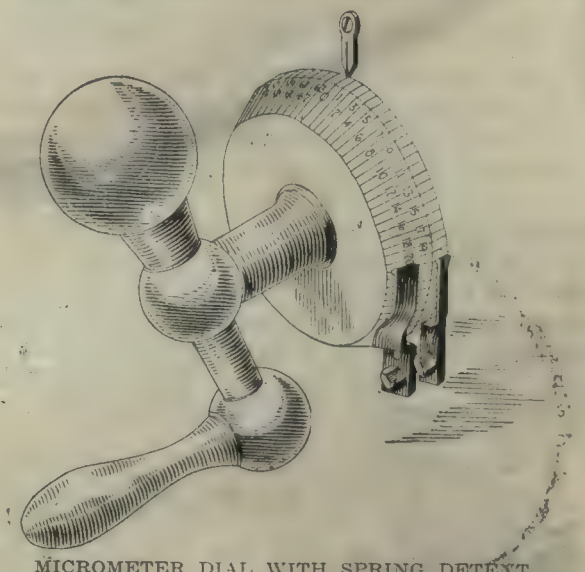
LARGE CASTING IN SMALL FLASK

pattern and iron arms would be molded within the flask, gave him the dimensions over the arms. When the pattern reached the foundry and the molder had given it the "once over," this is how it was molded: The pattern was imbedded in the floor of the foundry flush with the top of the arms. A flask 14 x 14 in. was used for the cope. The cope was made and lifted and the pattern withdrawn. The wrought-iron arms were then placed in position in the mold on the foundry floor and the cope put back in place, leaving the four wrought-iron arms exposed beyond the single-cope flask. Thus the piece was molded in a 14 x 14-in. flask and not in one about 6 ft. square as the patternmaker thought it would be.

Improved Micrometer Dial

By A. Allinger

The sketch shows a micrometer dial which is very useful on the cross-feed screws of lathes, the traverse screws of milling machines or other places where a minute, definite movement is required and where it is of ad-



MICROMETER DIAL WITH SPRING DETENT

vantage to be able to make such movement quickly and accurately without the necessity of taking the eyes off the work.

It differs from the ordinary micrometer dial only in having deep but narrow V-grooves milled radially over its face and across its periphery. A spring detent is made of sheet steel, the working edge of which is nicely fitted to the grooves and is left quite hard while the body is spring tempered.

The detent may be made for either position, as the sketch shows, and by its use the advance of the screw any definite number of thousandths may be easily felt.

Why Not Bronze Nuts in Cross-Slides?

By J. W. Lawson

We have had considerable trouble with the cross-slides of a certain class of machine tool by reason of the nut on the slide being merely a tapped hole in the cast-iron body of the slide.

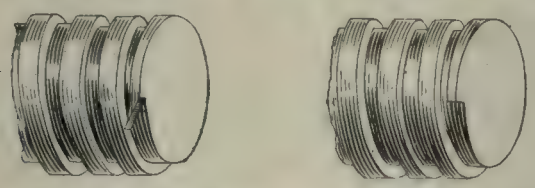
When the slide is run off the screw, as is frequently done by green operators, and they attempt to replace it without attracting attention, trouble is extremely liable to develop from the jamming of the thread, the first turn of which in the iron will probably be broken.

Frequent repetitions soon cause the whole thread to become bad, dirt and chips are worked into it with the result that it soon becomes loose and finally stripped.

The only remedy at this stage is to swing up the cast-

ing and bore it for a brass sleeve to replace the nut. The making of this small-diameter, square-threaded nut without a tap is some job for a shop of ordinary resources, yet it is the only recourse except the clumsy and unsatisfactory one, almost as difficult of accomplishment, of chambering the casting and running a babbitt nut around the screw.

Why do not manufacturers make the nut of brass or bronze and removable in the first place? Properly



FIXING THE END OF A SQUARE-THREAD SCREW

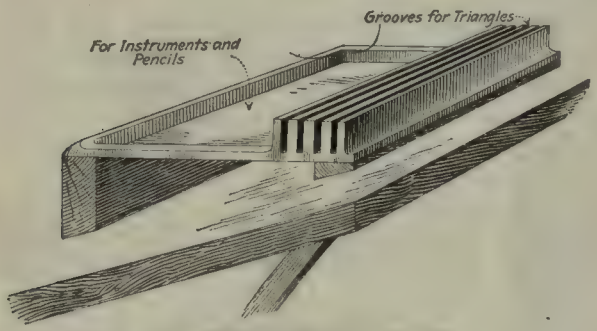
equipped for their manufacture the cost per machine could not be appreciably greater and the satisfaction to the customer would be immeasurable.

Another little point to consider is the thin end of the first quarter turn of a square thread. This end soon becomes broken and bent down, as shown in the sketch, and is a prolific cause of the trouble complained of above. A green hand who has run off his cross-slide and is trying to put it back surreptitiously will hammer away, trying to start a thread that will not start, until he has ruined half of the nut. We always chop these threads off square at the point where the full-section thread begins.

Tool Tray for Draftsman

By E. A. Kipps

The sketch shows a simple tray I made for use on my drawing board to hold tools. It can be made in a few minutes by anyone skilled in the use of wood-



DRAFTSMEN'S TOOL TRAY

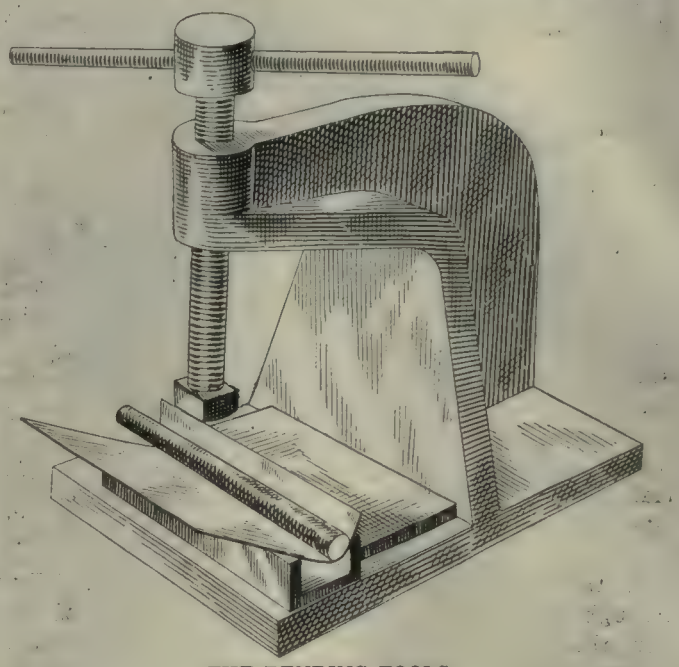
working tools and saves its cost many times over by keeping the tools where they can be readily found instead of having them sliding all over the board.

Guard for Planing Machine Ways

By H. Lauterbach

The method we used in bending guards for the ways of our planing machine may be of interest to the readers of the *American Machinist*. First, a sheet-iron pattern was cut to the required shape and height. A piece of channel iron 3 ft. long, a piece of 2-in. pipe the same length, a straightening screw, a hammer and a piece of iron to be used as a guide between the channel iron and the housing of the straightening screw were all that was required.

A guide line was drawn about 2 in. from the edge of the sheet iron and the first bend was made along this line. Another bend was made at about 2½ in. until the edge was about ¼ in. higher than the pattern. After the guard was bent on both edges the size across the



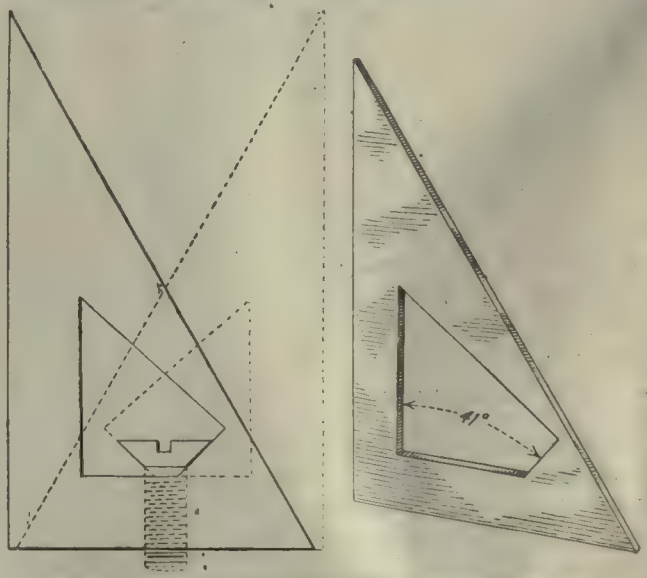
THE BENDING TOOLS

top was scant. This was remedied by laying the work bottom up on a narrow piece of iron and striking it with the hammer at the base of the curve, which opens it up to the required size. The sketch shows the way in which the tools were used.

Extra Angles on Triangle

By A. Kipps

Having frequent occasion to draw countersunk-head machine screws with included angle of 82 deg. I cut the center of an ordinary 60-deg. triangle to the shape shown in the sketch. It is little trouble to make and saves a deal of time on this work.



EXTRA ANGLE FOR DRAWING SCREW HEADS

EDITORIALS

The Price of Machine Tools

IN COMMON with customers in other lines, the users of machine tools are delaying the placing of orders in the hope of securing lower prices. This hope, we feel sure, will not and should not be realized except in a few extreme cases. Machine tools have, in general, been too low-priced in the past.

There are of course a few instances where prices have been unduly inflated, taking advantage of the necessity of the customer for an early delivery. But in most cases the builders of standard machines of high quality have not advanced prices unreasonably. Those who build machines which are the basis of all industry certainly deserve a fair return for their efforts; more than many of them have received in the past.

There is a noticeable difference between the average machine tool shop and the shops of other machine industries, and as usual there is a reason. With almost no exceptions the machine tool shop has come up from small beginnings. A machinist designed a new machine tool of some sort and started to build it in a small way with almost no capital. One or two men in a single room, with all the office work done at night (often by the wife), has been the beginning of many a well known machine tool shop of today.

In many cases the number of machine tools built does not allow of quantity production with its reduced costs. Then too, the fact that many of the builders are small in size and that the real amount of overhead expense is frequently not appreciated, has put the machine tool industry at a disadvantage in many ways. It has not, as a rule, seen its way clear to offer inducements either in the way of wages, salaries or shop conditions, equal to those of the automobile or other industries. As a result it has lost many good men who should now be in the ranks and who could have aided in its development.

The best interests of the country as a whole demand that superior mechanical talent be in that branch of the machine industry on which all of the others depend. This cannot be done unless the machine tool shop can offer at least as good opportunities for the mechanic and engineer as the other branches.

We believe that in most cases the present prices are justified and should be maintained. The profits secured by users of the machines are many times in excess of those realized by the maker and there is no room for just complaint on that score.

It is also necessary for the builders of machine tools to realize that the dignity and standing of the industry demand that its shops should be second to none in any way. There is no reason for them to take a secondary position or be content with anything but the best for themselves and their men.

This does not mean that this industry should demand or expect exorbitant profits. It should however always bear in mind that it is entitled to such a return as will enable it to maintain high-grade shops, to pay enough to attract the best men and still give a fair return on the investment.

Be Sure of the Right Medicine

HOW many times have you read of this or that estimable gentleman with a headache or other ailment getting up in the dark and taking a dose out of the wrong bottle? The headache never returns, but the undertaker is master of ceremonies shortly afterward.

How many times does business take the wrong medicine with similar results?

The readjustment period which we are entering is sure to contain many business disorders, and whenever any symptoms of disease appear business doctors of various kinds spring up with offers of medicine in great variety.

We are facing such a condition at the present time, and never was it more vital to avoid taking quack nostrums than at present. No matter how severe the headache, don't grope in the dark for the right bottle. Be dead sure you know the label and that you get the right bottle. The bankruptcy court is the undertaker for mistakes of this kind.

Most of the nostrums offered will be labeled "Efficiency" of some special brand and it's the brand that needs watching. Never mind the special name or the color of the label, but be sure that the "fish" part of it isn't dead or worse.

Too much of this kind of medicine is ten-tenths rules, charts and diagrams which go under the guise of management. It leaves out the human factor both in the manager and in the men in the shop. Real efficiency cares very much less about any particular system of rules and charts than it does about getting results; about getting dividends as the result of real coöperation, and about insuring the future as well as the present.

The German brand of efficiency made machines out of all but the chosen few. These were the planning department, and they never considered the individuality

of the workers. The system worked fine as long as it met no real obstacles, as long as it could be worked according to rules. But the Allies refused to know when the system said they were licked; which threw the system out of gear, and even the planning department couldn't get the schedule back into high.

There is no question but that most shops need a tonic after the last four strenuous years. But don't make the mistake of taking either a dope or an emetic. Liberal doses of mutual interest usually act as a real tonic. Coöperation is just as necessary in times of peace as it was in war. And the coöperation cannot be all on one side. It must come from both sides and meet in the middle. The great trouble has been that it has never met at all in too many cases.

Some of the best intentioned managers have never been in the shop and cannot appreciate the workers' point of view. Others who have grown up through the shop cannot realize that times have changed since they were workmen and see no reason why men should not now be content with all the discomfort they endured. Managers of this kind need an adviser or counsellor, and fortunately a new kind of business engineer has sprung into existence to meet the new emergency. But here again we must be careful not to pick up the wrong bottle in the dark.

First of all must come the desire for real coöperation, the desire to have the men take a real interest in the shop and its work. Next the manager must try to see things from the workers' point of view. He must try to see how things would appear to him were he in the shop instead of in the manager's office; to see how far he could or would be interested in anything but quitting time and pay day if he were merely a number on the payroll who could be fired at a moment's notice at the whim of a dyspeptic foreman.

Would he as a workman be content to have all the rules of his coming and going made for him without consultation or consideration of him as a human being at all? Would he enjoy having his first week's pay held by his employer until he left his job as is done in so many shops?

The feeling created by these things have probably never occurred to him as manager; they would appear very differently were he on the other side. And it is only by getting this other side that real coöperation and mutual interest can be acquired. The question of the method of payment alone has a greater bearing on shop harmony than many realize.

When a man has earned his week's pay he wants it. In most cases he needs it, as few have much surplus, especially if they have had a lapse between jobs. Loan sharks and pawnbrokers have waxed fat from men's necessities due to their needs. All realize the necessity of time to make up a payroll, but men object to the entire week's pay being held up on this account. Again those who realize how interest on deposits count up are very apt to do a little figuring as to the interest on thousands of dollars held up for a full week.

Then too men resent being treated like cattle when being paid off. Having earned the money they object to having to almost beg for it afterward. They feel that unless the management wanted their labor more than it wanted the money they would not have been hired, and believing that fair exchange is no robbery they feel that they should not be subjected to petty annoyances in getting what they have already earned. They object to standing in line like paupers at a soup kitchen for long and weary minutes after working hours, and often in the cold or rain, to get what belongs to them.

Some shops are finding that careful attention to this one detail has proved an excellent tonic in the matter of getting coöperation and loyalty. This human touch added to the cost system does much to make men forget other annoyances. One large concern devised a plan which divides the shop into groups of suitable size and pays off each group in its own department and on the company's time without fuss or bother or subjecting men to humiliating experiences. This firm insists on its paymasters being really human and not handing out the pay envelopes as though they were meant to be thrown to the lions in the zoo.

Other little human touches to take care of emergencies that arise, even in workmen's families, do much to create a bond of sympathy between the men and the management. Little accommodations that may even jar the workings of an iron-clad system occasionally often pay big dividends in good-will and real coöperation and loyalty.

Business needs good advice regarding the dealings with labor in these days of readjustment. But it wants to be very sure of its advisers and the brand on the medicine bottle. Patronizers or paternalism is not wanted—just plain, sensible personal relations, remembering that both sides are human, both sides liable to error and that all the brains are not in the office or even in the planning department.

Putting oneself in the other fellow's place, remembering that autocracy is not in style these days, that even its great exponent's (W. Hohenzollern) moustache is no longer turned upward, and that the shop which can obtain and utilize all the brains in its employ has every advantage over the rest, all point to the bigger problems of the present-day manager.

Beware of the quack doctor of any school, no matter how long he may have had his shingle swaying to the breeze. Consult the best specialists and don't swallow any medicine in the dark. The best tonic is common sense, even though we need some one of broad vision to show us the way to use it.

US
ARMY ORDNANCE NEWS

History of the Aberdeen Ordnance Proving Ground—II

BY MAJOR F. P. LINDH

The second installment of this history tells of some of the hardships of the early days of construction and the struggles that were made to overcome the difficulties. The organization adopted to handle the proving ground is described and some of the achievements of the various departments are recounted.

THE taking over of 35,000 acres of land naturally involved so many differences of opinion between the owners and the government that a commission of four disinterested men was appointed to handle the various appraisal problems which included everything from the value of swamp land to the losses entailed by the stoppage of hunting privileges. Eventually about three and a half million dollars were spent in acquiring the reservation and a three-mile right-of-way for a railroad to connect with the Pennsylvania at Aberdeen. It was discovered that only a few of the existing buildings could be used as most of them were in dangerous positions. This simplified the general plan somewhat as it meant starting from the bottom without any piecing and fitting. Plans for the structures that were most needed were obtained from the quartermaster and medical corps, and also from arsenals and manufacturers, and construction was begun as soon as the necessary surveys were completed.



THE 9.2 IN. HOWITZER

As most of the large contracting firms of the country had their hands full with other government work it was decided to give the contract for construction to a local firm that was familiar with the conditions. This firm worked under a contract based on the sliding profit scale used in the quartermaster corps and its operations were supervised first by Major W. R. King and later by Major A. B. Roberts. The conditions under which the contract was carried on were difficult in the extreme. The laborers employed by the contractor had to commute from Baltimore while the civilian employees of the proving ground traveled from Havre de Grace. The trains were always overcrowded and generally at least an hour late due to the severe winter weather. The range observers who worked down the bay spent most of their time getting to and from their posts and obtained on the average about six hours sleep. The officers at first slept on desks in the flimsy office building as the quarters had neither light, heat nor water. When the power house was put in operation conditions were hardly improved because the water pipes were in a chronic frozen state. A story widely circulated was to the effect that an officer awoke one morning to find his room unusually warm; delighted at this and curious as to the reason he discovered that the water which he had left running the night before had spread over the floor and filled up the gaping cracks with solid ice which shut out the wintry breezes.

When spring came, the thermometer rose and the ice melted but this only meant a different kind of trouble. The latter was in the form of a mud developed by the prolonged thaw of the heavy snow, which was bottomless, glue-like and apparently permanently wet. No vehicle could be moved except a tractor. Horses and mules were stuck frequently even on the main street of the camp and in one instance a mule got in so deep that he had to be shot. Men fared little better and some required the aid of a team of horses to extricate themselves. The only casualties during this condition were those suffered by official dignity.

By April as the camp began to take shape and permanent structures were considered the gloom was somewhat lifted. The hospital, many barracks and a few office and stores buildings were in use and four ranges were in operation for different types of firing. A frame power house supplied water and electricity for the camp, and an officers' mess and a post exchange were in full swing. The roads became passable and the railroad connection to Aberdeen was open for traffic. Up to this

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THE FIRST CASUALTY

time construction had been hampered by the necessity of providing for immediate needs before commencing permanent accommodations. Now, however, conditions had reached a stage where it was possible to start a brick storehouse and an instrument building. At first only the lighter guns were used at Aberdeen because of their relative mobility, the larger ones being left at Sandy Hook. Range firing began with the 2.95 in. mountain gun but the danger to observers of other firing and the difficulty of spotting the shots in the snow and underbrush necessitated a change to the old practice of firing over water. A fine residence about three miles from the main battery and situated on the shore line was chosen as a headquarters and connected by telephone with four range towers which were located by surveying across the ice. As the only transportation was by mule team the firing was carried on under great hardships but sufficient work was done by the end of March on the 75 mm. Bethlehem and 4.7 in. guns to provide the requisite data for range tables which were urgently needed by the artillery.



A WING OF THE HOSPITAL

One of the greatest difficulties encountered in early proof work at Aberdeen was the lack of suitable chronographs or velocity instruments. The standard type which had been in use everywhere for years took too long to complete and the supply was totally inadequate. As a result it was decided to devise a new instrument and the problem was turned over to Captain A. L. Loomis who, with the aid of Dr. Klopsteg of the Bureau of Standards, carried through researches and experiments which resulted in the Aberdeen Chronograph. This instrument was developed in a surprisingly short time and its design and immediate successful installation on a large scale at Aberdeen must be rated as a notable achievement.

The trench warfare range was a particularly interesting project because of the new type of weapon and the lack of precedent in the Ordnance Department for its use and testing. The guns tested here varied from the Stokes mortars and the 8-in. Livens projectors which are simply gas pipes closed at one end, to the 11 in. Sutton mortar which is an original and clever English weapon with a range of 4,000 yd. Rifle grenades were also tested in large quantities.

In May and June the 5 and 6 inch and the anti-aircraft guns were sent down from Sandy Hook and at about the same time the first of the new model 75's arrived for exhaustive tests. The English system of mirror position finders for the accurate location of shrapnel bursts high in the air was installed and with this apparatus the first accurate range firing of anti-aircraft guns in the United States was performed.

The administration of the Aberdeen Proving Ground was conducted by a staff of officers commanded by Colonel William A. Phillips, a regular army man with a long service record and a reputation as an expert on explosives. Six departments were formed called Administration, Construction, Proof, Military, Property and Service, each under a major who divided his work into sections headed by captains or majors. Civilians were employed for advisory and special duties but the control was entirely in the hands of officers. On Christmas, 1917, the operating staff included some two score officers but by April this number had grown to 120 and to over 300 at the time of the armistice. There were 1,130 enlisted men in April and 4,800 in November, while the civilian staff grew from 650 to 900. As far as possible the work was done by the enlisted men to maintain the military character of the post and they did everything from truck driving and farming to army paper work. Many of the civilians among whom were stenographers, machinists, electricians and clerks, came from Sandy Hook where they had had previous experience in ordnance testing work and the first enlisted men were drawn from the same source. Later demands of course were far in excess of the capacity of this supply and the second large contingent was taken from organizations recruited by voluntary enlistment to establish ordnance bases overseas but which were disbanded after changes in plans had postponed these projects. Most of the later recruits came from among



A COMMON OCCURRENCE ON MAIN STREET IN SPRING

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men rejected at the large camps for overseas duty. The post band, the Y. M. C. A. hut and the post exchange did their best to brighten the rather arduous duties of the men. A weekly newspaper called the "Rapid Fire" was started and proved a success.

The hospital has been one of the most indispensable features of the proving ground as the severe weather of the first winter and the hazardous nature of the work made sickness and injury frequent. About 400 patients a month were admitted when the work was in full swing and the present capacity is 225. The present buildings of the post are arranged in ten groups; the headquarters group composed of the barracks, hospital and office buildings; the officers' quarters group on Plum Point; the utilities group containing the power house, instrument building, machine shop; the main battery group of ammunition and artillery repair sheds, chronograph buildings and powder magazines; the group of civilian barracks at the head of Swan Creek, the aviation field, trench warfare, detonating and water ranges and the village of Old Baltimore near the bombing field. In addition to these there are sixty houses in process of erection at Aberdeen to be rented or sold to permanent Ordnanee employees.



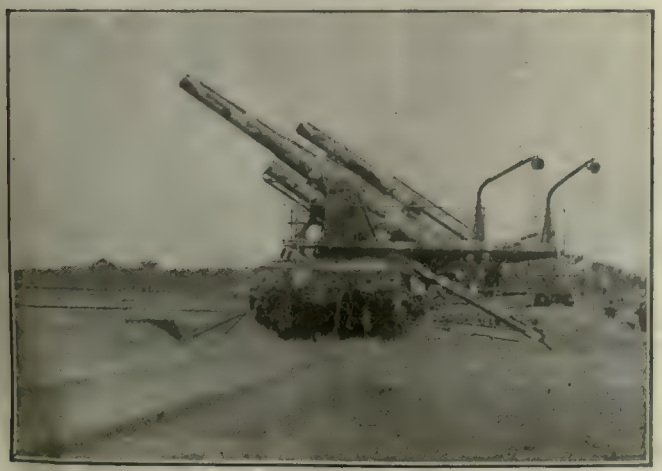
THE BEST WAY TO ELIMINATE DRAFTS AT ABERDEEN

The water supply of 1,000,000 gallons per day is drawn by air lift from wells dug on the reservation and stored in a large reservoir and several tanks. The normal pressure is 50 lb. which can be doubled in case of fire. The quarters and offices are supplied with all modern conveniences, including hot water. The central buildings are supplied with steam heat and electric light from the power plant but the outlying ones are independently supplied. Most of the power will be used by the machine shop which is equipped with heavy cranes for handling the big guns. A large plant has been erected to take care of the sewage disposal.

There are now about 30 miles of railroad on the reservation with two freight yards and a connection with the Pennsylvania main line. The rolling stock consists of 10 locomotives and 25 cars, some of which, notably the "General Rodman" locomotive, came from Sandy Hook. The post has its own telegraph office, post office, railroad station and telephone exchange, all operated by enlisted men or department employees.

The garage has been one of the most useful and at the same time most maligned institutions on the grounds. Before the railroad was built its automobiles provided the one practicable means of transportation to the outside world as well as to the outlying activities, and even after trains were in operation there were more calls for cars than could be answered. Operation of the cars twenty hours a day through real mud over country roads resulted in constant need for repairs, while the complete lack of facilities and the inexperienced personnel rendered repairs difficult. Consequently, a proving ground car could usually be told afar by its dilapidated appearance, its missing cylinders or its absence of lights. Nevertheless any kind of car was a hundred times better than walking four miles to Aberdeen in the spring of 1918 as many an enlisted man will testify. Besides for a major a real car was forthcoming on request. Vigorous criticism would be lavished on the garage when an officer arrived at Aberdeen at 4:30 a.m. Monday morning after a week-end trip to find no car available, and two hours to wait or four miles to walk.

In addition to its passenger cars the garage maintained an extensive truck service, operating truck trains to Baltimore, Philadelphia and New York to obtain supplies for the quartermaster or the post exchange and to convey Ordnance materials to and from factories, arsenals and points of embarkation. The drivers of these vehicles were enlisted men of many types; a hotel owner whose chauffeur took him about in his own car when he was on furlough, a New York taxi driver, a racing chauffeur, and farmer boys who had never



8-INCH HOWITZER ON TRACTOR MOUNT



155 MM. GUN ON TRACTOR MOUNT

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8-INCH RAILWAY GUN AT FULL RECOIL

driven a car before. The most interesting feature of the garage work has been the operation of powerful tractors in hauling guns about and in extricating trucks from mud holes. It is remarkable to see the ease and rapidity with which a small tractor can come up to a big truck, pivot about, hitch up with a chain and start off with the truck, however deeply the latter may be imbedded in mud. At present the garage operates about 70 touring cars and 80 trucks.

The Quartermaster Department does a large business at Aberdeen. In addition to supplying all the enlisted personnel with food, clothing and pay, and performing other routine duties, it has carried on extensive farming operations on the quieter portions of the ranges. Many fields were planted with winter wheat by the farmers in the fall of 1917 and many other fields were sown by soldiers in the spring of 1918. Some 1400 tons of hay and straw and 2,000 bushels of wheat were harvested on the reservation up to July, 1918. In addition plentiful fruit crops were gathered, notably several thousand baskets of peaches from Poole's Island. These crops were either used on the post or sold in Baltimore markets for the benefit of the Government. Over 1100 tons of hay and straw and 700 tons of grain were used by livestock on the post during the year of 1918.

Forestry and game preservation agencies have been considered, but little work has been done in these lines as yet. No hunting is allowed on the reservation and it is hoped that the proving ground will form a very valuable game preserve since peace time firing will not disturb wild life to any great extent. The fishing industry in the Bay is somewhat interfered with by the maintenance of a restricted area along the western shore of the Bay, where the firing is done, and by the killing of fish owing to the bursting of high explosive shell on the water, but these interferences will largely diminish under peace conditions. Fortunately the deep water channel for shipping is very near the eastern shore of the Bay and the western portion of the Bay is shallow, so that commercial shipping is not affected.

In July, 1918, the proof work, or actual firing at the proving ground took a sudden spurt so that over 50,000 rounds were fired that month, and consequently a larger number of firing officers was required. In recognition of the great volume of firing that was to be done and of the necessity for its rapid conduction, the Ordnance Department had started several other proving grounds to perform routine work of powder testing and of proof firing guns for acceptance, leaving the experimental work and the major caliber guns to Aberdeen. In this way all powder tests for the 75 mm. gun were actually performed by Carney's Point Proving Ground which is adjacent to the Du Pont Powder Co.'s works. The development of gas warfare was done at Lakehurst, and the proof firing of 75 mm., 4.7 and 155 mm. guns and howitzers was largely performed at the Savannah, Scituate and Erie Proving Grounds. Most of these new firing grounds were late in starting and many officers whose experience at Aberdeen rendered them particularly valuable to the new posts were transferred there.

In addition to these calls for more officers, the A.E.F. required some for duty overseas, as the practical knowledge of an Aberdeen proof officer was highly valued in France. These demands for commissioned personnel were met at Aberdeen by the Ordnance School, which



240 MM. HOWITZER

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received enlisted men as candidates from many Ordnance posts, gave them three months' intensive training and commissioned them as second lieutenants. Over 150 officers were so commissioned during the war.

A Railway Artillery School which, like the Ordnance School, had first existed at Sandy Hook, was transferred to Aberdeen when the railway guns began to arrive there. In this school selected enlisted men were trained in the care and handling of heavy guns and then sent overseas as repair units. Seventy-five men went overseas from the school in three batches.

PERSONALS

Second Lieut. Arthur Littman has left the service. His home is in Richmond, Mo.

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Capt. H. C. Lea has been discharged. He was formerly employed as an engineer by the Municipal Authorities at Aspinwall, Penn.

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Capt. Chas. F. Derby, who was commissioned in December, 1917, has left the service. He attended Drexel Institute and is a civil engineer.

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Lieut.-Col. George J. Siedler has been discharged. He is a graduate of Princeton University and was formerly employed by the Vim Motor Truck Co.

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Second Lieut. James P. Williams, who was formerly employed by the Southern Millwork Co., Orlando, Florida, has been discharged. He is a civil engineer and a graduate of Yale University.

* * *

First Lieut. Stanley L. Richter, who was commissioned from Plattsburg in November, 1917, has left the service. He is a graduate of Columbia University and practices law in New York City.

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First Lieut. Karl M. Knapp, who was commissioned in December, 1917, has left the service. He attended Valpariso University and was formerly employed by the Haynes Stellite Co., Kokomo, Ind.

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Lieut.-Col. Henry O. Bernhardt, who was commissioned in January, 1918, has left the service. His home is in Ypsilanti, Mich., and he was formerly employed by Harroun Motor Corporation, Hayne, Mich.

* * *

Maj. O. K. Wright, who was commissioned from Fort Snelling Training Camp in August, 1917, as First Lieutenant, has been discharged. He was formerly employed by M. K. Shafer & Co., Omaha, Neb.

* * *

First Lieut. James C. Patterson has left the service. He is a mechanical engineer and a graduate of the University of Pennsylvania. He was formerly employed by the Standard Cotton Co., Philadelphia, Penn.

Second Lieut. Chauncey McC. Ogden has been discharged. He enlisted in March, 1918, and is a graduate of Colgate University. He was formerly employed by the Firestone Tire and Rubber Co., Akron, Ohio.

* * *

Capt. Harold A. Brooks, who, before entering the service, was employed by the Potomac Electric Power Co., has been discharged. He is an electrical engineer and a graduate of the University of Sydney, Australia.

* * *

Capt. Charles E. McQuigg has left the service. He is a mining engineer and a graduate of Ohio State University. Before entering the service he was associate professor of metallurgy, Pennsylvania State College.

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Capt. Harry H. Sherman of Milford, Mass., has been discharged. He is a mechanical engineer and a graduate of Worcester Polytechnic Institute. He was formerly employed by the Webb Granite Co., Milford, Conn.

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Capt. Harold P. Hobart, who was commissioned in November, 1917, has been discharged. He is a graduate of Yale and a mechanical engineer. He was formerly employed by MacIntosh, Hemphill & Co., Pittsburgh, Penn.

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First Lieut. George M. Humphreys has been discharged after nearly sixteen months' service. He is a graduate of Yale and has been employed by the Cleveland Hardware Co., Cleveland, Ohio, as production engineer.

* * *

Capt. John J. Ehrhardt, who was formerly employed by the Allied Sugar Machinery Corporation, 120 Broadway, New York City, has been discharged. He is a mechanical engineer and a graduate of Stevens Institute of Technology.

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Capt. Edward F. Randolph, who was commissioned in November, 1917, has been discharged. He is a graduate of Stevens Institute of Technology and was formerly employed by the General Electric Co. His home is in Glenridge, N. J.

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Capt. Joseph C. Andrews, recently discharged, entered the service as First Lieutenant in November, 1917. He is a Cornell graduate and a chemical engineer and was formerly employed by the American Hardware Corporation, New Britain, Conn.

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First Lieut. Walter H. Schleck recently discharged, was commissioned from Fort Sheridan Training Camp. He is a graduate of the University of Wisconsin and has specialized in factory accounting. He was formerly employed by the Fountain Specialty Co., Grand Haven, Mich. His home address is 706 Monroe Ave., South Milwaukee, Wis.

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Capt. Frank Brookfield, recently discharged, was formerly with the Brookfield Glass Co., 2 Rector St., New York City. He is a graduate of Yale.

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Maj. William S. Conant, who was commissioned as Captain in June, 1917, has been discharged. He is a consulting engineer with offices in Detroit, Michigan.

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Second Lieut. William A. White, Jr., who was employed by the Gamble Motor Car Company, Toledo, before enlisting a year ago, has been discharged.

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First Lieut. George W. Fowler has been discharged. Before being commissioned in January, 1918, he was employed by Evans & Howard Fire Brick Co., St. Louis, Mo.

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First Lieut. Rudolph H. Fox, who was commissioned in August, 1917, has left the service. He is a graduate of the Massachusetts Institute of Technology and is a mechanical engineer.

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First Lieut. Sidney Coolidge, Jr., has left the service. He is a graduate of Harvard University and was employed by the Union Tool Co., Torrance, Calif. His home is Concord, Mass.

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Capt. George E. Brown, recently discharged, was formerly employed by the Aluminum Co. of America. He is a graduate of Yale and was commissioned First Lieutenant in August, 1917.

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Capt. Mark H. Robinson, who was employed by Eaton, Crane and Pike, Pittsfield, Mass., before entering the service, has been discharged. He was commissioned First Lieutenant in August, 1917.

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First Lieut. Philip J. Degnon, who was formerly employed by the Rowe Co., Plantsville, Conn., and was commissioned in January, 1918, has been discharged. He is a graduate of Manhattan College.

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First Lieut. Harry D. Balsinger, recently discharged, was formerly employed by the American Steel Foundry, Sharon, Penn., as production engineer. He is a graduate of Carnegie Institute of Technology.

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Capt. Herman L. Wittstein, who entered the service as a First Lieutenant in June, 1917, has been discharged. He was formerly Works Manager of the Standard Fuze Corporation, Paulsboro, N. J.

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Second Lieut. Herbert L. Greiner, who entered the service in November, 1917, has been discharged. He attended Drexel Institute and was formerly employed by Niles-Bement-Pond Co., as machine designer.

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Capt. Samuel W. Forder, lately discharged, was commissioned in June, 1917. He is a graduate of Washington University and a chemical engineer. He has been doing consulting work with offices at St. Louis, Mo.

First Lieut. Gordon B. Ellicott, who was commissioned in August, 1917, has been discharged. He is a graduate of Williams College and a textile engineer. He was formerly employed by Cheney Bros., South Manchester, Conn.

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First Lieut. Carl A. Kuhr, commissioned in January, 1918, has been discharged. He has been connected for many years with the automobile business, particularly the racing end of it. His home address is 3400 Bishop St., Cincinnati, Ohio.

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Second Lieut. Glenn A. Hammon, who has been discharged after eleven months' service, is a mechanical engineer and a graduate of Stanford University. He was formerly employed by the Hammon Engineering Co., San Francisco, Calif.

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Capt. Stuart Thomson, who was commissioned as First Lieutenant in December, 1917, has left the service. He is a chemical engineer and a graduate of Harvard University. He had been employed by the General Electric Co., Schenectady, N. Y.

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Capt. E. R. Baird, who entered the service as Second Lieutenant in August, 1917, has been discharged, and will return to the Union Gas and Electric Co., Cincinnati, Ohio, by whom he was formerly employed. He graduated from Yale as an electrical engineer.

* * *

First Lieut. John W. Elmes of Brooklyn, N. Y., was discharged on Feb. 20. He is a graduate of New York University and has had many years' experience in the New York National Guard, before entering the Federal service. He is a member of the New York Bar.

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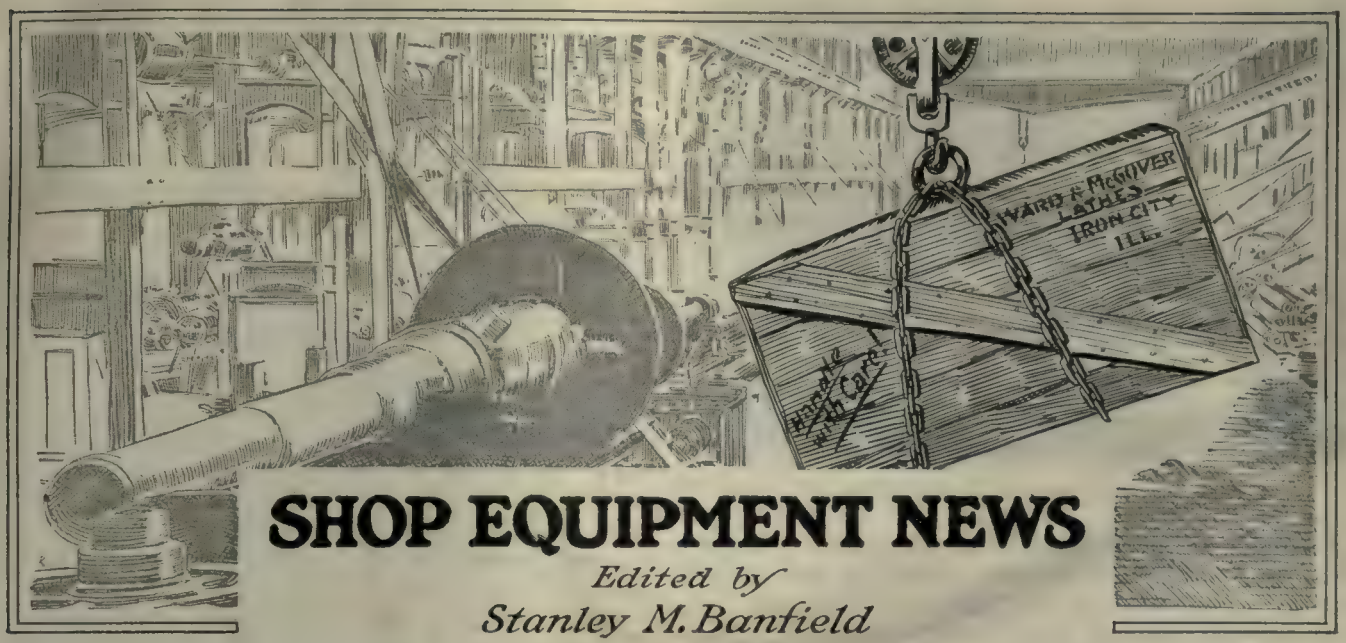
First Lieut. William S. Doscher has been discharged after sixteen months' service. He served nearly twenty years in the New York National Guard, and was with the American Express Co., 65 Broadway, New York City, before he was commissioned in the Ordnance Department.

* * *

L. S. Gatter, who as a First Lieutenant, was head of the Planning Section of the Inspection Division, Ordnance Department, U. S. A., for over a year in Washington, announces that he has become associated with William O. Badger, Jr., in the practice of law at 100 William St., New York City.

* * *

Two former employees of the General Electric Co. at the Pittsfield, Mass., works were recently discharged. They are Capt. Irvin P. Thompson, who was commissioned in February, 1918, and First Lieut. Elihu G. Sibley, who was commissioned in June, 1918. Captain Thompson is an electrical engineer and a graduate of Pennsylvania State College, while Lieutenant Sibley is a mechanical engineer and was graduated from the University of Michigan.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Kent Bar-Stock Racks

The Kent Machine Co., Kent, Ohio, has just placed on the market two types of bar-stock racks. Fig. 1 shows the unit for long stock, while Fig. 2 shows the unit for short lengths. Referring to Fig. 1 the arms for long stock are made in single sectional units which may be spaced any distance apart to accommodate the length of stock to be held. Each one of these units is made up of a number of interlocking sections so that any number of arms and any height of unit may be easily obtained. The base is heavy and projects out beyond the longest arm, thus giving stability and keeping the center of gravity of the load within the area of footing. It will also be noticed that the base is provided with a projection at the outer end in order that it may also be used for holding stock. The spacing of the arms is varied by using interlocking space collars and large spaces may be obtained for light bulky material, such as tubing. All arms and spacing collars interlock with the base and no set screws or holding devices are required in the assembly. The holes in the sectional pieces are bored to fit the vertical spindle and the interlocking devices are fitted so that there is practically no lost motion. With the combination of adjustable spacers and arms furnished, practically any rack size can be easily secured.

Fig. 2 shows the three arm sectional interlocking unit complete in itself for the storage of short lengths of stock. The construction of this unit is practically the same as the preceding one except that the arms are provided with three resting points for the stock instead of one, in order to conveniently handle the short lengths. Both types of racks are constructed of cast iron, and it is stated that the arms are of such strength as to carry all the material that can be stored on them.

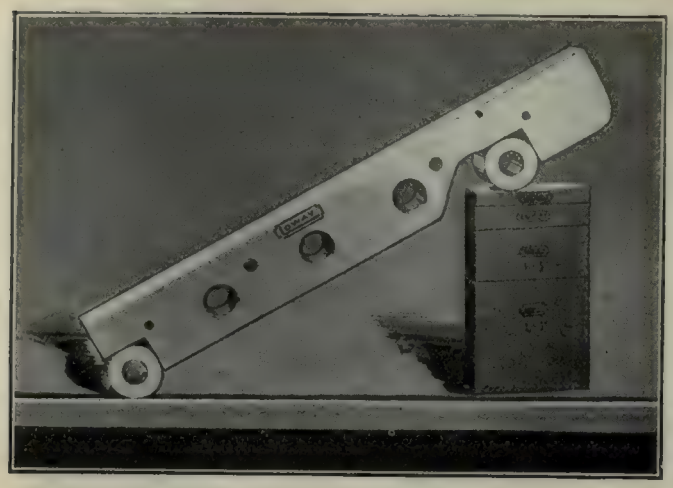
"Loway" Sine Bar

The A. F. Way Co., Inc., Hartford, Conn., has just placed on the market the sine bar shown in the illustration. The material used in the construction of the bar is all heat treated. It will be noticed that the two rolls on which all measurements are made are inserted





FIG. 1 AND 2. STORAGE RACK FOR LONG BAR-STOCK AND RACK FOR SHORT BAR-STOCK



THE "LOWAY" SINE BAR

in two right angle notches cut in the side of the sine bar. These rolls are held in place by a small coil spring passing through the side of the roll and into the sine bar, the ends being held by small pins. This construction is used to prevent any distortions and to keep the rolls in place at all times. The bar is provided with three holes, by means of which it can be attached to an angle plate. A feature of the outfit is the table of vertical setting constants, which gives at a glance the distance the high end of the bar must be raised in order to give any desired angle, this distance generally being secured by means of size blocks.

Presto Thread Grinding Attachment

The Presto Machine Works, 124 Pearl St., Brooklyn, N. Y., is now marketing the thread grinding attachment shown in the illustration. The device is intended to be attached to a bench lathe and its range on external work is up to 6 in. outside diameter and on internal work up to 4 in. in diameter. It is a development of the machine shown on page 267, Vol. 47. The attachment is so arranged that the wheel is permanently located with relation to the center line of the work and adjustments for diameter and depth of cut do not disturb the original setting of the head. Fig. 1 shows the machine performing a grinding operation, while Fig. 2 shows the machine with the wheel-truing attachment in place. The wheel is dressed after being adjusted to the helix angle and the dresser is so arranged that it can be swung out of the way when not in use. The spindle is mounted in a quill provided with adjustable bearings, the entire assembly of spindle, quill and bearings being easily removed from the machine. The bearings are bronze, tapered on the outside with a cylindrical hole for the spindle. The thrust is taken care of by a collar on the spindle which bears against a hardened-steel thrust washer, and the construction is such that adjustments to take up wear are easily made. All adjustments are equipped with accurately divided collar nuts to facilitate minute adjustments and a thorough lubricating system is provided.

Anderson Bench Type Die-Forming Machine

The Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn., has just placed on the market an improved form of die-forming machine. One of the very important features has been the incorporation of ball bearings on the main spindle. The lever at the front of the machine for releasing the cutter has been removed and a drawbar substituted allowing the chuck to be tightened by means of a wrench. This is said to make a very much more rigid construction. In order to hold the spindle while tightening or loosening the drawbar, a locking pin has been provided, which is held in a suitable opening in a portion of the main frame, just above the lower bearing at the front. This engages a hub forming part of the spiral gear and by inserting the plug, the spindle is held rigidly. The base of the machine has also been lengthened somewhat in order to secure a more rigid motor mounting. The motor is set on a block having the under face in the form of an inclined plane so that the height or distance from the bottom of the motor to the shaft center can be readily adjusted by moving the motor up or down the plane as necessary. Both bench and floor type of machines can be furnished. In the floor type the switch for starting and stopping the motor is connected to the treadle shown at the right. A spring that may be

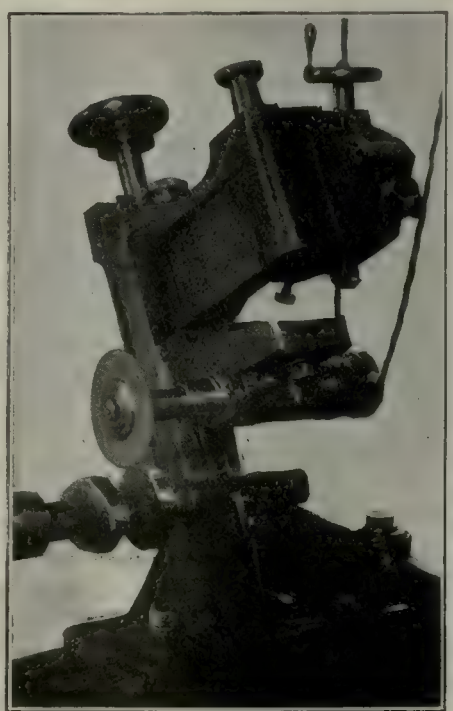


FIG. 1. MACHINE PERFORMING A GRINDING OPERATION

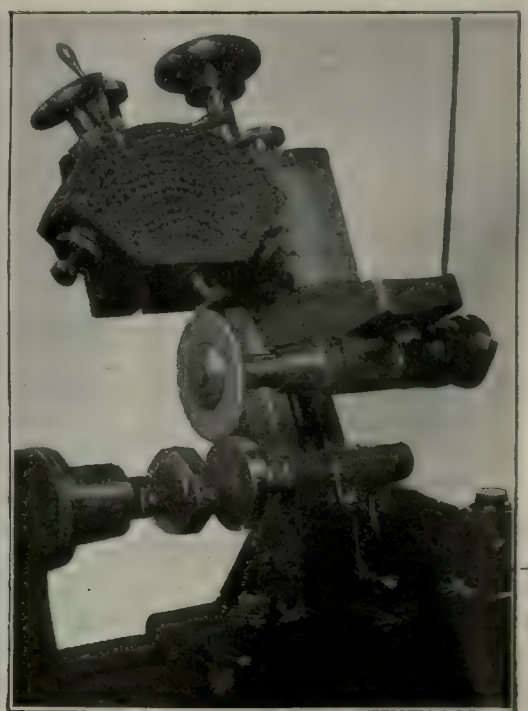
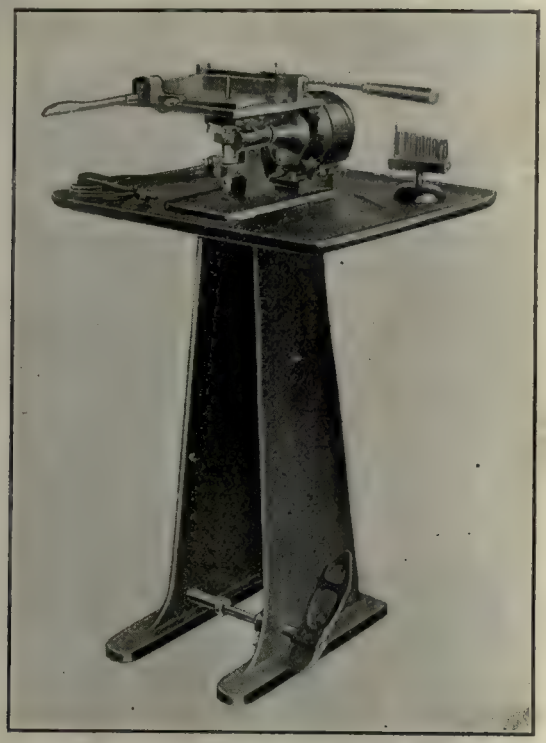


FIG. 2. MACHINE WITH THE WHEEL-TRUING ATTACHMENT IN PLACE

seen at the left end of the treadle shaft, serves to return the treadle to normal position. The switch is so arranged that a downward pressure on the treadle will start the motor. The foot can be removed, the treadle returning to normal position and the machine continuing to run until another downward pressure is made.



ANDERSON BENCH TYPE DIE-FORMING MACHINE

Capacity, cutters, $\frac{1}{16}$ to $\frac{5}{16}$ in. in diameter; thickness of dies worked, $1\frac{1}{2}$ in.; working surface of table, 8 in. square; height from bench over all, 12 in.; main spindle, chrome nickel steel hardened and ground; main spindle bearing, S.K.F. radial ball; chuck, draw back, with maximum capacity of $\frac{1}{4}$ in.; weight of bench type with motor, 85 lb.; weight of floor type, with motor, 290 lb.; regular equipment consists of machine equipped with 110 or 220 volt alternating current, 60 cycle single phase motor, or 110 or 220 volt direct current motor with flexible cord attachment, plug and switch, portable tool rack, one set of 12 cutters, pivoted universal feed lever and necessary wrenches.

This feature obviates the necessity for the operator holding his foot on the treadle all the time. All wiring is on the inside of the pedestal and is protected by conduits.

Arrow Thread-Lead Testing Device

A device, shown in Fig. 1, for testing the lead of thread gages has been constructed by the Arrow Tool Co., 200 Cannon St., Bridgeport, Conn., primarily for the purpose of testing the gages which have formed a large part of their own shop product and also with the intention of manufacturing it for the market as soon as business conditions warrant.

The base *A* of the machine is of cast iron ribbed on the under side like a surface or bench plate, with a special large rib running the full length of the casting under the point where the T-slot for the center supports is afterward milled.

The slideway *B* that carries the measuring parts is of mild steel, which after machining, is pack-hardened, ground and lapped to size. The slides *C* carrying the gaging pieces, and *D*, on which is mounted the micrometer measuring head, are carefully fitted to this slideway *B* and provided with means of clamping them in place.

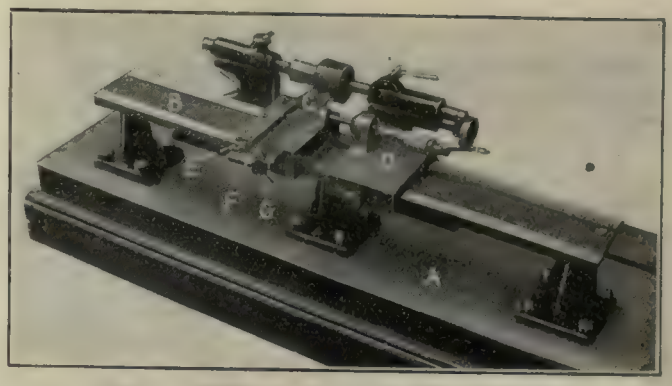


FIG. 1. THREAD-LEAD TESTING DEVICE

The gaging pieces *E* and *F* and the spacer *G* are of tool steel $\frac{1}{4}$ in. thick and $\frac{1}{2}$ in. wide and are closely fitted to the slide *C*. When they are arranged with the pieces *E* and *F* adjacent and the spacer *G* to the right, as shown in the cut, the gaging points are $\frac{1}{2}$ in. apart. With the spacer *G* between the gaging pieces this distance is 1 in. The advantage of this adjustment is obvious, as progressive errors will be more readily apparent when the gage to be measured is long enough to permit the wider spacing.

To use the device the gage to be tested is placed on the centers and tightened. One of the gaging points is then brought into contact with the gage, observation being made against a piece of white paper or other reflecting material laid on the base of the machine.

After this adjustment is made the slide *C* is clamped, and the measuring spindle of the micrometer head, which has been brought to some predetermined reading—say 0.100 in.—is brought into contact with the raised hub on slide *C*, and slide *D* is then clamped. The micrometer spindle is then turned back, the first gaging point is withdrawn and the second one advanced to contact with the thread. The gage under test must not be allowed to rotate on the centers. If any error exists it must be met by moving the slide *C* along the slideway until the second gaging point is in contact. When this is done the variation from true lead is measured directly plus or minus with the micrometer.

The top surface of the gaging pieces are in the same plane as the centers which support the work to be gaged. The points are beveled back sharply on the under side, so that the contact is virtually a knife edge and very minute errors are easily detected. All parts of the device are made with the utmost care, every essential part being lapped with the same degree of precision that is accorded to gage work.

Fig. 2 shows a peculiar light effect, advantage of

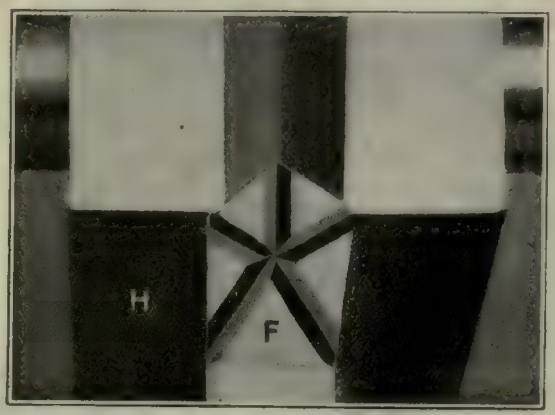


FIG. 2. THE SHADOW BANDS

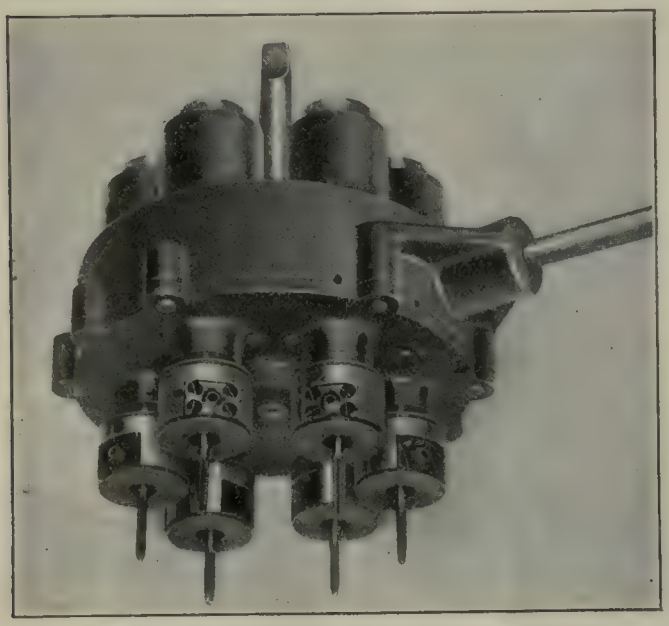
which may be taken in testing the gaging points of the machine. In this figure *H* is a gage, sometimes known in shop parlance as a "rat trap," which is used for setting a threading tool to do accurate work. While many of these gages are round, this particular one is square, and as shown in the cut is mounted on an arbor on the centers of the lead tester and set square with the base. *F* is one of the gaging points turned bottom side up.

Attention is called to the five bands of light and shade radiating from the center, which are caused by the reflection of the gaging point in the polished sides of the groove. In pushing the gaging point slowly into contact with the gage the operator may observe these shadow bands closing in very much after the manner of the iris diaphragm used in photographic apparatus, and any departure from absolute truth, being greatly exaggerated, is rendered very conspicuous.

Gaging points are of course provided for each different form of thread to be gaged.

Dorman Tapping Attachment

The illustration shows one of a line of multiple spindle tapping attachments placed on the market by John H. Dorman & Son, 1-9 Bethune St., New York City. The particular device shown is for tapping six



DORMAN SIX-SPINDLE TAPPING ATTACHMENT

holes at one time in ¼-in. sheet steel, 10-32 taps being used. The attachment is intended to be attached to the ordinary drilling machine by means of a taper shank and it is stated that it will tap from six to eight pieces per minute. The case is made of aluminum in order to reduce the weight, and the spindles are gear driven.

Nonferrous Metal Castings by the Morris Process

The Morris Engineering Co., 39 Cortlandt St., New York, is making nonferrous alloy castings under pressure. Some of these castings were tested by the Bureau of Standards and show unusual results. The tests made by the bureau of an alloy made up of 90 parts aluminum and 10 parts copper, on specimens from the same melt, some cast in sand and others by the Morris process, were reported as follows:

"The 10 per cent. copper-aluminum alloy as sand cast showed a normal tensile strength of approximately 20,000 lb. per square inch, with an elongation of approximately 1 per cent. (forged) as compared with tensile strengths of from 35,000 to 40,000 lb. per square inch and elongation of from 8 to 10 per cent. of the same alloy when in the drop-forged condition. The strength of the drop-forging is almost double, the ductility from 5 to 10 times as great and the toughness therefore, from 10 to 20 times as great as that of the sand casting. Hard castings can be produced in sand or in dies, but they are without exception brittle, having very little ductility."

Private laboratory tests made under the company's direction show that an alloy of 60 parts copper, 40 parts zinc and a trace of lead has an ultimate tensile strength of 49,500 lb. per square inch, an elastic limit of 29,750 lb. per square inch and an elongation of 45.5 per cent. in 2 in. An alloy of 86.5 parts of aluminum, 12 parts of zinc and 1.5 parts of copper gave results of 42,700 lb. per square inch ultimate strength, 29,400 lb. per square inch elastic limit and an elongation of 12.5 per cent. in 2 in.

A large order for fuse bodies for the British under specifications which called for an elongation of 7 per cent. in 2 in. in an alloy of 80 per cent. aluminum and 20 per cent. zinc was filled, with only 5 per cent. rejections, and the product showed an ultimate strength of 41,440 lb. per square inch, an elastic limit of 30,400 lb. per square inch and an elongation of 14.47 per cent. in 2 in.

It is claimed that an application of the process can be made to aluminum-alloy gas-engine pistons, reducing the coefficient of expansion by adding a small amount of iron to the aluminum and copper, and that the greater strength of the Morris-process casting would permit of an appreciable reduction in weight.

A System That Didn't Save

By John R. Godfrey

System and standardization are alike in one respect—it's always a question of how far you can carry either one without busting up the whole works.

Now, there's my friend Johnson, who is head of the whole outfit in the biggest shop in town. The war has thrown all kinds of work their way, and having more money than ever before he hired several system sharks to fit him up in the way he should go. And they got busy with a vengeance. You might have thought they were working piecework by the number of forms they devised and wished on the unsuspecting Johnson.

Before he really knew what they were doing to him he was carrying 20 per cent. of his people on the nonproductive list and had had system till he couldn't see. It so happens that his business consists of several departments which are in entirely different fields, and that the men in one field know absolutely nothing about the other.

A little thing like this, however, couldn't interfere with the system of centralization, and all went into the common melting pot. Draftsmen who had special-

ized on fine-instrument work were told that they must handle anything which came along, from voltmeters to boring mills. So the best ones promptly quit because they saw no chance of getting anywhere with such a hashed-up organization.

I happened along with Johnson one morning as he went through the drafting room. One of his best men was busy signing slips, dozens of them, and Johnson asked him what he was doing.

"Complying with the system, Mr. Johnson," he said. "You see I've got to make a few changes on one of the drawings of that XX voltmeter. I used to send a boy for the tracing from our own file, make the change and note it, recall all blueprints, issue new ones, return the tracing to the file and the job was done. It's different now.

"Foolem and Gouger didn't like that system. Said all drawings ought to be in the same file, no matter whether it's a voltmeter or a washing machine. So they've taken our tracings, given 'em serial numbers and had 'em filed along with the boring mills, washing machines and other junk. Sometimes that's the last we see of them—you know how hard it is to file letters



by the thousand and ever find the one you want every time?

"I sent to the drawing files for these tracings yesterday morning—just got 'em. There are 67 in the set, and they are bound together. They haven't taken them apart yet, but I presume they will soon—then we never find over half of 'em. I've got to change one drawing, but I've also got to sign a receipt for every blamed tracing in the binder—67 of 'em—got 23 more to sign.

"Along about noon I'll get to work if they don't spring a new one on me in the meantime. These receipts are only good for three days. If by any chance I can't get this change made in that time I've got to send these tracings back to the central file, send another requisition for them and decorate 67 more pink sheets with my famous autograph before I can finish the job.

"Gives me a lot of practice, and I sure do appreciate writing lessons on your time. I'll either be a star writer or else write so badly you can't read it by the end of the month."

Johnson wasn't happy for some reason or other. Didn't know just what to say, but knew something was due, so he told the draftsman not to get impertinent, but to give the new system a chance. They'd get it straightened out in due time.

"Nothing doing, Mr. Johnson. I've had a good job and I've enjoyed working for you. But instruments are my specialty and I've spent a lot of time studying 'em. I don't propose to switch off on washing machines, and I'm not keen on spending half my time trying to make a fool system "function." Guess that's the right word; it's what Mr. Foolem uses all the time.

"I'm getting through on the first and I'm hoping to tie up with someone who thinks more of getting out product than in making a cut-and-dried system fit every business. I hope you've made a bunch of money the last couple of years, because you'll need it before the system gets through with you. You always were tender-hearted and I suppose you felt that the poor suckers had to make a living somehow."

Johnson would have been happier if I'd been somewhere else, but he had to make the best of it of course. So to get me away from the wail of the draftsman he took me over to the new shop where he'd been making some new meters on a Government order. He knew things had been going well here and he wanted me to see a real live department. But the blight had struck while he was away and he was doomed to disappointment here also.

He had put a young chap in charge who labored under the idea that the main idea in running a shop was to get out product rather than to bolster up a weak-kneed, if elaborate, system. He had worked hard; had laid out the whole plant; had nearly 500 people at work and only had a small office force with 11 people all told on the nonproductive list.

He had a live little organization with every man on his job, with an apology for a system which managed to keep track of supplies, production and shipping so effectively that they had got out something over a thousand meters a day, much to the Government's surprise and gratification.

Johnson didn't know that the germ of the F. & G. outfit had flown over to the new plant and there was a surprise in store for him.

This shop with its small office force didn't fit into the great and only system of F. & G., and quite forgetting that this was the only department which was



really earning a real live dividend, they ripped it up the back and installed the system. This I suppose is on the basis of "what's a dividend anyhow among friends as compared with a real 18-carat system."

Things were not going well at all. Part of the plant was idle for want of stock. The system was there all right, but the stock clerk told Johnson that it took the requisitions so long to break its way through all the channels of red tape that the stock ran out before the purchasing agent had asked for a quotation.

"Never happened before, Mr. Johnson. Before they

busted up our plan of ordering material we had it ready every time."

Johnson found some other changes also, none of which seemed to be just to his liking. The office space had been enlarged to three times its former size. In place of 11 people there were now 36, a number of them high-priced individuals who never let a little thing like production stand in the way of operating a 12-cylinder system.

But while the office force had gone up the production board showed the opposite tendency as to the number of meters shipped per day. Johnson could hardly believe his eyes, but the figures were there. Instead of 1000 meters a day the highest output for the week was under 600 a day, and there seemed to be no improvement in sight—system or no system.

As a matter of fact there was another factor of which the new men with a skin full of system never knew existed. This was the human factor—the most important in the shop. Instrument makers are a temperamental lot as a rule, who will work their head off for a foreman they like or sulk like children when the boss rubs 'em the wrong way. And as the average systematizer knows about as much about human nature as a cat does about corn plasters, the F. & G. outfit



left this factor entirely out of the equation. In the meantime Johnson is paying the bill and wondering how he can save his face and his cash at the same time.

System is a great thing in any business. But you've got to have a few grains of horse sense to know human nature and appreciate its value, and to know when and where to use forms and furbelows and when to dispense with them. The systematizer who does not consider this in the future is going to have hard sledding.

Indispensability

By R. Blondin

In looking over a magazine the other day the advertisement of a correspondence school caught my attention on account of its "scare-head" introduction, "Are you an indispensable man?" and it brought to my mind examples of men who believed that they were "fire-proof."

There was Andrew, the production clerk in our shop, who could tell you right off the bat that pattern A-342 was the base bracket for the electric motor on our No. 3 machine and that if Jones' foundry lived up to its promise made when our requisition 41,144 was sent on January 'steenth, we would receive six castings next week to apply on our work order No. M-etc.

That is just a sample of the way Andy carried records in his head. He surely missed his vocation; he should have been a chess player who blindfolded could take on a dozen opponents at a clip.

Whenever anybody wanted to know what was going on in the shop Andy supplied the information "straight from the bean." Now beans are excellent storehouses for information, but when a man keeps it all to himself he might as well take all of the firm's records with him when he goes home at night. Or if he takes a notion to end his sorrows by plunging into the river he might weight his neck with a few ledgers and card files instead of the proverbial millstone.

Eventually Andy developed a "swelled head," became careless, and at last went in to tell the boss how good he (Andy) was and that if his salary was not increased 50 per cent. or so the company would be minus an indispensable man. Furthermore it was a surprise that his efforts and genius had not been recognized. He was the only man who knew how to find patterns; he was the only person who could give delivery dates and other vital information.

When he was all through airing his grievances and boosting his own stock the boss cut loose and told Andy a few things that he either did not know or did not want to know.

"Young man, do you realize that indispensability does not mean making a secret of your work so that when you are away two weeks, as you were, work is at a standstill simply because you have not been ingenious enough to devise some records for the guidances of those who must carry on your work during your absence? Do you realize that with all your knowledge of what is going on your estimates of production are weeks away from the mark?

"You may be a memory wizard, but even good memories cannot be trusted all the time. You know little about the work you are handling and are trying to cash in on your ability to remember facts. If you had a real desire to be a valuable man you would of your own initiative have kept some sort of record of your activities; you would have devised some scheme by which you could predict deliveries by some method more rational than mere guesswork.

"Please don't forget that your guessing wrong cost us the Armstrong contract and another slip of your prodigious memory caused us to order 40 more of those heavy press frames than we will be able to use in the next two years.

"Now you come to me and call yourself indispensable! You are on a par with the workman who 'soldiers' on a job to make it last. Also you are extremely dispensable and I've made arrangements to have you replaced by a young man who does not rely on his memory but puts things on paper, and when he has systematized the production job so that a clerk can handle the work I've got other work for him."

That was the end of Andy. I admit that for a few weeks we had a tough time of it without the "memory hound," but then, Napoleon lost his job too, and France is bigger and better than ever. *Sic transit gloria mundi!*—which means in plain United States, "Everybody gets his and the world lives happily ever after."



LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors



In 1918 31,512 motor trucks were registered in New York City against 25,078 in 1917, representing a gain of 6434 for 1918. During the same period New York State increased its trucks from 55,402 to 75,268, a year's gain of 19,866, representing 34 per cent. State Secretary Hugo estimates the number of motor trucks which will be registered in the state during 1919 at 115,000, which means an increase of approximately 40,000 trucks.

The Bureau of Standards in Circular 78 shows the result of tests of the use, serviceability, method of application and composition of solders for aluminum. It was found that all soldered joints are subject to rapid corrosion and disintegration and are not recommended except where protection from corrosion is provided. Suitable compositions for solders are obtained by the use of tin, with addition of zinc or both zinc and aluminum within wide limits.

The noninflammable balloon gas, helium, having 92 per cent. of the buoyant effect of hydrogen, is produced on a commercial scale at the Linde and Claude plants at North Fort Worth, Tex., and at the Jefferies-Norton plants at Petrolia, Tex. These plants are operated with a natural gas containing 0.9 per cent. helium by volume, and which is supplied by the Lone Star Gas Co. through a pipe line from the wells at Petrolia, about 100 miles northeast of Fort Worth, for domestic and industrial consumption. The Linde plant produced the first helium on Mar. 1, 1918, and by September had increased its yield to 7750 cu.ft. per day, of 67 per cent. purity, which was later repurified to about 92 per cent. At the time of signing the armistice the first shipment of 147,000 cu.ft. of 93 per cent. helium was on the dock about to be loaded aboard ship.

The annealing of the Hall-Scott airplane-motor cylinders to obtain a uniform hardness of about 30 points on the scleroscope is performed in specially constructed ovens for this purpose, as shown in the illustration. After the cylinders are placed in the ovens the fire is started and the ovens are brought to a temperature of approximately 1500° F. This process requires about five hours. The ovens are then allowed to cool to a temperature of about 200° F., after which the cylinders are taken out. The Hall-Scott airplane-motor cylinders, having an average metal thickness of $\frac{1}{8}$ in., are castings weighing 25 lb. each, yet they develop 30 hp. per cylinder. The water jackets, which are cast integral, are only $\frac{3}{32}$ in. thick.

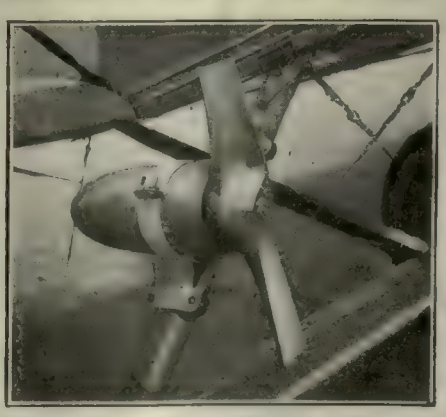


In the application of wireless telephony to the use of airplanes the development of insulating materials to exclude the noise of the engine and the air was one of the most difficult problems to be solved. The illustrations show the airmen equipped with a Western Electric Co. radio telephone transmitter and receiver as it is used. The wind-driven generator supplies electrical energy to the vacuum tubes.

The Motor Truck Club of New Jersey announces that no changes will be asked from the present Legislature for the motor-truck law of that state. There are several features of the present law which are particularly desirable. The examination for drivers' license comprises a written and a road test. The provisions setting the maximum weight of load and truck at 30,000 lb. are such as meet all practical requirements. This makes ample provision for the operation of a 7½-ton truck loaded to capacity.

Joseph E. Pogue spoke before the members of S. A. E. about engine fuel substitutes as follows: "There are three substitute engine fuels in sight—benzol, alcohol and shale-oil distillate. Benzol is now ready to compete with gasoline in a small way; alcohol and shale-oil distillate will be ready to compete only on a higher level of prices. As to the resources of each, benzol is a by-product of coal and the quantity produced depends upon the coal subjected to by-product recovery; benzol will be manufactured in constantly increasing quantity, but the total supply can never fill more than a small part of the engine-fuel requirement. Alcohol and shale-oil distillate on the contrary are main products made from raw materials of almost unlimited availability. They may be produced to fill any need however great if we are willing to pay the price. Whether shale-oil distillate or alcohol will eventually become the more important engine fuel cannot be foreseen. But since shale oil is similar to crude petroleum and can be made to yield an analogous range of products a shale-oil industry is certain to supplement and eventually to succeed the petroleum industry and hence shale-oil distillate is bound to become a prominent motor fuel."









Sparks from the

Forty Thousand Tractors Needed in France

Only 3033 Tractors in France and More Than 8,000,000 Acres to Be Cultivated Mechanically

France can absorb 40,000 agricultural tractors during the next four or five years, according to an estimate made by Representative Compère-Morel of the Agricultural Commission. This estimate, which appears to be a very moderate one, is based as follows:

In the period immediately preceding the war, France had 44,500,000 acres of land under cultivation for grain, potatoes and beets. It is estimated that about one-fifth, or 8,600,000 acres, will be cultivated by mechanical means within a very short time. These 8,600,000 acres will have to be plowed in 100 days, on an average; but two-thirds of this land, which is made use of for autumn sowing, will have to be plowed in a period of about sixty days. This gives, therefore, 5,900,000 acres of land to be worked in sixty days, or 98,000 acres per day. It is estimated that a tractor will plow 2½ acres per day. This is probably a rather liberal estimate. On this basis, therefore, 40,000 tractors are required.

A short time ago, figures were issued showing that France possesses only about 800 agricultural tractors. These figures were incomplete. The total number of tractors in service at the end of December, 1918, was 3033, composed as follows: 1835 belonging to French farmers, 898 belonging to the government and loaned to farmers on special terms, 300 tractors in government's reserve. Of the 898 practically all were of American origin, for only forty-seven had been bought from French manufacturers, as follows: Filtz, 20; Doizy, 12; De Dion-Bouton, 3; Tourand-Latil, 10, and Julien, 2.

In the opinion of Representative Compère-Morel, the immediate requirements of France will have to be met by gasoline tractors. But the greatest development, he considers, will be with electrically propelled tractors, the electric current being generated either from water power or from windmills. At the present time all tractors are either gasoline or steam driven.

* * *

January Exports Exceeds Previous Months

January exports exceeded in value the total for any previous month in the history of American commerce, according to a statement issued recently by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

The export figure announced for January is $623,000,000 against a total of $566,000,000 for December and $505,000,000 for January of last year. Only twice before have exports reached the $600,000,000 mark. During the seven months of the fiscal year ended with January the exports totaled $3,798,000,000 compared with $3,450,000,000 for the corresponding period of the previous year.

The value of imports into the United States in January was $213,000,000 compared with $211,000,000 in December and $234,000,000 in January, 1918. For the seven months ended with January imports totaled $1,698,000,000, which is a slight gain over the $1,634,000,000 for the similar period of the previous year.

The excess of exports over imports in January was $410,000,000, an impressive total when it is remembered that the excess of exports for the entire fiscal year 1914, the last normal year, was only $470,000,000.

Imports of gold amounted to $14,000,000 for the seven months ended with January against $79,000,000 last year. Exports totaled $23,000,000 for the same period compared with $173,000,000 in 1918.

Imports of silver amounted to $41,000,000 for the seven months, or practically the same as for the previous year. Exports amounted to $179,000,000 against $52,000,000 for the corresponding seven months of the fiscal year 1918.

Swedish Market for American Products

Sweden offers to American exporters a market for a variety of products, including automobiles; asbestos; motor plows; trucks; inner tubes, and tractor tires; brass; belting of all materials; bicycle accessories; benzine casks; all kinds of chemicals; copper sheets and tubes; cutlery of all kinds; all kinds of clocks; electrical appliances, batteries, motors, and wires; glass industry materials; glasses for boilers; hardware; iron tubes, sheets, wire, and pig; leather; accessories for looms; machinery and tools; all kinds of oil, both for use in the varnish industry and for lubricating; paint and paint-industry materials; paper-making machines; petroleum; rubber goods; hydraulic presses; steel; tin plates; tools; typewriters; woodworking machinery; watches. It is requested that catalogs in quadruplicate be sent to Consul Wallace J. Young, Goteborg, Sweden.

Personals

FRANK D. JENKS, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now with the Bardons & Oliver Co., Cleveland.

LEON HART, recently with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in consulting work in Hartford, Conn.

ALBERT V. BROUILLETTE, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in efficiency work as a consulting engineer.

R. W. HERRICK, formerly with the Ford Motor Car Co., Detroit, Mich., has taken a position as efficiency engineer with the Hart-Parr Co., Charles City, Iowa.

FLOYD G. HODSON of Clarksville, Iowa, has returned from France where he has been the representative of the International Harvester Co. for the past two years

FRANK RAYBOULD, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now with the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

CHARLES W. MOON, formerly director of personnel of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has taken a similar position with the Timken Roller Bearing Co., Canton, Ohio.

J. B. CHILDE, formerly of the Cleveland-Canton Spring Co. and the Cleveland Axle Co., is now the general manager of the Canton Spring and Forge Plants, Standards Parts Co., Cleveland, Ohio.

CHARLES N. THORN, of the Intercontinental Machinery Corp., New York, will sail for England in the near future. He expects to make arrangements for an active representation of his company in Europe.

IRA C. WILLHITE has been appointed manager of the Hart-Parr Company's branch house at Wichita, Kansas. Mr. Willhite's position in the sales department of the home office will be taken by A. A. TEAL of Davenport, Iowa.

H. Y. SMITH, formerly vice president of the Kern-Hunter Co., Milwaukee, Wis., is now engaged under his own name in the handling of contractors' and industrial plant equipment at 1227 First National Bank Building, Milwaukee, Wis.

E. S. DAVIS has returned to the Tate-Jones Co. after six months of service as Chief of the Fuel Oil Section of the Bureau of Oil Conservation, United States Fuel Administration. He will be district manager and director of sales and service in the Chicago district, with offices at 931 Monadnock Building, Chicago.

World's Industrial Forge

By E.C.Porter, News Editor

Exporting Furnace Equipment to Mexico

The Electric Furnace Co., Alliance, Ohio, is constructing for shipment to Mexico, a complete Baily Electric Furnace equipment for melting brass. The furnaces are of the tilting type, and are rated at 105 kw. electrical capacity, 1500 lb. hearth capacity, and a melting rate of 600 lb. per hour. The equipment has been purchased by G. Amsinck & Co., N. Y.

* * *

Engineering Council in Annual Meeting Reviews Year's Work

At its second annual meeting in New York Feb. 20 the Engineering Council voted to appoint a small committee to advise and confer with the Reconstruction Commission of the state of New York. This action was taken in response to a request from Abram I. Elkus, chairman of the commission, which request probably resulted from the letter sent by the Engineering Council to Governor Smith. The executive committee reported on the effect of the hearing called by the Engineering Council in regard to the sudden dismissal of 339 Public Service Commission engineers and the fact that reinstatement followed. It was also decided to appoint a special committee to consider the classification and salaries of railway and Government engineer employees.

Among the many committee reports one of the most important was that of the Engineering Societies' Employment Bureau, which up to Feb. 15 had 1400 applications for positions and found positions for 200, and to which the national societies have agreed to give larger appropriations.

The new representatives in the Engineering Council are A. N. Talbot, past president of the American Society of Civil Engineers; J. R. Worcester, consulting civil engineer, of Boston; M. E. Cooley, president of the American Society of Mechanical Engineers, and Albert Ladd Colby of South Bethlehem, Penn., representing the American Society for Testing Materials. The other members whose terms expired were re-elected. The total number in the council is now 26.

The new officers are: Vice-chairman, E. S. Jacobus, advisory engineer of Babcock & Wilcox Co.; C. S. Churchill, second vice-chairman, vice president of the Norfolk and Western R.R. The additional members of the executive committee are Comfort A. Adams, president of the American Institute of Electrical Engineers; Philip N. Moore, past president of the American Institute of Mining Engineers; Charles E. Skinner, engineer of the research division, Westinghouse Electric and Manufacturing Co. J. Parke Channing and A. D. Flinn were reëlected chairman and secretary respectively.

Business Items

The Standard Parts Co., Cleveland, Ohio, has moved its executive offices to the Standard Parts Building, 12th St. and Walnut Ave., Cleveland.

The Morse Engineering Co., western representative of the Morse Chain Co., has moved its Kansas City office from R. A. Long Bldg. to Suite 211-212, Finance Building.

Louis G. Henes, San Francisco, Cal., has moved his offices from the Monadnock Building to 75 Fremont St., where he will display a complete line of machine tools and shop equipment.

The Hess Steel Corporation, Baltimore, Md., has established a branch office in the Kresge Bldg., Detroit, Mich. Geo. B. Norcross, who is now representing the Hess Steel Corporation in that district, will be in charge.

The Wellman-Seaver-Morgan Co., at its annual meeting in Cleveland on Feb. 18, reëlected the retiring board of directors. Immediately after the meeting of the stockholders the following officers were elected: Edwin S. Church, president and general manager; S. H. Pitkin, vice president; George W. Burrell, second vice president, and W. H. Cowell, secretary and treasurer.

The American Bronze Corporation, Berwyn, Penn., at its annual meeting held recently elected George D. Porter of Philadelphia president, succeeding John W. Watson, who severs his active connections with the company to devote his time to a new company bearing his name, the details of which will be announced shortly. Mr. Watson, however, remains on the board of directors and continues his financial interest in the business. The active management of the business will continue in the hands of Matthew C. Dittmann as vice president and general manager. Edwin G. Anderson, advertising and sales manager, was elected secretary. Mr. Anderson has been connected with the company for some years past, originally acting as Pacific Coast representative. Charles H. Baker, formerly associated with the Timken Roller Bearing Co., Canton, Ohio, was elected assistant secretary and treasurer, and in addition to these duties will be in charge of production.

France Has Removed Its Import Embargo

Announcement Made by War Trade Board. List Includes Metals and Various Articles Made of Metal

The War Trade Board announces in a new ruling (W. T. B. R. 612), for the information of exporters in the United States, that the French import restrictions have been removed from the following list of commodities:

Metals.—Iron ore; iron scrap; iron filings; copper ore; lead ore; tin ore; zinc ore; nickel ore; native mercury; arsenic and its ore; cadmium, unrefined; bismuth, water glass; ores not above mentioned (except those of chromium, molybdenum, and wolfram).

Manufactures of metal.—Machines for paper manufacture; machines and presses for printing, typography, lithography, phototyphy copper-plate, and for all other forms of printing on paper, cardboard, wood, metal, celluloid, plastic material, in black or in colors, flatwise, in grooves, or in relief; machines for folding, and goffering; machines for coating, polishing, pasting, bronzing, automatic machines, machines and materials for book-binding; ruling machines, perforating machines, envelope-making machines, wood and tubes for trimming, cutting, stamping, lathes for setting and boring stereotype plates; presses and machines for stereotypy, other than hydraulic presses and machines; drying presses, crucibles, and furnaces for stereotypes; presses for casting cylindrical stereotypes; cylinders, laminating machines; linotypes, and other composing machines; machines for rinsing, corking, capping, and filling bottles; machinery and tools for refrigeration; stereotypes, plates, and dies for printing on paper, other than coloring, with or without drawings obtained by photo-mechanical processes or others; sewing needles; sewing machine needles; needles for lace, tulle, and wool trades; modeled and jointed; hooks and awls for embroidery, button hooks; office and store punches for perforating paper and cloth; pins; buckles, clasps, hooks, eyes, and fasteners for garments, suspenders, belts, gloves, shoes, and all other such material of iron, steel, copper, brass, and other common metals in whole or in part; hooks; umbrella mountings; household articles of iron, steel, and black sheets not listed; coffee grinders.

* * *

Steel Treaters' Society Formed

A society known as the American Steel Treaters' Society was recently formed in Chicago the object of which will be to promote the arts and sciences connected with the heat treatment of steel. The society will hold meetings

for the reading and discussion of papers bearing upon processes, instruments, equipment, apparatus, etc., employed in practical and research work connected with the art; collection, publication and dissemination of technical and practical knowledge for the improvement of conditions in connection with the heat treatment of steel; and to closely unite those engaged in the practical and technical branches of same.

This society publishes a monthly journal which brings the papers and discussions at various meetings directly to members. Sample copies of the journal and other information may be had by addressing the general office of the society at 154 East Erie St., Chicago, Ill.

Trade Catalogs

Zelnicker's Bulletin No. 261. Walter A. Zelnicker Supply Co., St. Louis, Mo. Listing a few specials, such as rails, cars and trucks, bridges, pipe, generator sets, car tanks, and used track spikes. The bulletin is free to the trade.

The Universal Electric Tools. The independent Pneumatic Tool Co., Chicago, Ill. Circular. Pp. 4; 9 x 12 in. It gives a brief description of Thor portable electric drills and grinding machines and illustrates the various models.

Handbook on Die Castings. Precision Castings Co., Syracuse, N. Y. Catalog. Pp. 95; 6 x 9 in. A useful handbook giving complete information about dies and casting processes, metals, methods of fabrication, finishing, etc., with useful tables. It is profusely illustrated.

Price List. Chas. A. Schieren Co., 3038 Ferry St., New York. Booklet. Pp. 12; 6 x 9 in. This new price list differentiates the various kinds of Schieren beltings not only by name and markings but also by grades and weights. Detailed specifications and illustrations are given.

The Story of Schieren Beltings. Chas. A. Schieren Co., 30-38 Ferry St., New York. Catalog. Pp. 38; 7¾ x 5¼ in. This is really a textbook on the leather-belting business. It describes and illustrates every step of the process of manufacture from the selecting of the hides to the shipping of the finished product.

Selectometer. Smith Serrell Co., Inc., New York. This is a chart in the form of a dial that determines the correct size of Francke flexible couplings for any given drive. The instructions are on the back of a card. The Selectometer may be had by writing to the Smith Serrell Co., 90 West St., New York.

New Publications

George Westinghouse: His Life and Achievements.—By Francis E. Leupp. Three hundred 6 x 9 in. pages; illustrated; bound in cloth. Published by Little, Brown & Co., Boston. Price, $3.

Mr. Leupp's story of one of America's great inventors and engineers is interesting and readable. He touches on Westinghouse's boyhood, his experience in the Civil War, his three months' trial of Union College and then proceeds to narrate his career as inventor and manufacturer. A car replacer, suggested by a tedious wait due to a train wreck, was his first commercial venture. His successes with the air brake, lighting the Columbian Exposition, elevated-railway electrification and Niagara power are all described. An idea is given of the magnitude of Westinghouse's manufacturing operations and his control of them up to the receivership of the Westinghouse Electric and Manufacturing Co. in 1907. The personal relationships of Westinghouse are sketched but briefly.

The book is addressed to the non-technical reader, but its engineering detail is sufficient for most engineers who are not specialists.

Obituary

M. THOMAS O'LEARY, president and treasurer of the L. W. Pond Machine and Foundry Co., Worcester, Mass., died at his home in Worcester, Mass., on Feb. 22, 1919. Mr. O'Leary was born in Millbury 42 years ago, but had been a resident of Worcester the greater part of his life. After the completion of his studies, he entered the employ of the L. W. Pond Machine and Foundry Co. and advanced to the position of general manager and treasurer. Four years ago he purchased the control of the company and became the president and treasurer. He was a director of the Merchants National Bank and a trustee of the Bay State Savings Bank. He was a member of the American Foundrymen's Association, the New England Foundrymen's Association, the Washington Club and Alhambra Council, Knights of Columbus.

Export Opportunities

George Komorowski, an engineer now at Ugine, Savoie, France, would like to correspond with American makers of machinery, factory supplies, and hardware for shipment to Poland under an exclusive sales agency agreement.

The Factory Products Corporation, 2 Rector St., New York, has formed an association with the Engineers' Corporation, a subsidiary of the J. G. White Engineering Corporation, for the special purpose of exporting American machinery, hardware, engineering supplies and building material. The Factory Products Corporation is a consolidation of the Factory Products Export Corporation, organized in 1914 to make shipments to the Allies, and of the Manufacturers' Agents Co., Inc., organized in 1916 to develop American trade in South America. The trade connections of the consolidated corporation extend to Argentina, Chile, Ecuador, Venezuela, Mexico, the British West Indies, China, India, the Philippines, the Straits Settlement and the Dutch East Indies. It has ten resident agencies established in the Far East. The officers are Walter W. Vick, president; Frank Smith, Earl Harding, vice presidents, and D. M. Barclay, secretary and treasurer.

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item:

A man in Norway desires to purchase or secure an agency for the sale of drugs, chemicals, colors, dyestuffs, paints, iron and steel, metals, heavy hardware, general hardware, specialties generally included in hardware stocks, and steel, copper wire and cable. Correspondence may be in English. Reference. No. 28297.

A man in France wishes to secure an agency for the sale of tools, machine tools, metal saws, lubricating apparatus, faucets, ball bearings, and belts. Correspondence should be in French. Reference. No. 28571.

An agency is desired by a man in France for the sale of machine tools, tools, steel, steel plates, chains, nails, bolts, screws, etc. Correspondence should be in French. No 28577.

A man in France desires to secure an agency for the sale of machine tools and crowbars. Correspondence should be in French. References. No. 28581.

A man in Norway desires to purchase iron and steel, metals, heavy hardware, machinery, electrical apparatus and supplies; light, heat, and power service, lead and steel and copper wire and cable. Terms, cash against documents at destination. Correspondenne may be in English. Reference. No. 28305.

An agency is desired, by a man in France, for the sale of metals, hardware, tractors, and raw cotton. Correspondence should be in French. He is willing to come to America for personal consultation with firms References. No. 28535.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, Mar. 18, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Manufacturers' Aircraft Association, Inc. Annual aeronautical exposition to be held in New York, Mar. 1 to 15.

National Foreign Trade Council. Annual meeting at Chicago, April 24-26.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month Oscar S. Teale, secretary, 240 Broadway New York.

United States Chamber of Commerce Annual convention to be held at St. Louis Apr. 28-May 3.

Western Society of Engineers, Chicago Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Vise, Quick-Action "Supreme"

Spafford Tool Works, 10 Hoadley Place, Hartford, Conn.

"American Machinist," February 27, 1919

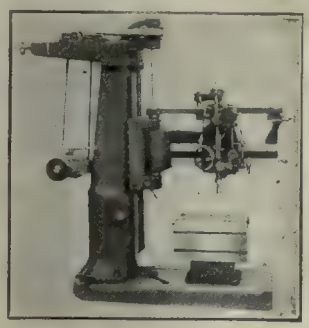


Made in four sizes, with jaws 3, 4, 5 and 7-in. wide; openings of 2⅝ in., 3⅜ in., 4¼ in. and 6½ in. respectively; jaw heights of ⅞ in., 1¼ in., 1⅝ in. and 1⅞ in. respectively and total heights of 2⅛ in., 3⅛ in., 3½ in. and 4¼ in. respectively. All steel parts are of drop-forgings or bar stock and are hardened and ground to size. All parts so far as possible are made to gages to insure interchangeability. The stationary jaw is let into a recess in the semisteel base in order to prevent it from changing position.

Drilling Machine, Radial "Avey"

Cincinnati Pulley Machinery Co., Cincinnati, Ohio

"American Machinist," February 27, 1919

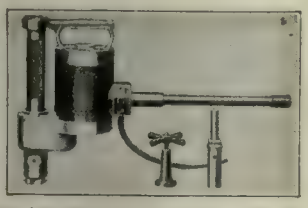


The machine is ball bearing throughout and is said to incorporate a number of new and novel features. It is regularly supplied with plain hand feed and tapping attachments, but power feed can be supplied if this is desired. Length of arm, 2½ ft.; distance from nose to spindle, 48 in.; spindle speeds, six, three with open belt and three with back gears on the countershaft; speeds on power feed machine, four, obtainable through gear box located on side of head; vertical feed of spindle, 8 in.; taper in spindle nose, No. 2 Morse.

Driver for Bolts, Nuts and Lag Screws

George C. McKay Co., 4247 Greenlee Ave., Cincinnati, Ohio

"American Machinist," February 27, 1919

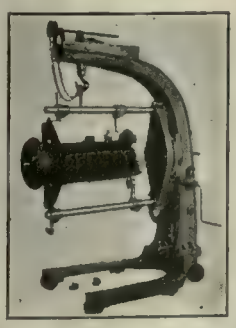


The machine will drive nuts and bolts from ½ to ¾ in. in diameter to a dead stop, meaning by this that they will be driven down as tight as they can be pulled with a 3-ft. hand wrench. Equipped with automatic burn-out device that protects the motor against over-loading the machine beyond its capacity. Weight, 29 lb.; spindle speed under full load, 60 r.p.m.; bearings on armature and gears, S.K.F. ball type; thrust bearing on spindle, S.K.F.; spindle equipped with internal square, 1¼ in. and external square, 1⅛ in.; height from tip of spindle to top of machine, 17 in.; total length to end of handle, 26 in.

Crane with Gasoline Engine Stand

Canton Foundry & Machine Co., Canton, Ohio

"American Machinist," February 27, 1919



A portable floor crane and hoist shown equipped with a special type of engine stand for the quick and economical handling of repair jobs on automobile engines. With this device the engine can be removed from the chassis, hooked on the motor stand and then moved to any part of the shop where the work can be most conveniently done. It is also possible to turn the motor into the best position to obtain the desired lighting. The hoist has a capacity of 2 tons with a clearance or lift of 6 ft. 2 in. The crane is equipped with Hyatt roller bearings.

Valve Grinding Machine, Electric

Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md.

"American Machinist," February 27, 1919



A motor-driven poppet-valve grinding machine for gasoline engine work. The construction is such that the spindle oscillates with a long, steady sweep similar to the movement obtained in grinding by hand, but much more rapidly. The motor is of ¼ hp., air cooled, and operates on power circuits of 25 to 60 cycles alternating current or on direct current. It is made in voltages of 32, 110 and 220. The motor and gearing are completely inclosed in an aluminum housing, the gearing being separated from the motor compartment and packed in grease. The grinding spindle has a ball thrust bearing, the armature shaft runs on ball bearings and the gears are mounted on shafts supported at both ends in phosphor-bronze bushings. A number of bits are provided to make the tool adaptable to various types of valves.

Grinding Machine, Heavy-Duty, Oscillating Surface

Springfield Manufacturing Co., Bridgeport, Conn.

"American Machinist," February 27, 1919

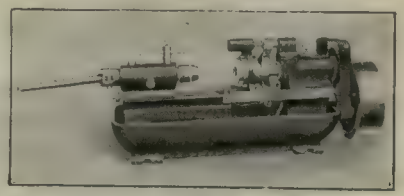


The particular machine shown is equipped with a sandstone for grinding steel lithographing plates, but it can be equipped with a nemy wheel for other types of work, the drive to the table being by means of bevel gears and a screw-reversing device the same as is customarily used on planing machines. The wheel and wheel spindle are carried in heavy and substantial slides fitted to the saddles on the faces of the upright, and when the machine is in operation the wheel oscillates across the work as this passes under it. Size of wheel, 36 in. in diameter, with 10-in. face; capacity for work on table, 26 in. wide by 60 in. long; approximate weight, 13,000 lb.

Threading Machine

Eastern Machine Screw Corporation, Truman & Barclay Sts., New Haven, Conn.

"American Machinist," February 27, 1919

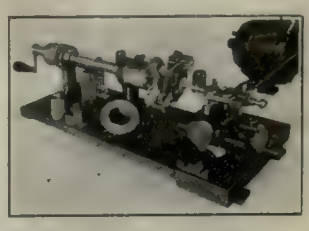


Designed for threading work which cannot readily be threaded on the automatic screw machine or such work as it is not desirable to thread on an automatic machine. Is equipped with a self-opening die head, and with a spring collet or expanding arbors for holding the work. The oil pump and countershaft are incorporated. When the desired length of thread has been cut the die head automatically opens and the carriage is moved back by hand. The present type of machine will cut standard threads up to ¾ in. in diameter and fine threads up to 1 in. in diameter.

Grinding Machine, Thread Gage

International Thread Gage Co., 100 West 23rd St., New York City

"American Machinist," February 27, 1919



This machine is of the bench type and is portable, being driven by an independent motor of about ¼ hp. Current is obtained from the ordinary lighting circuit. The illustration shows the machine set up for grinding an internal thread but external thread grinding can also be handled. The grinding wheel is located rigidly in the line of its axis while the work is being ground, the work being fed forward to secure the proper pitch by means of a master screw mounted on the work-holding shaft at the left. The master screw is held to the shaft by set screws and can be quickly changed for cutting threads of varying pitches. For dressing the grinding wheel, the slide rest is removed to a special fixture equipped with truing tools. The machine measures about 3 ft. long, 1 ft. wide and weighs approximately 150 lb.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34.60	$35.85
Northern Basic	31.80	31.80
Southern Ohio No. 2	32.80	32.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	36.15
Southern No. 2 (silicon 2.25 to 2.75)	39.95	39.95
BIRMINGHAM		
No. 2 Foundry	31.00	31.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	36.15*
Virginia No. 2	35.10†	38.10†
Basic	33.90*	33.90*
Grey Forge	33.90*	33.90*
Bessemer	.....	.....
CHICAGO		
No. 2 Foundry Local	31.00	31.00
No. 2 Foundry Southern	37.25	37.20
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	31.00
Basic	30.00	30.00
Bessemer	33.60	32.20

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For ⅜-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$2.90	$3.50
Warehouse, New York	4.17	4.70
Warehouse, Cleveland	3.90	3.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.22	6.[illegible]	5.75	6.385	6.22	6.45
*No. 26 black	4.60	6.12	6.12	6.35	5.65	6.285	6.12	6.35
*Nos. 22 and 24 black	4.55	6.07	6.07	6.30	5.60	6.235	6.07	6.30
Nos. 18 and 20 black	4.50	6.02	6.02	6.25	5.50	6.185	6.02	6.25
No. 16 blue annealed	4.10	5.37	5.37	5.65	4.95	5.585	5.37	5.65
No. 14 blue annealed	4.00	5.27	5.27	5.55	4.85	5.485	5.27	5.55
No. 10 blue annealed	3.90	5.17	5.17	5.45	4.75	5.385	5.17	5.45
*No. 28 galvanized	6.05	7.57	7.57	7.70	7.15	7.635	7.57	7.70
*No. 26 galvanized	5.75	7.27	7.27	7.40	6.85	7.335	7.27	7.40
No. 24 galvanized	5.60	7.12	7.12	7.25	6.70	7.185	7.12	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 10%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
3/32, 11/32, 5/16, 1/4, 7/32, 1/16, No. 8, 3/32 and No. 10	25.50 to 33.00	5/16 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
5/32, No. 14 and 1/16		5/16 by 19 in. long	10.00
No. 18		1/4 by 21 in. long	10.00
No. 20		**Special Welding Wire, Coated**	
Domestic 20c. for 1/16, 15c. for 1/4 to 3/16.		1/4	33.00
		5/32	30.00
		1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	47%	20½%	¾ to 1¼	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	¾ to 1¼	36%	21%
½	48%	35½%			
¾ to 1¼	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	23%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.00	18.50	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.25	5.00	7.25
Spelter	6.75	6.6[illegible]	7.75
ST. LOUIS			
Lead	5.00	4.65	7.10
Spelter	6.40	6.25	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	24.50	29.00	31.50–33	25.50	32.50	32.00	36.00
Copper wire (carload lots)	25.00	28.00	32.00	24.00	28.50	28.50	33.50
Brass sheets	20.50	29.00	30.75	26.00	32.00	29.00	33.50
Brass pipe	30.00	37.00	36.50	33.00	38.00	37.00	38.00
Solder (half and half) (case lots)	36.50	41.00	62.00	41.50	48.50	39.00	40.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.50	$25.25
New York	19.50	26.25
Cleveland	25.00	30.00
Chicago	28.50	37.00

March 20, 1919

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WANTED— One Million Labor-Saving Machines

BY
Arthur J. Baldwin,*
VICE PRESIDENT OF THE McGRAW-HILL CO.

Will the reconstruction of Europe provide a market for improved machinery? Does England's embargo on certain imports indicate a return to hand work and slow processes? How will the nations of Europe pay for what they need from us? So far as competition in the world's markets is concerned Europe must devise means for making good her loss of 10,000,000 man power. The only way this can be done is by the utilization of labor-saving devices whereby one machine may do the work of 10 men. When Europe equips herself with 1,000,000 machines that can do the work of 10,000,000 men she will be in a productive position comparable with her situation in 1914 prior to the war.

The Kaiser wrote to Francis Joseph in the fall of 1914:

> *"My soul is torn asunder, but everything must be put to fire and blood. The throats of men and women, children and the aged must be cut and not a tree nor a house left standing."*

I HAVE visited the land where fire and blood were applied. The devastated area of France is a region about 15 miles wide at the Belgian border, varying in width up to 60 miles and extending southward 100 miles. In this region the Kaiser's mandate was thoroughly carried out. There are no towns, no industries, no homes, no trees, no vegetation left. The occupied region of France, that is the region between the devastated area and the eastern border of France, has suffered from spoliation, from the deliberate removal of machinery, the destruction of plants, and from other forms of vandalism designed to cripple France industrially. Not only are the industrial plants destroyed but all the railroads that constituted lines of communication have vanished. In passing over the devastated area one is impressed with the fact that it is in truth a desert.

But the demolition of material things is not the only destruction that is manifest in France and in Europe. Thousands of little wooden crosses on the battlefields, and the numerous legless and armless men one meets on the streets bring home to one's mind the appalling fact that Europe has lost not less than 10,000,000 producers. From an industrial standpoint this is her greatest loss.

Another great drawback that Europe will have to overcome is the absolute lack of upkeep of all mechanical equipment. For four years no new machinery has been built and no new device has been created, except such as made for war. The automobile has disappeared except where it is used by the army. Repairs on buildings and property have been entirely suspended. The rolling stock of the railroads is in deplorable condition. Railroad trips that formerly required six hours now take twelve. That great portion of the world's industry which was occupied in making comforts and conveniences for the human race has stood still for four years, while the arts of war have progressed, and now that peace is here this lapse in the world's production of four years must be made good.

Prior to the war Europe competed with America for the markets of the world. Europe paid very low wages and depended for keeping her costs down upon the abundance of her man power. America competed in

*Mr. Baldwin visited England and France during October, November and December, 1918, as a guest of the British Government.

the world's markets and depended on keeping her costs down by the use of labor-saving devices. Before the war a coal miner in France produced an average of 1.3 tons of coal a day. In England and Wales a miner produced two tons of coal a day, while in America the average production of a miner was six tons a day. So far as competition in the world's markets is concerned, before Europe can get back to her prewar position, she must devise means for making good her loss of 10,000,000 man power. How can this be done?

The only way this can be done is by utilization of labor-saving devices whereby one machine may do the work of ten men. So when Europe equips herself with 1,000,000 machines that can do the work of 10,000,000 men she will be in a position for competition comparable with her situation in the world's affairs in the year 1914.



The manufacturers of Europe have a busy task in front of them to reëquip Europe with automobiles, to construct thousands of steel bridges that will take the place of the destroyed stone bridges, and to replace the motive power and rolling stock of railroads. Have European manufacturers the time or the facilities for the quick making of the 1,000,000 labor-saving devices which Europe needs *immediately* wherewith to replace herself in the economic condition she was in prior to the war?

Usually the problem that confronts a manufacturer is to find a demand for his product. That is no longer the problem today. The demand exists; the world's warehouses are empty and Europe is hungry for our products.

There is another very grave problem that is presented, and that is the question of credit. "How can these needed goods be paid for?" is the ever-present question asked by the countries of Europe.

One of the most important officials in any financial establishment is the credit man. Experience has taught him that it is not always wise to sell even though a purchaser wishes to buy unless the purchaser has the means for payment. The problem of the world today comes because of the poverty of Europe. When England a few weeks ago announced an embargo on certain of our commodities, considerable harsh criticism was indulged in by the unthinking. England has always had the reputation of paying her debts *because she backs her obligations with gold.* During the month of December England imported $250,000,000 more goods than she exported. In finance this simply means that England, to maintain her financial reputation, must deplete her resources of gold to the extent of $250,000,000 for the month of December. The trade balance against her for January and February will unquestionably be as great as the month of December. The merchants of England were and are clamoring for our goods, but her bankers saw that buying must stop until some arrangement was made for the payment of the goods.

We have always prided ourselves on being an export nation, but we must pause and consider the great change that has been wrought by the war. For the 10 years preceding its outbreak we were indebted to the old world to about the sum of ten billion dollars for borrowed capital, and we were annually sending abroad about a half a billion dollars in payment of our interest due. We were paying huge sums to foreign ship owners for the transportation of our goods. We were paying foreign insurance companies large sums for insurance premiums. Hundreds of thousands of Americans visited Europe annually and spent money freely. To pay this indebtedness we manufactured and sent abroad quantities of merchandise and food, and from this surplus of export over our imports we paid our foreign obligations; also in this manner the flow of money to and from the old world was regulated.

A great change has come over our foreign relations. For the past four years our manufacturers have sold their products abroad at fabulous prices. It is estimated that we have entirely liquidated our foreign debts and that from a debtor nation we have become a creditor nation. The old world now owes us not less than ten billion dollars, which will require their sending to us at least $500,000,000 annually in payment of their interest charges. There are only two methods by which this flow of money can be regulated; first, by our purchasing more goods from abroad, and second, by our reinvesting our money in Europe. Inasmuch as we desire to remain an export nation we must lend Europe our money, and her indebtedness to us must constantly increase. We must finance new railroads in South America, in Russia and in Asia Minor; we must build electric-light plants and tramways for Rome, for Moscow, for Lille and for Bagdad. We must be purchasers of foreign securities issued to rebuild the Old World. We must lend to Europe the money necessary to purchase from us the ten million labor-saving machines that she must have, and above all we must not as a nation feel aggrieved that England refuses to buy immediately that which she has not made arrangements to pay for.

But why should the American manufacturer turn his

eyes entirely to the foreign field in seeking an opportunity to develop a market? The same processes have been going on in this country as have been going on in Europe, although to a less extent. During the months that we were actually at war our citizens enforced rigid economy in the luxuries and conveniences of life. Never in the history of America have we practiced such economy as during the last two years. Never have our working people received such wages, and never have they accumulated and saved so much in any period as they have in the last two years. Our per-capita wealth has doubled. The purchasing power of the American people was never so great as it is today.

We have a vast territory with only 110,000,000 people. The region between the Mississippi and the Rocky Mountains alone can readily absorb, sustain and make wealthy another 100,000,000 people. It is true that we have a shortage of labor; but the work is here to be done—the coal is here to be mined, the ore is here to be melted into steel, the iron must be wrought into implements, the fields must be tilled, and to supply this shortage of labor water power must take the place of the miner, the tractor the place of the mule, the machine the place of muscle. We are the richest nation on earth. We should therefore be the most charitable.



We must bear in mind that Austria is now struggling under a national debt equal to 60 per cent. of the total value of her developed wealth; Germany has obligations (apart from indemnities) equal to 50 per cent. of her developed wealth; Italy has 45 per cent., France 45 per cent., England 44 per cent., and the United States but 8 per cent. Why should we look to the impoverished nations for our markets? Our logical market is here. Let us enter in and possess it. We have 50,000,000 acres planted to winter wheat, and our farmers in the current year will harvest record crops. Never was there so much food produced, and still there is a market for it all. Mr. Hoover says that we must ship Europe $1,500,000,000 worth of food by July 1. Our people will have more money to spend during the current year than ever before in the history of our nation and at the same time they will have more wants to be supplied. This market must keep our manufacturers busy, and after our own wants are supplied then the wants of the world will furnish the market. It is to be hoped that the peace conference now in session will make some provision for the stabilization of the flow of money between the nations of the earth, and when this is done the world markets as well as our own will be opened.

A Two-Position Milling Fixture

By P. P. Fenaux

I desire to take exception to the criticism of G. R. Richards on page 220 of the *American Machinist* of the two-position milling fixture described by me on page 772, Vol. 49, especially as we considered making a fixture along the same lines as his and turned it down for this reason.

At 3 in. feed per minute and 4-in. cutters it takes 30 sec. to make a cut and 10 sec. to complete the cycle of the table. With the indexing fixture the indexing is done while the table travels, and allowing 30 sec. to remove one piece and set another one, it takes: Cut, 30 sec.; travel and index, 10 sec.; cut, 30 sec.; travel and stop, 10 sec.; change work, 30 sec.; total, 1 min. 50 sec., to complete one piece. With the stationary two-position fixture it would take: Cut, 30 sec.; travel and stop, 10 sec.; change two pieces of work, 60 sec.; total, 1 min. 40 sec., showing a gain of 10 sec., which would be more than lost in the endeavor to keep the locating seat for the second setting clean and maintaining the work to exact size to fit that seat. As in the particular piece under discussion the only important part is the ratchet tooth, it would be a useless expense to maintain the sides to arbitrary dimensions. We used a No. 2 P. & W. automatic milling machine, as it was the only one that was available.

Regarding the life of the cutters we made a built-up gang, which allowed us to reset them after grinding, although we milled several hundred pieces without changing the size sufficiently to necessitate grinding.

The stock was approximately 0.20% carbon openhearth steel, which explains the 3 in. feed. As a matter of fact on heavier pieces of same stock we have used up to 5 in. feed per minute on these machines.

Tapping with a Drilling Machine

By Leroy R. Williamson

Having several thousand pipe flanges of fairly large diameter to be tapped and no suitable machine to do it in we rigged up an ordinary drilling machine by extending the lower driving shaft, putting on extra pulleys and adding a belt to drive in the reverse direction. An extra fork on the shipper rod provided convenient means for reversing the direction of rotation for withdrawing the tap.



VI. Thermit-Welding Compromise Rail Joints*

This article not only shows how to weld various types of rail joints, but contains hints for the practical mechanic, which may enable him to execute special repair jobs in the machine shop.

THERE is very often a demand for a compromise joint to be supplied quickly when some bolted or cast-welded joint has failed. An inexpensive shop-welding outfit enables traction companies to weld their own compromise joints in a few hours, and these will give the same results in service as a regular Thermit rail weld.

When a large number of compromise joints are to be made on the same rail section it is advisable to have patterns and mold boxes made especially for the purpose. Where only two or three are to be welded, however, the work can be done by the "wax method," which is the method used in all general repair work. To assist in the aligning and surfacing of the rails when two short lengths are to be welded together it is advisable to provide a suitable bed to which the rails can be bolted. Two stringers running about 10 in. x 6 in. x 10 ft. long, on which four wooden or steel ties can be bolted, answer this purpose very well. The two center ties should be spaced about 18 in. in the clear and the second tie spaced to take care of the shortest length of rail to be welded. It is best to imbed the surfacing bed in the ground up to the top of the stringer. To hold the rails to the ties long bolts can be used in place of track spikes. These bolts should be allowed to project through the face of the tie a sufficient amount to take the smaller of the two rails. Allowance must also be made for a U-clamp, or bridge clip, one end of which will bear on the base of the rail and the other on the tie, or in the case of a small rail, will rest on a spacing block.

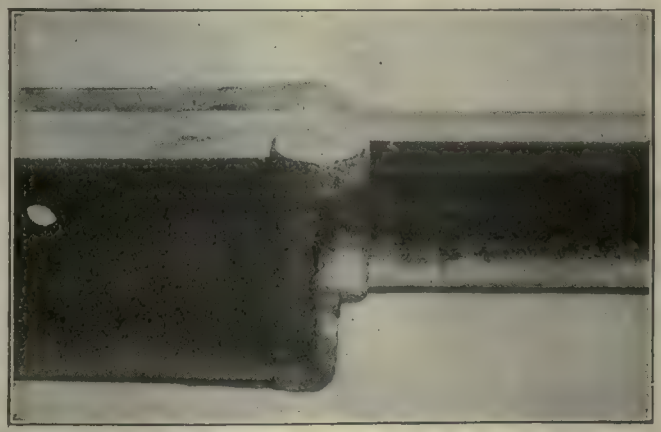


FIG. 64. WELDED COMPROMISE JOINT BETWEEN T-RAIL AND GROOVED RAIL

To bring the smaller rail up to the surface of the high rail a filling block is placed under the base, and to obtain accurate surfacing, shims or old hack-saw blades may be used in addition. With the rails spaced $\frac{3}{4}$ in. apart and accurately adjusted, the U-clamps are bolted down tight and the insert fitted as described for making ordinary rail welds. If patterns and mold boxes have been provided in advance the work proceeds in the same way as for ordinary rail welding, but if the wax method is to be used about 3 lb. of wax should be broken into small pieces, placed in a pan and heated until entirely melted. The wax is then allowed to cool until it becomes plastic. It may then be shaped by hand around the rail ends in the form of a collar.

In cases where five or six compromise joints are to be welded between the same rail sections considerable time and trouble can be saved by using a short length

*For the author's forthcoming book, "Modern Welding and Cutting." All rights reserved.

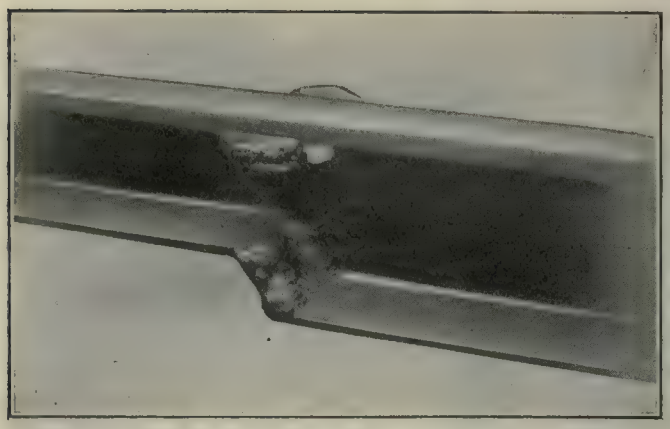


FIG. 65. WELDED COMPROMISE JOINT BETWEEN TWO T-RAILS, SHOWING FALSE LIP

of each rail section as a pattern. These should be about 8 in. long, butted together and fastened by tacking with the oxy-acetylene-welding process so that they will be held together securely. Mold boxes of sheet iron in two halves can be cut to fit with the oxy-acetylene cutting flame so that they will fit the sections to approximately $\frac{1}{16}$ in. all around. Each half of the mold box will then have a different section cut in each side. A wax collar is formed around the joint of the two pieces of rail in the regular way as described above and then one-half of the mold box is laid on the ground back down, placing the pattern made by tacking the two rail sections together on this half of the mold box. Then thin pieces of sheet iron is laid on top of this half to obtain a parting when the other half of the mold box is placed on top. The other half may then be placed in position and rammed up to the height of the riser with molding material, using a wooden pattern for the riser opening. When this has been completed the whole mold box, pattern and all, is turned over and the bottom half of the mold box rammed, inserting a wooden riser pattern in a similar way to the first half. This bottom half is then rapped slightly and lifted from the pattern. Then by rapping the pattern it may be lifted from the other half of the mold box. After removing the riser pattern the molds are ready to be placed on the rails to be welded, but before doing so the space between the lip and the ball of those rail sections should be rammed flush with molding material. When the boxes are adjusted they should be luted carefully with fireclay around the outside edges between the mold and the rail to guard against any run out of Thermit steel. The joint can then be preheated and poured in the regular way.

This method will be found to save considerable time over waxing each joint separately, and the two short rail sections can be used as a pattern for any number of molds. If both right-hand and left-hand compromise joints are required the same pattern and mold boxes can be used by simply disconnecting and rearranging for either right or left. A welded compromise joint between a grooved and a T-rail is shown in Fig. 64.

Where a compromise joint is to be welded between two T-rails as shown in Fig. 65 the same method can be used except that in this case it is necessary to arrange for a false lip to be cast out of Thermit steel similar to the lip of a grooved rail. In other words the Thermit-steel collar must be carried around each side of the head and on one side must be shaped in a corresponding manner to the lip of a groove rail. This is necessary because when the metal begins to cool and contract there must be an equal shrinkage force on each side of the insert extending to the top of the head tending to draw the rails together, otherwise the insert will not be thoroughly butt-welded into the head.

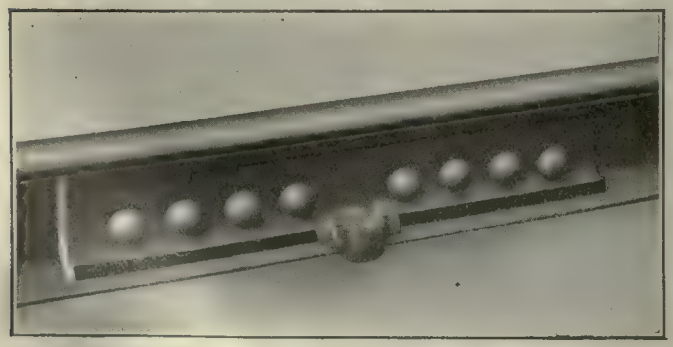


FIG. 66. COMPLETED CLARK JOINT

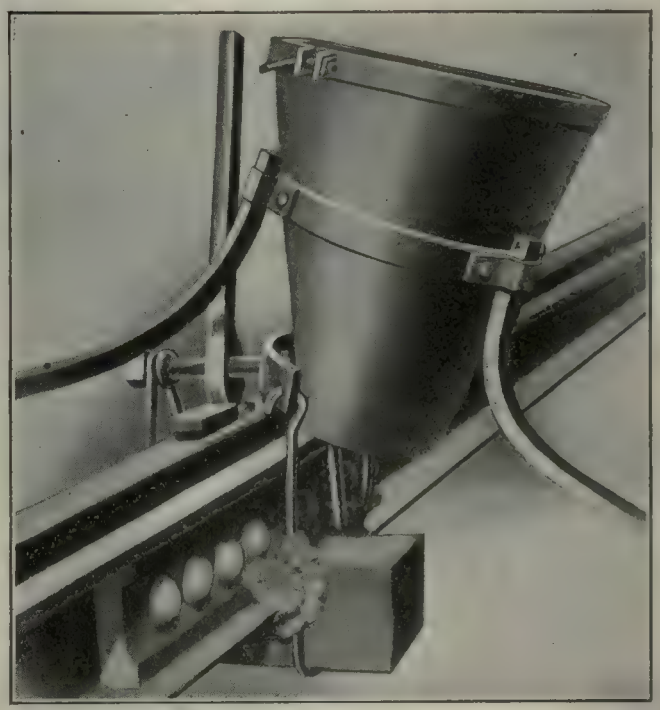


FIG. 67. OPEN MOLD AND CRUCIBLE IN POSITION FOR MAKING CLARK JOINT

Shortly after the development of the Thermit rail-welding process, Charles H. Clark, chief engineer of the Cleveland Railway Co., perfected a joint known as the "Clark joint," which has proved exceedingly successful in Cleveland and other Eastern cities where many thousand joints have been installed.

In its original form it consisted of a combination of splice bars and Thermit steel, it being Mr. Clark's opinion that the head of the rail could be supported by using plates that would come under the ball of the rail. Furthermore, in order to hold the rail rigid he considered it important that there should be no play in the bolts, so the holes in the plates and rails were drilled round and machine bolts used after reaming for a drive fit. In order to keep the bolts and plates from working loose and to afford bonding between the rails a Thermit-steel shoe was cast around the base as shown in Fig. 66.

In practice the rails and splice bars are drilled with

holes $\frac{1}{16}$ in. less in diameter than the bolt to be used. The splice bar is then applied in the ordinary way and held in place by a couple of temporary bolts, a drift pin being driven into one hole each side of the joint to keep the rails in position. The remaining holes are then reamed with straight-end cutting reamers, after which the machined bolts are driven and tightened up in the usual manner. After preheating the rail ends



FIG. 68. COMPLETED MODIFIED CLARK JOINT, SHOWING WELD OF BASE

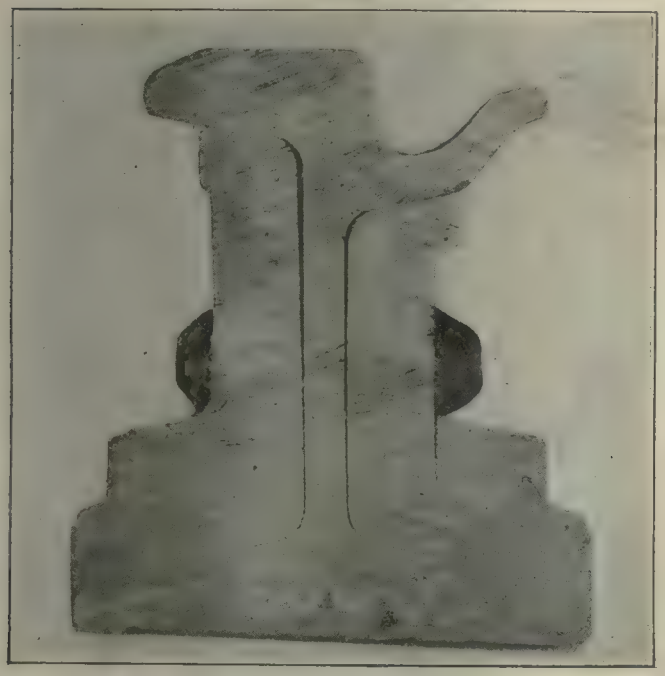


FIG. 69. SECTION THROUGH MODIFIED CLARK JOINT. IT WILL BE NOTICED THAT THE LOWER PART OF THE RAIL AND FISH PLATES ARE ENTIRELY AMALGAMATED

the Thermit steel is run into an open mold surrounding the lower part of the rails as illustrated in Fig. 67.

In the latest type of Clark joint rivets are substituted for the machined bolts, the riveting being accomplished by a pneumatic riveter suspended from the rear end of a flat car carrying an air compressor.

A modification of the Clark joint, shown in Fig. 68, has been adopted with marked success by the United Railways and Electric Co., Baltimore, and is also being used on other properties.

The object of the modification was to obtain a larger weld of the base, and in order to do this the Thermit steel was poured into an inclosed mold box instead of into an open mold and the rail ends were preheated to a red heat with the molds in place before the Thermit charge was ignited. Furthermore, the design of the fish plates is somewhat changed, these being of special design 1 in. in thickness and 32 in. long and being so



FIG. 70. APPLIANCES IN POSITION FOR WELDING THIRD RAIL

formed as to fit snugly the contour of the head and base of the rail. At the same time they provide a minimum amount of space between the web of the rail and the vertical sides of the fish plates. The channel bars and rails are of the same kind of steel (high carbon) and both are punched at the mill with ten $1\frac{1}{16}$-in. holes, spaced 3 in. centers and beginning 2 in. from the end of the rail.

The joint has been applied thus far exclusively to 7-in. girder groove rails weighing 103 lb. per yard. These 7-in. girder sections are undercut by the manufacturers $\frac{1}{16}$ in. so as to provide a space of $\frac{1}{8}$ in. at the base when the rail heads are butted. This precedure more effectively enables the Thermit steel to weld the rail and fish plates into a solid mass at the joints, as shown in the section, Fig. 69.

Welding the Third, or Conductor, Rail

The welding of the third rail has been carried on more extensively abroad than in the United States. This is especially true of France, where several thousand joints have been welded for the Metropolitan Railway and others in the neighborhood of Paris where this method of bonding is now standard practice.

In making these welds in France the base and flange only of the rail was welded with Thermit steel.

As a great deal of third rail, both here and abroad, is used in tunnels and subways, it is not necessary to make

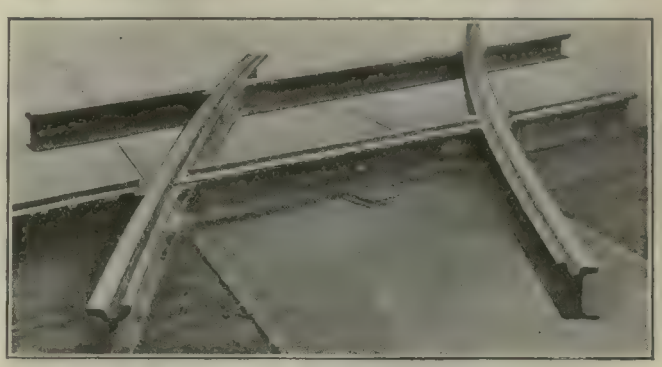


FIG. 71. A WELDED-UP CROSS-OVER

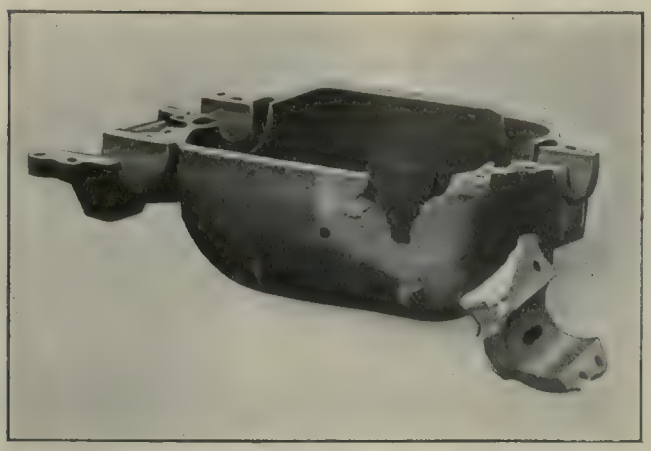


FIG. 72. MOTOR CASE WITH BROKEN LUG PREVIOUS TO WELDING

any provision in such cases for expansion and contraction, it having been found from practical experience that the temperature changes seldom exceed 25 or 26 deg. F. These are the figures that were determined by experiment in the subways controlled by the Metropolitan Railway of Paris. In cases, however, where the third rail is laid in open stretches of track where it will

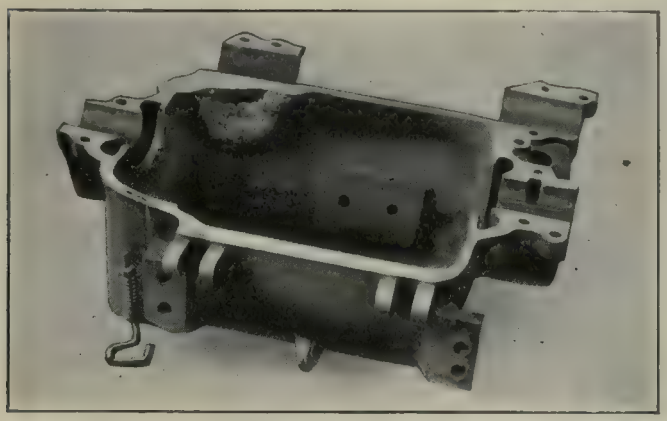


FIG. 73. MOTOR CASE WELDED AND READY FOR SERVICE

come under the full influence of atmospheric changes in temperature it is of course necessary to provide suitable means for taking care of the expansion and contraction, and this can be easily done by installing an expansion joint at regular intervals.

Welding third rails has advantages that need hardly be enlarged upon, providing, as it does, for a uniform electrical conductivity of the rail in question and a method of bonding which will not deteriorate.

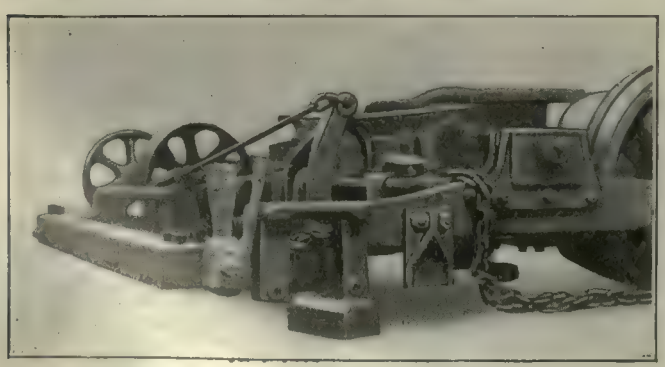


FIG. 74. WELD ON BROKEN TRUCK FRAME

A Thermit outfit in position for welding a third rail is shown in Fig. 70.

A very simple way to make cross-overs of any desired form is shown in Fig. 71. The rails are cut, shaped and then Thermit welded together and then the surfaces are ground. The result is as smooth and solid a cross-over as it is possible to make. This is suggestive of many other similar uses.

The same outfit required for welding compromise joints can be used most advantageously for welding motor cases and truck frames. The process offers special advantages for such repairs, owing to the fact that the collar, or reinforcement of Thermit steel, which is fused around the weld may be made heavy enough to insure against future breakage.

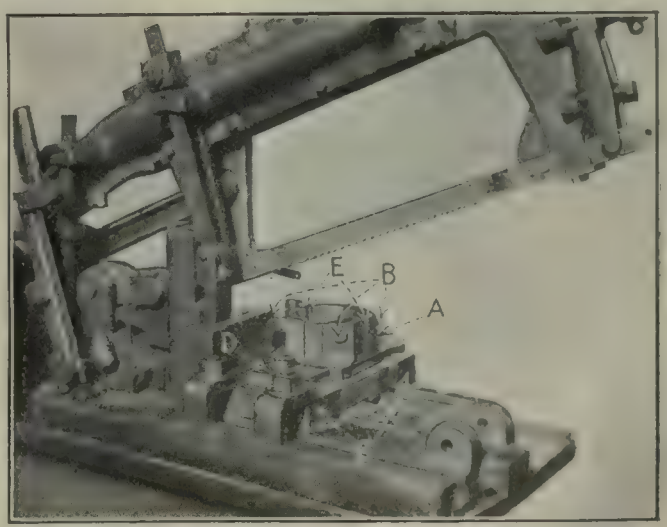
In Fig. 72 is shown a broken motor case, and in Fig. 73 a welded one. A welded truck frame is shown in Fig. 74.

Splitting Collets with a Power Hacksaw

By E. A. Thanton

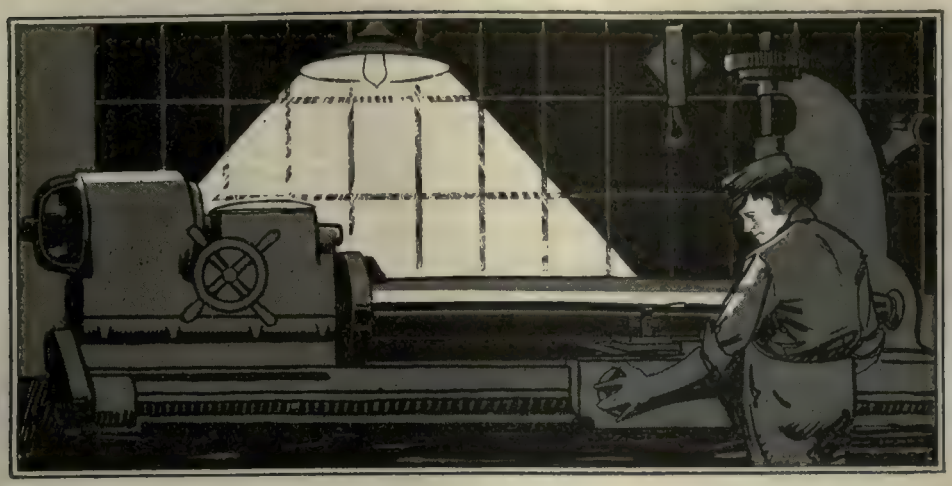
When a number of turret-lathe collets are to be made it is often a problem as to how they may be split to the best advantage. The average machinist would probably select a milling machine and either place the collet to be split on a soft mandrel or else hold it endwise in the table vise.

The Acme Machine Tool Co., Cincinnati, Ohio, has evolved a very simple method of splitting the collets



HACKSAW FITTED WITH COLLET-SPLITTING JIG

for their turret lathes in a power hacksaw, as shown in the illustration. The jig is made to clamp onto the table of the machine in place of the regular stock vise. The collet to be split is placed jaw-end up in a square-based jig *A*, and is held in place by screws at *B*, which engage the holes for the false jaw screws. The square base of the collet holder is slid in between two blocks *C* clamped to the bed of the machine. These blocks locate and hold the square base of the collet holder. Clamps like *D* keep the holder firm during the cuts. The saw is fed down into the slits *E* of the holder, cutting the collet as it goes, until it reaches a stop. The saw is then raised, the clamps *D* loosened and the collet holder turned a quarter way round and reclamped. The next cut is then made, which finishes the splitting.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Emergency Shop Power and Coal Conservation

This article outlines some of the important points that confront shops having their own power plants but which are inadequate to take care of emergency demands. Many such cases have doubtless arisen in which it has been absolutely essential to seek power from some central station. A decision for or against the purchase of power rather than the operation of a small isolated power plant must often be made by a new industry. For each of these cases there are interesting points concerning economy. Today the question of coal conservation is added to that of whether it is best to purchase power or to produce it in the smaller generating rooms of each industry.

MUCH discussion has been devoted to whether it is the best policy to purchase electric power from the nearest central station or to operate a small generating plant in connection with each industry. Advocates are to be found for each system, and those shops which have their own power house and which have use for exhaust steam for heating and the like have at least one good argument in favor of operating their own plant. This article will touch in a small measure on the advantages for and against the purchase of power and emphasize at some length its importance in relation to the question of coal conservation in its broader aspect.

Fixed Charges and Operating Costs

For simplicity in the discussion the use of exhaust steam for other than power purposes will be omitted as a factor, and it will be assumed that a given quantity of power for operating the shop must either be developed in a power house connected with the shop or that it must be purchased from some nearby large generating station. Our first proposition then is that the total cost of producing power will be made up of two factors, which we may term (a) fixed charges, such as interest and depreciation on the investment for the boilers, engines and electric generators, and (b) the strictly operating charges such as coal, labor and the like.

The fixed charges obviously go on whether the amount of power delivered by the plant is large or small, and it follows that if the plant delivers its full capacity for a small number of hours out of the 24 each day, then the fixed charges per unit of energy delivered must naturally be higher than if the plant delivers its full capacity for a larger portion of the entire 24 hours.

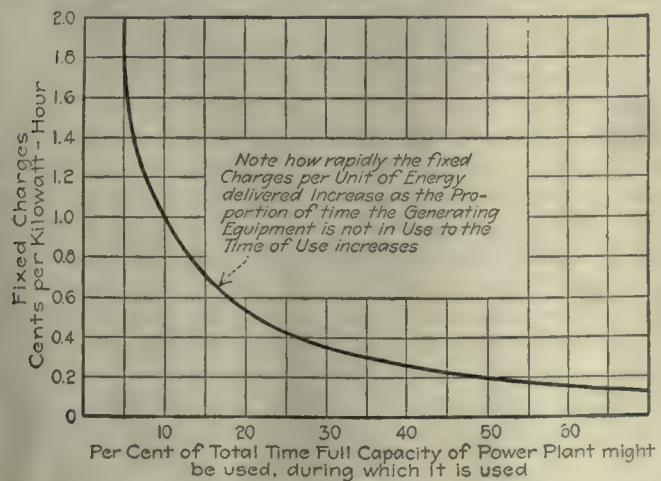


FIG. 1. VARIATION OF FIXED CHARGES PER UNIT OF ENERGY DELIVERED FOR DIFFERENT VALUES OF THE "PERCENTAGE OF USE" FACTOR

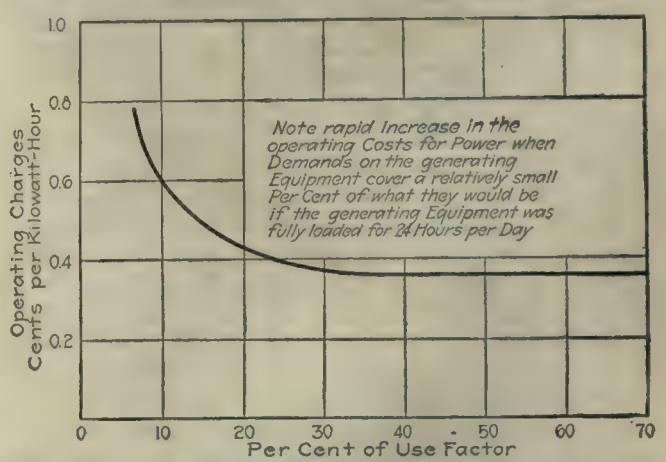


FIG. 2. CURVE SHOWING HOW OPERATING COSTS PER UNIT OF ENERGY DELIVERED MAY VARY FOR DIFFERENT VALUES OF THE PERCENTAGE OF USE" FACTOR

The curve in Fig. 1 is based on published data for given conditions in a power plant and shows the relations explained in the foregoing paragraph. The percentages used as the scale of the base line of Fig. 1 represent what is referred to above as the part of the total 24 hours each day during which the plant delivers its full capacity. This percentage factor is defined in central-station practice as the load factor of the plant power house, although for present purposes the general idea expressed is sufficient to convey the meaning of the base-line scale in both Figs. 1 and 2.

From Fig. 1 it will be noted that as the percentage of the base line becomes smaller the amount of fixed charges per unit of energy delivered becomes greater. Now in the small individual plant the percentage of the total day during which power is required will naturally depend upon the nature of the work of the shop.

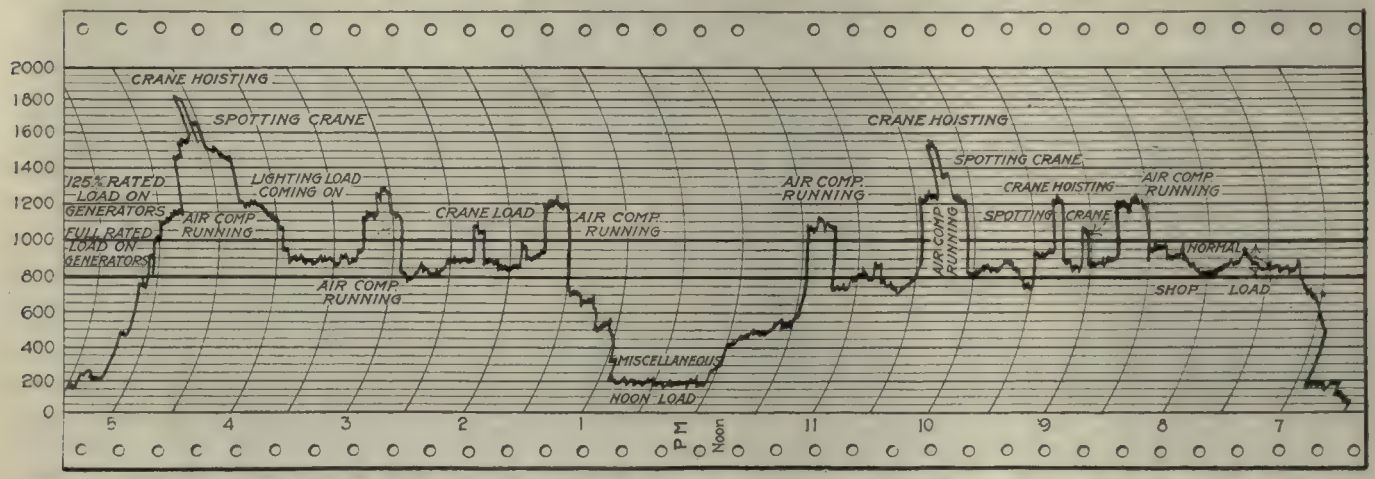


FIG. 3. GRAPHIC RECORD OF THE LOAD IN A SHOP POWER PLANT SHOWING THE PEAKS OF LARGE OVERLOAD

In rush times, when the plant must operate both night and day, the power house will be called upon for a large part of the 24 hours of each day; at other times the percentage of the base line in Fig. 1 will go down and the fixed charges per kilowatt-hour will increase.

Figures of the percentage factor used in Fig. 1 show that in some individual power houses this factor is as low as 6 per cent., and in many cases, in normal times, that it is not more than 20 per cent. Of course other cases will occur where it is considerably higher. In large central power plants supplying electrical energy over a large territory both for lighting and power purposes there is an opportunity, owing to the diversity of the loads, to increase this percentage factor.

It may be seen that even from the standpoint of fixed charges upon the generating equipment there is a chance that the costs per kilowatt-hour will be lower in the large central station than in the smaller power house of the individual concern. This principle is often either overlooked or not given sufficient weight in the estimates on the cost of power in the individual industrial concern. However, our present purpose is to emphasize another aspect of the power problem, and this leads to a consideration of the operating costs of power and its dependence upon the factor mentioned above and also upon the efficiency of the generating apparatus.

In Fig. 2, which is based on data published elsewhere, it will be seen that the operating cost per unit of energy delivered by a plant goes up as the base line percentages decrease. This, in a general way, will be apparent when one considers that the amount of labor does not change ordinarily from day to day, so that the delivery of a small amount of power per day must cause an increase in the cost of labor per unit of energy delivered. Again, when the plant is lightly loaded, the machinery may be operating at a loss in efficiency resulting in a higher coal consumption per kilowatt-hour delivered. This shows why the curve of operating cost in a given plant should go up if the load on the plant falls off in the time out of the 24 hours each day during which the full capacity of the plant is utilized.

Another important consideration is that the equipment in large central power stations usually possesses a higher utilization efficiency of the coal consumed than is possible in the smaller power plant, and it is on this basis that one of the main arguments of this article rests. In smaller industries that are about to install their own power plants as a part of the shop equipment the argument against the purchse of power may be that they can produce their own power at as low a cost as it can be purchased.

From the standpoint of the present necessity for coal conservation this argument should take due account of the fact that in the generation of a given quantity of power the actual amount of coal consumed by the large power company is materially less than that required by the small isolated shop power house. Numerous other arguments may be advanced by the individual shop why it should have its own power plant, but aside from the possible exception of the requirement of steam for heating and other purposes not falling under the head of power it would seem at this time that the outstanding factor on which to base a decision for or against the purchase of power should be, how can the power be secured with the least consumption of coal. The agitation in the public press looking to the centralizing of power development into large central generating power plants for the purpose of coal conservation is an indication of the way the whole problem is looked at in the light of the present unusual conditions.

The foregoing notes merely outline some of the economical aspects of the shop-power problem on a basis of which it is now possible to look more closely at the

question as related to emergency demands for power due either to a gradually increasing load which overloads the generating equipment of the shop power plant or more particularly to a sudden excessive demand for power due to an unexpected expansion of the plant, a condition which has undoubtedly been faced by many industries.

In the last-mentioned cases there may have been no alternative between purchased power and enlargements of the shop plant due to an inability to obtain additional generating equipment to meet the emergency power requirements. In other cases the question of additional generating equipment may be up for a decision at this time, and for such the following notes may prove helpful in the analysis of the situation.

First, it may be stated that an apparently large overload on the shop power house is not always of constant

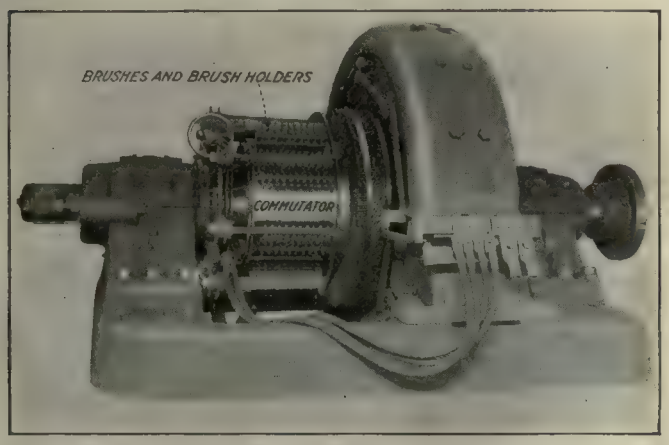


FIG. 4. MILL MOTOR SHOWING SOME CHARACTERISTICS FOR DIRECT-CURRENT SUPPLY CIRCUITS

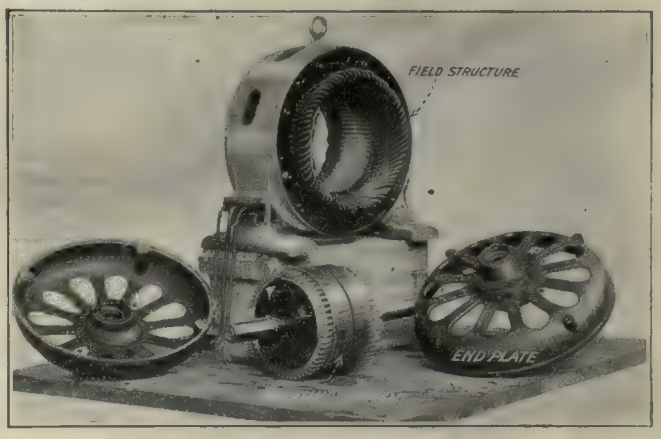


FIG. 5. PARTS OF A SQUIRREL-CAGE INDUCTION MOTOR FOR ALTERNATING-CURRENT CIRCUITS

or even approximately constant duration, and excessive peaks of load of short duration may sometimes be mistaken for a more or less uniform condition of overload. One way for reducing such conditions to a satisfactory basis for analysis is the use of a graphic meter in the power room. Fig. 3 shows a record in a plant where the purchase of additional boilers, engines and generators was about to be made to relieve what seemed to be an aggravated case of overload on the generating equipment.[1]

The chart, of which Fig. 3 is merely a part, indicated that while the excess loads were greatly above the capacity of the generators of the plant they covered relatively short periods, and ultimately this plant saved itself the purchase of about $15,000 worth of new equipment by the purchase of enough power to take care of these excess peak loads from a large centralized power station.

Thus far attention has been centered upon the question of power either from the private shop power house or from a central station. There are, however, several points which call for special mention in comparing these two possible sources for the power to use in operating a machine shop. One of these relates to the kind of current available from the central station as compared with that generated in the existing shop plant. The requirements of the motors in the machine shop are likely to be more exacting in regard to speed adjustment than in certain other classes of service. Many of the motors used for driving certain machine tools may be of the adjustable speed type.

Where this is the case it is essential to have available a supply of direct current. On the other hand, if all the motors in use are of the constant-speed type it is possible to employ either direct current or induction motors.

In some cases the importance of the adjustable-speed direct-current motor may be so great as an element in the successful operation of the machine tools that even with an alternating-current supply from the central station additional conversion equipment in the shop may be considered desirable for changing the central-station supply from alternating to direct current; at least that part of the total supply required by the adjustable speed motors in service. Figs. 4, 5 and 6 are included merely to give the reader a general idea of the appearance of the direct and alternating current motor, since these two principal types are closely related to the question of the power supply as at present understood.

Fig. 4 shows the characteristics of a large direct-current mill motor with the commutator and brushes to the left. In certain cases this part of the direct-current motor is partly inclosed or even entirely inclosed if the nature of the surroundings or the operation for which it is used warrant a protection for the sliding contact between the commutator and its brushes. Fig. 5 gives a good idea of the parts which go to make up an induction motor for alternating-current circuits known as the squirrel-cage type. Note that the rotating members (shown on the floor in this view) has no commutator or sliding contacts of any kind. Fig. 6 indicates the so called slip-ring type of induction motor, in which there are contacts with brushes resting on continuous circular rings as shown to the left.

It is not intended to make the relative merits of these motors a part of this article.

Another item which should be mentioned in its relation to the purchase of power is that of taking into account the nature of the load which is to be taken from the central-station supply mains. This has a bearing upon the rate for energy which the central

[1]Fig. 3 and the notes accompanying it are included by courtesy of the Esterline Co.; Figs. 4, 6 and 8 are shown by courtesy of the General Electric Co.; Fig. 5 of the Wagner Electric Manufacturing Co.

station is willing to make for the service, and while naturally the central station might be looked upon as the party that must show cause why the rate charged is at the given value it is almost equally important for every shop to have at least some knowledge of the factors which govern the rates charged by the large central stations for power supplied for shop purposes.

The object of those concerned with the shop power supply should be to view the problem partly, and of course largely, from the standpoint of the needs of the industry itself and partly with an attitude of coöperating, as far as is consistent with economy in production costs, in the large project for a conservation of the

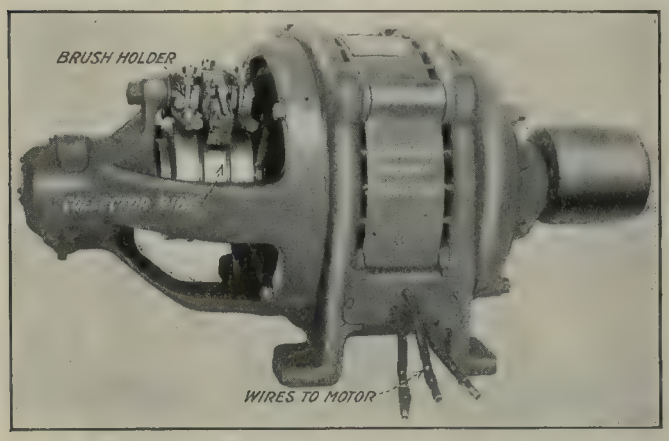


FIG. 6. SLIP-RING INDUCTION MOTOR FOR ALTERNATING-CURRENT CIRCUITS

nation's fuel resources. As pointed out in a previous discussion under the title "From Coal Pile to Machine Tools and Lamps," the need today is for a coöperative attitude on the part of every individual with a due consideration for every possible saving in the use of coal no matter how insignificant it may seem to the individual.

It is believed that with an attitude of fairness to every plan suggested along these lines there is a possibility of greater economy in coal used than seems feasible even without a curtailment of production. In brief, then, from the standpoint of the discussion in this article, the central station represents the idea of specializing in the generation of power.

Note—If the reader is interested in giving further study to this question of fuel conservation as a factor in the gross available energy from all sources in America today reference may be made to an excellent paper on this subject by Dr. Charles P. Steinmetz entitled "America's Energy Supply," published in the Proceedings of the American Institute of Electrical Engineers for June, 1918.

Testing Relative Merits of Case-Hardening Materials

By A. P. Freeman
Birmingham, England

The tests described by Mr. Underwood on page 569, Vol. 49, are doubtless satisfactory for casehardening articles for which the only requisite is to obtain a hard case of the necessary depth.

There are circumstances, however—i.e., gears for motor cars—which not only require a good, hard case of such quality as will not chip under shock, but it is also imperative that the core shall be in condition to withstand frequent and heavy shock without breakage. Now for such circumstances the tests described are totally inadequate and would lead to a faulty decision, for if the test pieces were fractured immediately after quenching as described, the core would most certainly show a coarse crystalline fracture that would indicate complete inability to withstand shock.

With high-class casehardening such as we are now considering it is certainly necessary to allow the articles to cool off with the pot without exposure to the air, and then take them from the pot and reheat to the correct hardening temperature and quench. In the highest class of casehardening two reheatings and quenchings are resorted to for reasons which are mentioned later.

Without going too deeply into the theory of hardening it will be sufficient for our purpose to state that the reason for this slow cooling off and reheating may be simply stated as follows:

The temperature at which the iron will absorb the carbon is well above the temperature at which the iron itself should be quenched for the best results, and is higher still than the best temperature for obtaining a good, hard but fine-grained case. It is therefore necessary to allow the articles to slowly cool off in order to normalize the crystal structure.

If merely good results are required all that is now necessary is to reheat the articles to the temperature required to harden the case and quench. By this process the core, while vastly superior to that obtained by quenching direct from the carbonizing pot, is not the best obtainable from high-class carbonizing steel, and to obtain this result the articles must first be reheated to the correct temperature to give the core its best crystal structure and quenched. The articles are then reheated to the temperature to give the case its best crystal structure and quenched.

The core requires a slightly higher temperature than the case, and if the articles are left at the first quenching they would be very hard, the core good, but the case would be likely to chip or peel off. The second reheating and quenching, being at a lower temperature, does not seriously affect the grain of the core.

Now the temperatures which are best to carbonize, reheat for the core and reheat for the case depend upon the quality of the steel used, and they must be found and strictly adhered to and the real test for casehardening compound should be made to suit the steel and the bulk of the articles. Small articles might be seriously damaged by 3 hours' exposure to the high carbonizing heat, whereas a large, bulky article would stand and really might require 12 hours' exposure to the same temperature.

For this class of casehardening therefore the various temperatures to get the very best results from the steel should be ascertained either by trial or consultation with the steel makers (preferably both) and the various compounds tested at these temperatures, not for various periods, but to give the deepest and hardest case at the correct temperature and time exposure.

The record of the tests as given by Mr. Underwood are very interesting and show great care and thought. I should like to have seen particulars of tests for hardness by Brinell or sclerescope instruments, and perhaps Mr. Underwood will include these in any future tests he may make.

Standards for Large Taper Shanks and Sockets*

By LUTHER D. BURLINGAME
Industrial Superintendent, Brown & Sharpe Manufacturing Co., Providence, R. I.

War needs have demanded machine tools embodying taper shanks and sockets of larger dimensions than it has been customary to use. Most of the tapers of the early days present irregular variations in size and in depth, even within the same system, and the application to the large sizes of the rules followed in proportioning these early types does not give the dimensions required to meet the new conditions. To supply this deficiency the Magnum standard tapers, described at length in this paper, have been developed. The diameters at the large end of these tapers vary from 4 to 14 in. and those at the small end from 3¼ to 12 in. The depth of taper is made equal to twice the diameter of the large end plus 4 in. The selected standard taper is ¾ in. per foot.

ONE of the problems presented by war needs is that of designing machine tools of greater size than any previously built, and in proportioning those which require the use of taper shanks and sockets the taper per foot and the length must be determined. No standards are known to have been established for tapers of the large sizes now required for these machines or which the exigencies of the near future may require. The problem of working out such a standard was presented to the Brown & Sharpe Manufacturing Co., and after investigation and study it arrived at the tentative form here described. The choice was based on a study and analysis of present established tapers, an investigation of the laws governing the use of tapers and a referendum of experience and opinion from a number of manufacturers and engineers who, because of their close contact with conditions most nearly like those desired to be met, it was felt would best be able to judge of the requirements.

History

Up to within comparatively recent times tapers for shanks and sockets above 3 in. in diameter have had a somewhat limited use. For lathes, drill presses, boring mills and milling machines, where the conditions of use are somewhat similar, the tapers used have varied from ½ in. to 1½ in. per foot, with widely varying lengths. Table I gives particulars of those most widely used and generally described in textbooks.

This wide variation in practice, where the conditions seem about the same, raises a question as to what, if any, are the reasons for such variation, and as to whether any rules can be laid down determining the most satisfactory taper per foot to be used. As it would not be feasible to change tapers now in extensive use this would be a mere academic question were it not, as already pointed out, that new taper sizes are required.

*Presented at the annual meeting of the American Society of Mechanical Engineers, held at 29 West 39th St., New York, December, 1918.

Most of the tapers mentioned in Table I were established in the early days, before the question of standardization was given much attention, and so the variations in size and depth are irregular even in a given system. Such formulas as exist, if followed for the proposed larger sizes, would not give the proportions required to meet the new conditions. Thus the Brown & Sharpe taper, while increasing somewhat uniformly in depth to No. 12 (1½ in. in diameter at the small end), would be longer than usually necessary if the same proportions were carried above that size. For this reason when B. & S. sizes above No. 12 were established at a later date than the small sizes a new ratio for length was used, by which large sizes to No. 18 (3 in. in diameter at the small end) do not increase as rapidly in depth relative to the diameter as is the case of smaller sizes.

TABLE I. DATA ON TAPERS IN GENERAL USE

Taper per Ft. In.	Included Angle	Ratio	Name	About When Introduced	Where Used
½	2° 23′	1 : 24	Brown & Sharpe	1860	Milling machines and general
$\frac{5}{16}$	2° 52′	1 : 20	Jarno	1889	Reed lathes, Pratt & Whitney machines, etc.[1]
$\frac{3}{8}$	2° 59′	1 : 19⅛	Morse	1862	Twist drills, drill presses, etc.
¾	3° 35′	1 : 16	Sellers	1862	Lathes, boring machines, milling machines, etc.
1	4° 46′	1 : 12	Cambria	....	Steam-hammer piston-rod ends
1½	7° 9′	1 : 8	Muir (England)	....	Milling machines, "patented couplings" for arbors.

[1] Also since used for German metric tapers.

The Jarno taper, proposed by Oscar J. Beale of the Brown & Sharpe Manufacturing Co. (and given its name because of the pen name "Jarno" under which Mr. Beale wrote), has an established ratio of diameter to length, each ⅛ in. of diameter at the large end and each $\frac{1}{10}$ in. at the small end adding ½ in. to the length. This standard, because of the easily remembered relations of its dimensions, has appealed to designers and has already come into extensive use. When the formula is applied, however, to large sizes, such as are here considered, it does not give practical proportions. So far as other standards now in use follow well-defined proportions in the relation of length to diameter these proportions also fail when applied to large sizes.

Taper per Foot

As shown in Table I the well-established tapers for shanks and sockets now in use vary from ½ in. to 1 in. or more per foot, the tendency being to use a somewhat steeper taper for the larger sizes than for the small ones, perhaps because with small tapers the liability to slip produced by the work is not so great and the "bite" of the taper when forced into the socket is sufficient to secure effective driving. In the larger sizes, tenons or tongues must be provided to aid in driving, and in the still larger sizes keys of some form are needed, as unless the angle of taper is very light the tenons are liable to be twisted off. When such auxiliary means of driving is provided the taper can be made steeper, giving the advantage that the parts can be more easily separated.

An illustration of the use of a greater taper per foot for large as compared with small sizes is found in the old "American taper" having $\frac{9}{16}$ in. taper per foot up to the size 1 in. in diameter at the small end, beyond which the taper became $\frac{5}{8}$ in. per foot.

An extreme application in the direction of steep tapers is in the arbor couplings used for milling-machine arbors made by Wm. Muir & Co., Ltd., of England. These arbors are drawn into and removed from the socket by means of differential-threaded nuts, the taper being $1\frac{1}{2}$ in. per foot.

On the other hand tapers as slight as $\frac{1}{2}$ in. per foot have given satisfactory results in milling machines and other machine tools, where they have been in constant use for at least the last sixty years. When driven in place the "bite" on the small sizes is sufficient to hold without working loose under jar, while the angle is not so small as to prevent driving apart when desired. It is found, however, that occasionally a taper of $\frac{1}{2}$ in. per foot will stick so tightly as to require considerable force to separate the parts, perhaps in such cases as where a cold arbor is driven into a heated spindle. With a taper as slight as $\frac{1}{2}$ in. per foot there is seldom trouble from having the tenon twist off, as is so often the case with twist drills made with a taper of approximately $\frac{5}{8}$ in. per foot and where on account of the greater taper the "bite" of the taper fit does not carry so great a proportion of the load.

Principles on Which Tapers Depend

At the time Mr. Beale proposed the Jarno taper he made an investigation of the principles on which the taper of shanks and sockets should be proportioned, and published his findings in the *American Machinist* of Oct. 31, 1889, page 3. His analysis is a clear statement of conditions governing the taper per foot.

After asking, "Is there a scientific principle involved in establishing a taper?" he answers: "There is this principle, that the angle of the taper must not be so large that a center will not stay when driven in and that the angle need not be so small as to make it very difficult to back the center out," and after illustrating by means of a diagram he continues: "The average angle of repose in metals having smooth surfaces that are oiled is placed by Unwin at $4\frac{1}{2}$ deg. and by Willis at 5 deg. Rankin gives an angle the same as or a little smaller than Unwin and adds that in some experiments the angle has been as small as 2 deg." From a further demonstration Mr. Beale concludes regarding tapers that if the angle must be such as to permit slipping it should be as great as 10 deg., while if it should not permit slipping it should be less than 4 deg. Also: "If a center be of a taper whose sides make an angle of less than 4 deg. it is not likely to slip out after being driven in, even though it be oiled. An angle of 4 deg. makes a taper of nearly $\frac{7}{8}$ in. per foot. No center, so far as I have seen, has a taper greater than this, which is interesting as indicating that the machinist, in practice, has not exceeded the angle of safety given in the textbooks. . . . The smallest center angle that I know is something less than $2\frac{1}{2}$ deg., which in practice has been found to be small enough. We are therefore at liberty to choose any angle of taper between 2 and 4 degrees."

Mr. Beale chose for the Jarno taper 0.6 in. taper per foot (2 deg. 52 min.) as an average between these limits. This gives a ratio of 1 in 20, a ratio which has since been adopted for the German metric standard and is especially adapted for use with a decimal system of measurement. In applying it to the English system of measurement, however, it gives the dimension at one end of the taper in tenths and at the other end in eighths, a feature which while not especially objectionable lacks the advantage derived from using the taper of $\frac{3}{4}$ in. per foot, which gives with each inch of depth $\frac{1}{16}$-in. variation in diameter, so that when applied to large tapers the depth of which may be made to vary by 2 in. or 4 in. the diameters at both large and small ends come in whole or convenient fractional sizes.

A taper of $\frac{3}{4}$ in. per foot also gives an advantage over 0.6 in. or other tapers with a less steep taper in the ease with which it will release when it is desired to drive it out. Further it is a taper which apparently is now in most general use for large work, although its proportions, as far as I know, have not previously been standardized.

The taper of $\frac{3}{4}$ in. per foot was adopted by William Sellers & Co., Inc., Philadelphia, about 1862, when they abandoned the flattened end or tenon and adopted a key fitting lengthwise of the taper for driving rather than to depend largely upon the "bite" of the taper for that purpose.

William H. Thorne, in a paper ("Transactions," Vol. 7, p. 132) on twist drills presented before the Society of Mechanical Engineers in 1885, after pointing out the objections to driving by a tongue as is the usual practice in using twist drills, says: "A far better device is a key fitted permanently into the sockets and extended the entire depth of the latter. This key fits a groove in the shank of the drill, and supplies a perfect means of driving the latter with a minimum of wear and strain. The end of the shank for a short distance is turned smaller, and is hardened to prevent any upsetting by the use of a drift or wedge in removing the drill. The amount of taper proper for the shank is a disputed question. The Morse taper averages less than $\frac{5}{8}$ in. in diameter per foot, but with drills driven by means of a key $\frac{3}{4}$ in. per foot is better as it enables the drills to be more readily removed from the sockets, and at the same time prevents them from falling out by their own weight."

TABLE II. MAGNUM STANDARD TAPERS DESIGNED BY THE BROWN & SHARPE MANUFACTURING CO.

No. of Taper	Diameter at Large End, In.	Diameter at Small End, In.	Depth of Taper, In.	
19	4	$3\frac{1}{4}$	12	
20	5	$4\frac{1}{8}$	14	
21	6	5	16	Taper = $\frac{3}{4}$ in. per ft.
22	7	$5\frac{7}{8}$	18	Depth of taper = 2 × diameter at large end + 4 in.
23	8	$6\frac{3}{4}$	20	
24	10	$8\frac{1}{2}$	24	
25	12	$10\frac{1}{4}$	28	
26	14	12	32	

George R. Stetson, in discussing Mr. Thorne's paper, said: "The objection to a sharper angle or taper is that the drill has a tendency to draw out of the socket when coming through its work. This twists the tongue and produces most of the trouble complained of and would be best obviated by a taper of less than $\frac{5}{8}$ in. to the foot."

What applies to the use of tapers for drills in this discussion applies in general to the use of tapers for

sockets and shanks, and the conclusion can be drawn that if the "bite" of the shank is to be depended on to a considerable extent to do the driving the taper should be small, even at the risk of finding occasional difficulty in separating the parts.

On the other hand if adequate means of driving is to be provided in addition to the "bite" of the taper there are advantages in making the taper greater, although not so great as to allow of jarring loose or dropping out readily.

Assuming that in all cases of machine tools using by some Philadelphia manufacturers who have made the depth three times the diameter for moderately large sizes is admitted by them to be probably longer than necessary even for these sizes. Such a proportion would make the above 14-in. taper 42 in. long.

By the use of a constant a formula has been derived applicable over a wide range, and giving, it is believed, satisfactory proportions. Fig. 1 illustrates the relation of the proposed taper standard for length as derived from this formula, to the established Brown & Sharpe sizes, showing that these new tapers follow in a regular

TABLE III. EXPERIENCE OF MANUFACTURERS WITH LARGE TAPERS

Name	Kind of Machines	Taper per Foot Recommended	Depth Recommended	Remarks
William Sellers & Co., Inc. (Coleman Sellers, Jr.)	Lathes; horizontal boring machines	¾ in.	3 × diam. at large end (or a little less)	Have used up to 8 in. diam.
Mesta Machinery Co. (J. E. Mesta, Assistant Superintendent)	Rolling-mill machinery, etc.	½ in.	3 × diam.	.....
Newton Machine Tool Works (Nicholas P. Lloyd, General Manager.)	Milling Machines, etc.	Use ¾ as std.: rec. 1 in. for large	.....	Have used to 6 in. diam.
Tabor Manufacturing Co. (Wilfred Lewis, President)	General	0.6 or ¾ in.	.....	.....
Mead-Morrison Manufacturing Co. (J. T. MacMurray and Robert Gow)	General	1 in.	About 1½ in. × diam. + 2 in.	.....
Westinghouse Electric & Manufacturing Co. (E. R. Norris)	General	¾ in.	3 × diam.	.....
Bement & Niles (W. J. Hagman)	Steam hammers	½ and ¾ in.	.....	The greater taper used for sizes above 3½ in.
	Steam forge hammers	1 in.	.....	Sizes 2½ to 12 in. diam.
	Lathes	¾ and 1 in.	Up to 5 in. at large end, 2½-3 × diam. 5 in. and over, 2.1 and 2½ × diam.	Sizes above 5 in. are 1 in. taper per ft.
	Drilling and boring machines	⅝ in.	.....	All sizes
	Milling machines	¾ in.	.....	All sizes

these large tapers, either longitudinal keys or cross-hold-back keys or both will be used for driving, a greater taper per foot can be used, thus obtaining the advantage of easy removal with no sacrifice in driving efficiency. To meet these conditions a taper of ¾ in. per foot for large sizes seems ideal, based on scientific grounds and also on the experience of users.

Lengths for Tapers

While the length can be more elastic, a variation being less objectionable than in the case of the diameter or taper per foot, it is desirable to standardize it also. As previously pointed out the tapers already established do not give proportions for lengths suited to large sizes. Thus the Jarno formula would make a

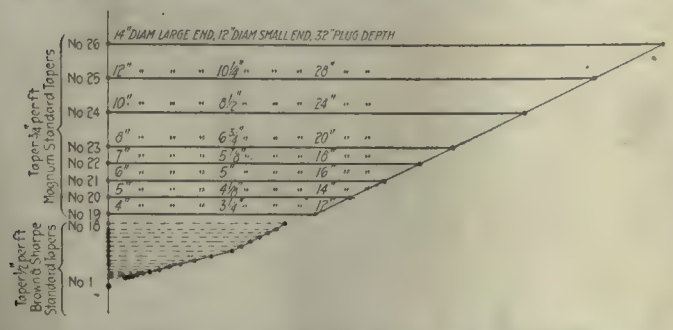


FIG. 1. RELATION OF PROPOSED STANDARD TAPER LENGTHS TO ESTABLISHED BROWN & SHARPE SIZES

taper of 14 in. in diameter at the large end 56 in. long—much too long for practical needs and adding an excessive amount to the cost of both gages and reamers as well as of the machine. A proportion used progression beyond the largest established Brown & Sharpe sizes.

As a result of this investigation the sizes in Table II are proposed, to be known as Magnum standard tapers.

The reason for beginning the numbering at 19 is to avoid lapping on to the numbers of any of the systems now in use, No. 18 of the B. & S. standard being, so far as known, the largest standard as yet suggested. No. 19 of the new system is proportionately larger than the B. & S. No. 18, so that, starting with No. 19 seems logical, even though the new standard has a different name and is of a different taper per foot than the old.

The diameters at the large end are made basic and vary by inches, and with the length of taper obtained by the formula the diameters at the small end are in convenient fractional sizes.

Before determining on the proportions of the Magnum tapers the question of the proportions of large standard tapers was taken up with manufacturers and engineers having experience along these lines, in some cases by personal conferences, in others by sending the following letter:

Mr.——

We have been asked to carry our standard tapers above the 3-in. size, which is the largest we have so far standardized, and the question has arisen among our engineers as to whether in the large-sized tapers of this character, used for arbors, centers, etc., the taper should be more than ½ in. per foot (our present standard), in order not to bind so tightly as to be difficult to drive out, and if made to a greater taper, what would be the limit at which the arbor would tend to jar loose.

We have been referred to you as having had direct experience in these matters, and we would appreciate the

advantage of your professional experience or the practice of your company in this matter.

The question of depth of taper fit, that is, as to whether it should be 2, 2½ or 3 times the diameter, etc., is also a question involved.

If there is any well-known standard established, we desire to comply with same, rather than establishing something new.

Table III gives a digest of the opinions received from various sources in answer to an inquiry I made as to their past experience with large tapers.

Technical and Industrial Education and the War

By Entropy

Will the war have any permanent effect on technical and industrial education? On first thought the answer would seem to be, "No, because it upset the established order and then gave up its work before any results could possibly appear." On second thought, however, it does appear that a change must come about, not through official efforts, but because of the changed conditions.

Formal education has always stalled, killed time and otherwise tried to hold boys and young men until they were 22 to 25 years old merely for the purpose of having them reach a certain degree of maturity so that they could absorb the more difficult studies. This has necessitated about a half-speed program. It has meant the use of fillers or padding in the courses. Part of this has been done in the engineering schools so that they could be classed as colleges, give degrees and bring their faculties under the Carnegie Foundation.

The Men Are Coming Back

Men are coming back from the war, whose education has been suspended from one to two years. There are many of them. They have matured very rapidly; they know what they want and they have got over standing any nonsense. They have stripped the world naked, and have given up rating men by their clothes, their degrees, their academic records. Moreover they are coming back, the larger part of them, at a time when colleges are saying that their doors are closed; they must wait until next September. Next September is a long way off. They want to begin a few weeks after they reach home. If they cannot, and many will not be allowed to, they are going to raise quite a little noise in the front yard. Some may throw bricks, especially in colleges where the members of the faculty have lacked patriotic feeling. The schools that can read the handwriting on the wall will establish entrance requirements based on ability to absorb rather than on academic history, and they will hook the front door wide open days, nights and Sundays.

Another change to which educators will have to become accustomed is the moving of men from industry to school and back again. There will be much more calls for special courses to fit special needs. Men are going to shy at taking German in order to be allowed to brush up on hydraulics. Our schools are too often closed to men who might make excellent use of their facilities because they cannot afford the time required to take all of a regular course up to when the desired study appears in the set curriculum. In fact they are closed to many more men than they take in. Columbia has just sent out word that men are to be received there on the strength of their mentality rather than on the amount of formal education through which they have struggled and sometimes stumbled. We need universities that will be universal, that will take every man, woman or child above the age of compulsory schooling, and prescribe and advise and try out the possibilities of each for education. Such a school should have departments for every subject that was ever taught in a school and then find some more. It should be professional, industrial, agricultural and every other thing that man can think of.

This is a real need growing out of the war. The men who were killed in action comprise some of the best material for leadership that we had. They were the men who could tip the scales our way and they did it. We do not realize as yet the greatness of our losses. We must multiply the actual figures by 10 to get at the relative loss to the country as compared with the European nations. The men who come back, with their education incomplete, will insist on being given the training they need and being allowed to go out and be part of the world again as soon as possible. They are not going to stand for padding and what does a B. S. stand for alongside of a D. S. C.?

Flexibility Unknown to Educators

Flexibility is something unknown to the great mass of educators. To them the only way to teach is to a class, all of the same level, all taking the same thing every day, the laggards eliminated and the pace set so that about one-quarter of the students will be laggards. They find it difficult to think of students as individuals, coming into the work with all kinds and no kind of preparation and at different times. They do not see how to organize the work. They encounter the same difficulty that presents itself to the man who has always worked in a continuous-production industry, who finds himself thrown into a job shop where every job is different from every other.

The solution of the problem is about the same in both cases. First, the personnel must be changed and the men who can only work with stated classes must be allowed to follow their bent in some other school, and second, the men who are capable of giving individual help to the men who need it must be paid enough so that they will be contented and not always hoping that the mail will bring them the offer of another job.

Difference Between School-Education and Self-Education

After all the chief difference between self-education and school education is in the inspiration of numbers and the laboratory apparatus. Boys and men are not so dependent on teachers as the teachers think. They can learn by correspondence if they will. The reason why so few do is because they lack the inspiration of comparison with the work of others. They need intellectual companionship, whether they are learning to be doctors of law, or doctors of automobiles. Given the inspiration of companionship, they need laboratories in which they can try out their wings and see whether or not the theories they have been reading about agree with the facts. The key to the scientific world is the alphabet and the multiplication table. Once in, the student without the help of an expert may knock over the apparatus and kill himself, but if not he soon learns to go alone. Then his instruction can easily become individual, and he will need comparatively little.

Standards of Temperature and Means of Checking Pyrometers

SPECIAL CORRESPONDENCE

All measuring instruments are liable to change from use or abuse and probably none more so than those used for recording the high temperatures of furnaces. The only method of determining their accuracy is by careful and constant testing in comparison with reliable standards. This article describes the standards for testing pyrometers and gives directions in detail for their use.

THE pyrometer is a precision gage that has to withstand extremely severe temperature changes, and its successful use requires some means of checking. To be of practical value it must be accurate, as it is in competition with a measuring instrument which within its own limits is quite reliable, and upon which many place great reliance, namely the human eye. The pyrometer left to itself may easily become less accurate than the eye, and when it does confidence in it is lost.

Present-day requirements demand accuracy and constancy in temperature control, which may be obtained by checking all pyrometers at frequent intervals, a method pursued by many large concerns.

Different pyrometer systems require different amounts of attention, but all may be handled by a standard checking method, the most practicable one being by comparison with a standard. The pyrometer consists of three parts that are liable to error, namely, the thermocouple, the measuring instrument, and the lead wires connecting the two.

A Reliable Method

A method that has been found reliable in carrying out the test provides first for the maintenance of standards of temperatures in the plant and, second, for convenient comparison of these standards with the works instruments. The standard of temperature for the works should consist of at least one platinum-platinum-10-per-cent-rhodium thermocouple previously calibrated by the Bureau of Standards and a potentiometer. While one platinum couple may be sufficient three platinum couples should be available for comparison one against the other. The couple must be subjected to high temperature when used and it is not impossible that it may change. If only one couple is used the change will not be manifest until after the damage has occurred. If only two couples are available and one changes there is no way of telling which has changed; but if three couples are available and one changes it will be immediately apparent which one has changed.

The platinum thermocouple that is regularly used for checking other thermocouples should be mounted in a protecting tube with a mercurial thermometer in the head. The two other platinum couples can be unmounted, and when not in use may be kept in a safe. The mounted platinum thermocouple is used for calibrating secondary standard couples, which may be of the base-metal type, and these standard base-metal couples may be carried about in the works for checking thermocouples in working furnaces. Checks of the working standards against the fundamental standard should be made frequently enough to insure against faulty calibration. The stock of secondary standard base-metal couples which has been checked in the laboratory against the platinum couple also serves as a reserve for replacing works couples which are burned out.

The standard couple or couples should be used for standardizing purposes only, and with a potentiometer, since the potentiometer is the accepted standard instrument for electromotive-force measurements. It should be so designed that its scale can accommodate with full sensitivity both platinum and base-metal couples. If potentiometers are used extensively, one laboratory standard is all that will be required, since this may be checked against the works potentiometers, and if by chance the laboratory standard instrument should develop a flaw it will be apparent because the works instruments will deviate by the same amount from the standard. If the works instruments are millivoltmeters there should be two laboratory potentiometers for checking against one another.

Electric Furnace Necessary

For use with the thermocouples and potentiometers there should be an electric furnace having a zone of uniform temperature of at least 12 in., throughout which temperature variation is not in excess of 20 deg. F. This furnace should have an internal cross-section of not less than the equivalent of a circle 2 to 2½ in. in diameter.

All thermocouples should be checked in the laboratory furnace. The couple being tested is placed in the furnace with its hot junction in close contact with the hot junction of the standard platinum couple and left there long enough for conditions to stabilize. Readings are then taken alternately on the platinum standard and on the works instrument. Having ascertained the relation of electromotive force to temperature for the base-metal couples the latter may be put into service immediately or may be used as secondary standards for the calibration of couples already in use.

This done, some base-metal couples are inserted into the works furnaces so that the hot junction of the secondary standard couple is quite close to the couple to be checked. After leaving the secondary standard in the furnace long enough to come to temperature it is read by means of a portable potentiometer and the result contrasted with those of the works instrument. If there is agreement and the works instrument is in good condition the operator may pass to the next instrument. If there is a discrepancy to justify attention it then devolves upon the operator to find out what is wrong.

What actually is measured is the electromotive force generated by the thermocouple, and what is to be determined is the relation of this force to the difference in temperature between the hot and the cold ends of the couple. If there is any deviation of the electromotive force actually generated it will lead to an error in inferring the temperature. To ascertain whether such change has taken place the service couple should be connected directly to the portable checking instrument and readings alternately taken on the secondary standard couple and the service couple.

Errors due to the variations in the electromotive force generated by the hot junction at given temperatures can be minimized by protecting the thermocouples against contamination, using always the same depth of immersion, and by discarding old couples systematically. The gases and vapors often present in furnaces diffuse at high temperatures through protecting sheaths and affect the couples. The best guarantee of accuracy is careful checking of calibration initially and frequent recalibration. Where the safety and quality of work depend on accuracy checking of thermocouples must be made part of the routine.

As the voltage generated by the thermocouple depends on the difference between the hot and the cold ends of the thermocouple the temperature of the cold

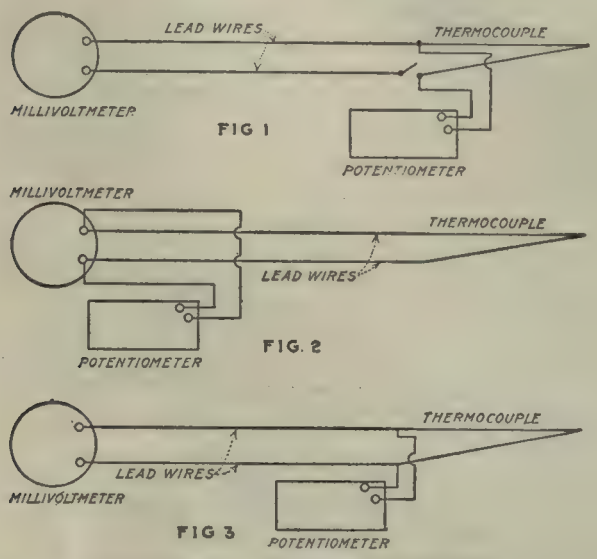


FIG. 1 TO 3. WIRING DIAGRAMS

Fig. 1—Connection for measuring true thermocouple electromotive force. Fig. 2—Connection for measuring true thermocouple electromotive force less drop in couple and leads. Fig. 3—Connection for measuring true thermocouple electromotive force less drop in couple

end must be known in order to obtain the temperature of the hot end. The cold end is that point at which the special alloys constituting the thermocouple terminate, and are connected either to the copper leads, which are in turn connected with the measuring instrument, or to where the special alloys terminate at the measuring instrument.

Millivoltmeter System

If the electromotive force generated by the couple is measured by measuring the current it can produce, errors may appear, due to changes in the resistance of the thermocouple, of the lead wires or of the millivoltmeter; or to changes in the calibration of the galvanometer traceable to changes in the pivot or suspension of the coil or to variations in the magnetic field; or to the cold-end temperature of the thermocouple being different from that for which the millivoltmeter was calibrated.

The operator should know the line drop or loss of potential due to the flow of current through the lead wires for which each millivoltmeter in service is intended. This information should be obtained either from the nature of the instrument or directly by measurements. To determine the effect of resistance on the reading connect a potentiometer to the terminals of the thermocouple, disconnecting the millivoltmeter, as in Fig. 1, and take a reading. Then connect the couple to its millivoltmeter and connect the potentiometer also to the terminals of the millivoltmeter, as in Fig. 2, and take a second reading. The difference between the two readings will give the drop in voltage due to the current flowing through the thermocouple and lead wires. The pyrometer under test may or may not have been calibrated to take care of this drop, but any variations occurring on successive calibrations will appear directly as errors in the pyrometer and should be counted as such.

Another test may be made by connecting, as in Fig. 3, directly to the terminals of the thermocouple, with the couple connected to its millivoltmeter, and contrasting the measurement with the electromotive force of the couple connected to the potentiometer only. The difference between these two readings will show the drop in the couple only, and as the couple deteriorates the difference between the value as connected in Fig. 1 and the reading as in Fig. 3 will show the effect of increase in the resistance of the couple itself, due to temperature or other causes. The lower the resistance of the millivoltmeter the more frequently should this test be applied, for the greater will be the relative influence of the thermocouple resistance.

If after the foregoing tests no resistance trouble is located in the leads or in the thermocouple and the couple gives the proper voltage and the pyrometer still reads in error the trouble must be in the millivoltmeter, which should then be taken out for repair or sent to the maker.

Cold-Junction Temperature Effect With Millivoltmeter

A thermal electromotive is generated at the cold junction of the two metals forming the thermocouples as well as at the hot junction, and the net electromotive force actually measured is the difference between the two. The electromotive force of the cold junction is small and usually not subject to important variations at any given temperature, since the cold end is not ordinarily subjected to high temperatures, contaminating gases or other conditions that would be apt to modify its characteristics. The necessity of making any correction for the cold end may be eliminated by holding the temperature of the cold end always at the temperature for which the pyrometer was calibrated, as by surrounding the cold end with a jacket through which water is circulated or by inclosing it within a steam box or an ice box. Another way is to bury the cold end in the earth not less than 10 ft. and not near sources of high temperature. Whatever method is adopted the temperature of the cold end should be taken

from time to time by means of a mercury thermometer, as variations may occur due, for example, to the clogging of water or steam circulation or to changes in subsurface temperatures brought about by building operations, heating systems, etc. Variations in cold-end temperature thus discovered must be allowed for, as will be explained later.

While provision is made for keeping the cold-end temperature constant, extension leads of the same materials as the thermocouple must be provided, as it is hardly ever convenient to place the constant-temperature device near the furnace. Where a millivoltmeter is used this introduces further resistance, and it becomes necessary to ascertain from time to time whether the resistance of the extension leads has changed. A method similar to that shown in Fig. 3 for measuring the potential drop in the copper lead wires may be used for this purpose.

With base-metal thermocouple and lead wires of the same materials as the thermocouple all the way back to the millivoltmeter the cold junction is, of course, located at the binding posts of the latter and variations must be allowed for, as also variations in the resistance of the leads brought about by temperature changes.

Checking Required With the Potentiometer System

When using the potentiometer system all resistance checks are omitted, since no current flows through the thermocouples, lead wires or galvanometers when a balance is obtained. Reading is then taken. If the resistance of this circuit should become excessively high, as from defective contact, it will be shown by a lack of sensitivity when making the balance. The thermocouple used with the potentiometer should be checked for the relation between temperature and electromotive force, as already mentioned.

The potentiometer itself may give faulty indications from two causes—variations in internal resistance, as from the failure of imperfectly soldered joints, and variations in the electromotive force of the standard cell, which is the basis of measurement. As all instruments are inspected and tested repeatedly in the process of manufacture, structural defects are rare although possible. Properly made standard cells free from impurities retain their electromotive-force characteristics indefinitely. In use on the potentiometer they are subjected only to very minute currents which flow sometimes one way and sometimes the other through the cell, charging and discharging the latter as a storage battery.

By having two potentiometers at hand a check may be made by connecting them so that one "bucks" the other. When they are balanced so that no current flows the settings of the two instruments should agree, and if they do not the one in error can be discovered by comparison with a third instrument. The cause of the trouble may then be located by anyone of sufficient experience in electrical instruments, or the instrument may be sent back to the factory. Variations in standard cells can be discovered by connecting them in opposition to one another and finding by means of a potentiometer whether there is any resulting electromotive force. The agreement should be within less than 0.0001 millivolt.

The character and completeness of the checking equipment will depend largely on the nature of the works' equipment with which it is to be used, and a complete laboratory standard equipment for a large plant doing high-grade work might cost more than the works' equipment of a small plant.

First—A plant requiring in the works 30 or more thermocouples and turning out a high-grade heat-treated product should have the following laboratory equipment: Laboratory standard precision potentiometer with accessories; portable double-range potentiometer; one mounted platinum thermocouple; two unmounted platinum thermocouples with accompanying insulators, etc.; checking furnace with control panel; extra standard cell.

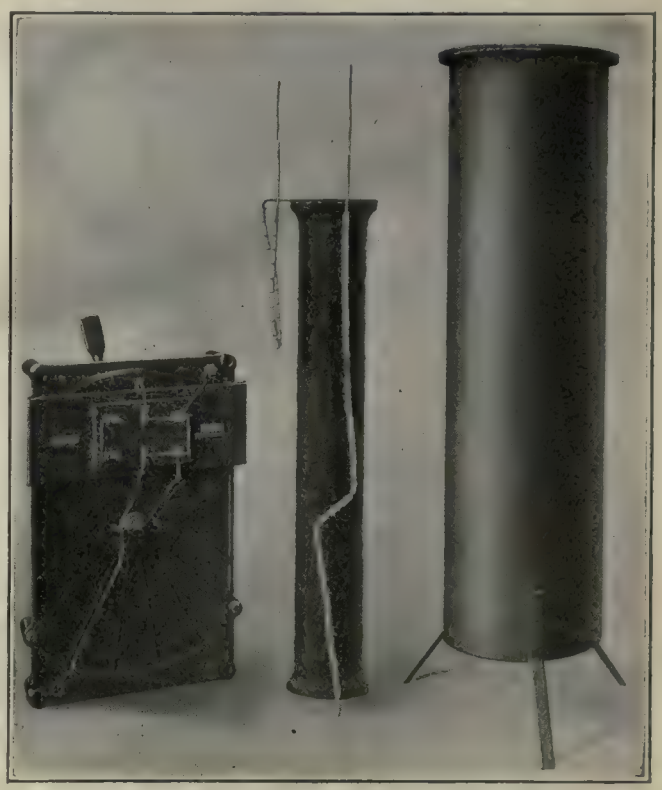


FIG. 4. THERMOCOUPLE CHECKING FURNACE

Second—For a smaller plant: Two double-range portable potentiometers; one platinum thermocouple mounted; two platinum thermocouples unmounted, with necessary insulators; one checking furnace, complete, with panel board.

Note—If a potentiometer system is in the works one of the portable potentiometers may be omitted.

Checking Furnace

The right kind of furnace for checking thermocouples is as important as to have standard couples, and this is true whether platinum couples or base-metal couples are employed. The furnace should be of ample size, which implies the use of a comparatively large checking furnace, giving a uniform temperature for a distance of at least 12 inches.

The heating element of the Leeds & Northrup thermocouple checking furnace, Fig. 4, consists of a nonoxidizing resistance wire wound on a tube of refractory material, which is then further coated with a refractory paste and baked. The tube rests on a bottom brick of

refractory material, which in turn is supported by an asbestos-board bottom in the cylindrical sheet-iron casing. The space between the heater element and the casing is filled with a powdered insulating material. The annular opening at the top between the heater and the casing is closed by a refractory-top brick, which is

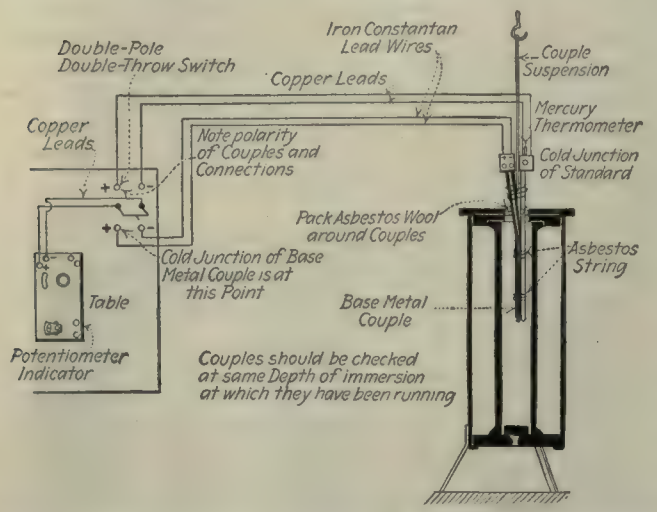


FIG. 5. THERMOCOUPLE CONNECTED TO POTENTIOMETER (SETUP 1)

covered by an asbestos board. The top board and brick have a central opening of the same diameter as the inside of the heater, while the bottom brick and asbestos-board bottom have a small plugged opening for cleaning purposes, above which is placed a platform on which the couples can be rested. The connections to the heater are brought out through the bottom board.

The Heater Tube

The heater tube is 36 in. long from end to end, and it is guaranteed that when at full temperature a section at least 9 in. long will be found in which the temperature does not vary over 10 deg. Fahrenheit.

Windings of two different resistances are used in the heaters, for 110 and 220 volts respectively. Each furnace is supplied with a panel, bearing on the front a double pole, double-throw switch, and on the back a rheostat for controlling the current flowing through the furnace. This controller panel is designed to be mounted in a vertical position on a wall.

Directions for Setting Up and Using the Thermocouple-Checking Equipment

A small, clean, light room should be set aside for the checking equipment, particularly if the laboratory precision potentiometer be included. In this outfit the galvanometer is separate from the potentiometer case and, together with the lamp and scale, should be supported on a firm foundation free from vibration. The controller for the furnace should be so located, preferably mounted on a wall, that the person using the potentiometer can control the furnace without leaving his seat. The location of the furnace itself is immaterial, except that it should be placed at some distance from the instrument.

The standard thermocouple and the thermocouple to be calibrated should so arranged that their junctions will occupy as nearly as possible the same point in the furnace. This is best assured by tying the junction of the base-metal couple against the tube of the standard thermocouple, using asbestos string. The couples may be further tied at several places along their lengths to insure their staying together. The base-metal couple should be bare, that is, not inclosed in its tube. A piece of sash chain may then be attached to the thermocouple heads and passed through a pulley secured to a hook or other support in the ceiling, so that the couples will hang centrally through the opening in the top of the furnace. The couples should not be let in so far that the mercury thermometer of the standard couple will register a high temperature. The head should project at least 8 in. beyond the top board of the furnace.

Connecting Thermocouples to Potentiometer

Two ways of connecting the thermocouples to the potentiometer recommended by the Leeds & Northrup Co. of Philadelphia are shown in Figs. 5 and 6 and marked "Setup No. 1" and "Setup No. 2" respectively. In setup 1 the lead wires to be base-metal couple are of the same materials as the latter, so that the cold junction of the base-metal couple is carried back to a double-throw switch, which is connected to the potentiometer by copper leads. The cold end of the standard couple is connected to the double-throw switch by copper leads. Its cold junction is thus in the head where the mercury thermometer is placed. In setup 2, which is suggested for comparing secondary standard base-metal couples with works couples, both sets of leads are of the materials used in the couples, thus bringing both cold ends back to the double-pole, double-throw switch. If the leads connecting the latter with the potentiometer are made of the base-metal couple materials the cold end may be carried back to the potentiometer, and corrections for cold end temperatures can be made directly in the potentiometer itself. The furnace controller, thermocouples and potentiometer all being thus placed and connected, preparations may be made to run a comparison between two thermocouples. The interior of the furnace should be clean, any rust being swept out through the hole in the bottom. The latter should be

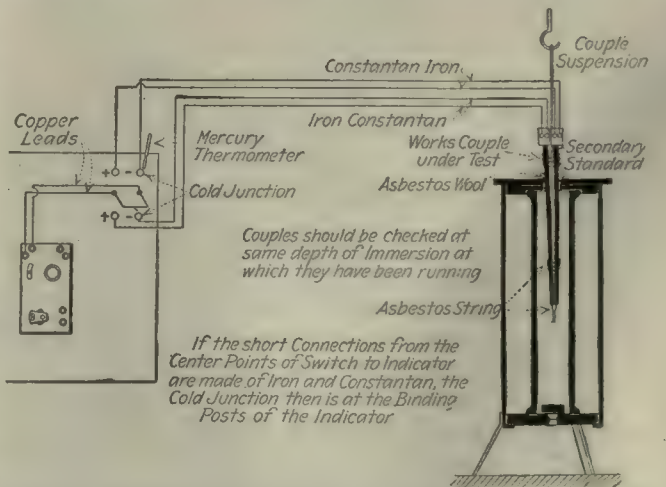


FIG. 6. THERMOCOUPLE CONNECTED TO POTENTIOMETER (SETUP 2)

closed with the conical plug provided, over which should be placed a small brick of fire clay. Some asbestos wool should be on hand for packing around the thermocou-

ples when they are lowered into the furnace. Before doing this the furnace should be brought up to temperature.

The furnace having been brought up to a full temperature of say 1600 deg. F. the couples may be lowered into it and the open space around the couples closed with asbestos wool. Set the rheostat on the point to hold approximately the temperature desired, taking alternate readings on the standard couple and the couple under test by throwing the switch. Enter the readings in two columns, heading one "X" and the other "Standard." By allowing a regular time interval, say one or two minutes, to elapse between readings, the rate of change in temperature may be observed. The final reading used for comparison of the two couples should be taken only after the temperatures have remained approximately the same for five or ten readings, the number of similar readings to be taken depending on the speed with which the couples have been approaching the temperature of the furnace or the speed with which the furnace temperature has been changing. True comparison cannot be made while changes in temperature are going on.

Cold-Junction Correction

It is convenient to refer the electromotive force of thermocouples to some standard cold-junction temperature. 0 deg. C. or 0 deg. F. are usually selected for this purpose. With the cold junction at 0 deg. F., the relation between the hot-junction temperature of a Leeds & Northrup base-metal thermocouple and the net electromotive force is shown in Fig. 7. It will be seen that

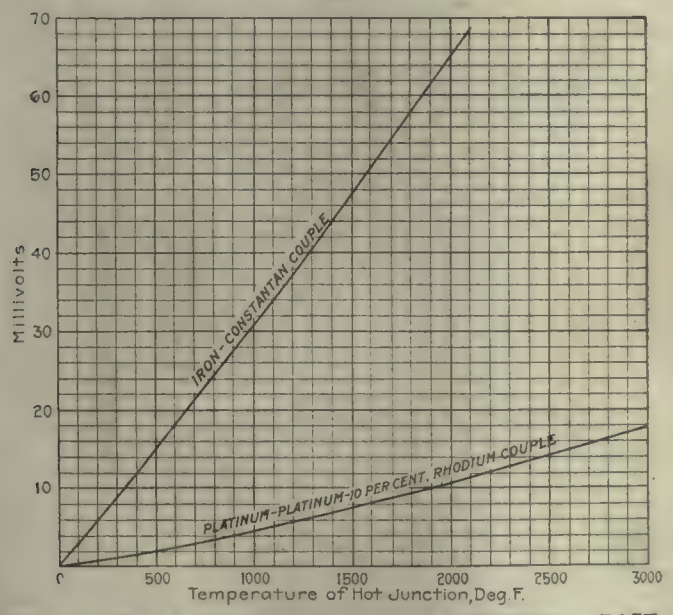


FIG. 7. CHART SHOWING RELATION BETWEEN A BASE METAL THERMOCOUPLE AND THE NET ELECTROMOTIVE FORCE

the line is nearly straight. The line for a platinum-platinum-10-per-cent-rhodium couple, however, is far from straight, and it will be observed that 10 deg. added to the temperature at 1600 deg. F. causes a greater increase in the electromotive force than 10 deg. added to the temperature at 32 deg. F. With cold junction at 32 deg. F. and hot junction at 42 deg. F. 0.035 millivolts are available for measurement by the potentiometer or millivoltmeter, while if the cold-junction temperature is raised to 1590 deg. and the hot junction to 1600 deg. F. the number of millivolts available for measurement will be 0.060.

If the hot junction is at 1600 deg. F. and the cold junction at 42 deg. F., the electromotive force available for measurement is 8.075 millivolts, while if the cold junction is at 32 deg. F. the millivolts measured would be 8.110. The difference is 0.035 millivolts, or the number of millivolts corresponding to the cold junction at 32 deg. and hot junction at 42 deg. F. If the scale of the pyrometer has been laid out in degrees on the assumption that the cold junction will be at 32 deg. F., whereas it is actually at 42 deg. F., the instrument will read 1594 deg. F. instead of 1600 deg. F.

It will thus be seen that to correct for cold-junction temperature the number of degrees difference between the standard cold-junction temperature, say 32 deg. F., and the actual cold-junction temperature, say 42 deg. F., should not be added to the number of degrees indicated by the instrument when the cold-junction temperature is at 42 deg. F. Instead the reading should be converted to millivolts, then the millivolts for cold junction at 32 deg. F., and hot junction at 42 deg. F., viz., 0.035, added to the millivolts actually read with cold junction at 42 deg. and hot junction at 1600 deg., viz., 8.075, will give 8.11 millivolts, which corresponds to 1600 deg. F. with cold junction at 32 deg.

If the scale of the millivoltmeter or other instrument is marked in degrees and not in millivolts, the corrections may be calculated as follows: Divide the electromotive force corresponding to cold junction at 32 deg. F. and hot junction at the actual cold-junction temperature by the ratio expressing the slope of the curve at the actual hot-junction temperature. For example, if it is known that the electromotive force for cold junction at 32 deg. F. and hot junction at 42 deg. F. is 0.035 millivolts and that the rise in electromotive force for increase of hot-junction temperature from 1590 deg. F. to 1600 deg. F. is 0.06 millivolts the correction to be added is

$$(42 - 32)\frac{\frac{0.035}{42 - 32}}{\frac{0.06}{1600 - 1590}} = 6 \text{ deg.}$$

and the indicated temperature would be 1594 deg. F., plus 6 deg. equals 1600 deg. F., which is correct.

Dividing in Degrees and Minutes

By Anton Brunner

When it is necessary that lines be drawn or holes drilled at points separated by a certain angular distance, if it is possible to mount the work on a dividing head the work may be done very quickly as follows, provided the desired spacing be not closer than $\frac{1}{6}$ deg. or 10 min. of arc:

With the indexing pin in the 54 circle of the index plate, multiply the number of degrees required by 60, add the number of minutes, divide the sum by 54 and the quotient and remainder will be turns and holes respectively.

The reason for this is not hard to find, as the 54 circle divides to 2160 spaces, or one-tenth the number of minutes in a circle, therefore each hole represents 10 min. of arc.

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments. The mechanical hands may be used for many common operations.

Mechanical Hands and Arms

BY J. A. LUCAS



The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

The photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

An Electromagnetic Die Ball

SPECIAL CORRESPONDENCE

There are some classes of work handled by toolmakers in which a third hand would be a desirable asset, particularly if the hand had a grip sufficiently powerful to enable it to hold a piece of work against filing and chipping operations, and withal flexible enough to assume any position that would assist the worker in getting at the surfaces operated upon. The die ball is perhaps the nearest approach to this desirable medium, but the ordinary form of die ball has decided limitations, which are made somewhat more remote by the device herein described.

THE tool variously known as a ball vise, die ball, swivel vise, and doubtless by many other names, is indispensable to the worker who has to do with small drop and stamping dies or other work that involves scraping or light filing of pieces of irregular contour the position of which must be constantly changed as the work proceeds in order to present at all time and to best advantage that particular portion of the surface requiring for the moment the worker's attention.

Perhaps the most familiar form of this tool is a block of iron cast in the form of a hemisphere, with two lugs projecting above the meridian, one of these

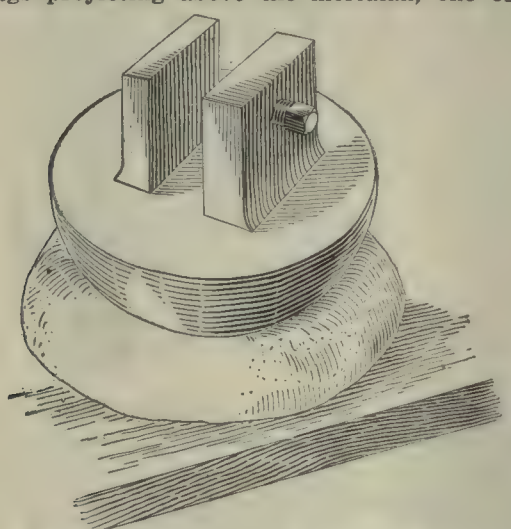


FIG. 1. ORDINARY FORM OF DIE BALL

lugs being fitted with setscrews, so that together they form a sort of vise in which work may be held.

The convex portion of such a piece generally comes about as near being truly hemispherical as a patternmaker can turn with a hand tool, his "eagle eye" being the guide, and about as smooth as is convenient for a molder to cast it. The other member of this device is a leather-covered stuffed pad with a depression pounded in the center for the iron "die ball" to rest in.

Sometimes the ball fits the hollow spot in the pad closely enough so that it will lie still in one position if it is not disturbed, but at its best it is not rigid enough to serve for more than very light work, and its resistance to the constant movement necessary is all out of proportion to its stability. This form of die ball is much affected by jewelers and others whose work is very light, and in the sizes used by them it is so small that it can be handled continuously without paralyzing the left wrist of the worker who furnishes the motive force. This form of die ball is shown in Fig. 1.

When real work is to be done on the piece held in the die ball, such as scraping or perhaps chipping out corners in a die, the leather pad does not furnish sufficient holding power, and after the worker has followed the work over the horizon and has righted the pesky thing a few times, he gets on his ear, throws the pad under the bench (or out of the window) and hunts up a cast-iron ring of suitable size, into which he sets the ball. This increases the resisting power of the implement to a considerable degree; indeed so much so that moving it has become a two-handed job, and after the worker's wrists are tired out he is ready to hunt up the leather pad again.

In the next stage of evolution the workman mounts the ball in the lathe, sets a tool in the compound rest

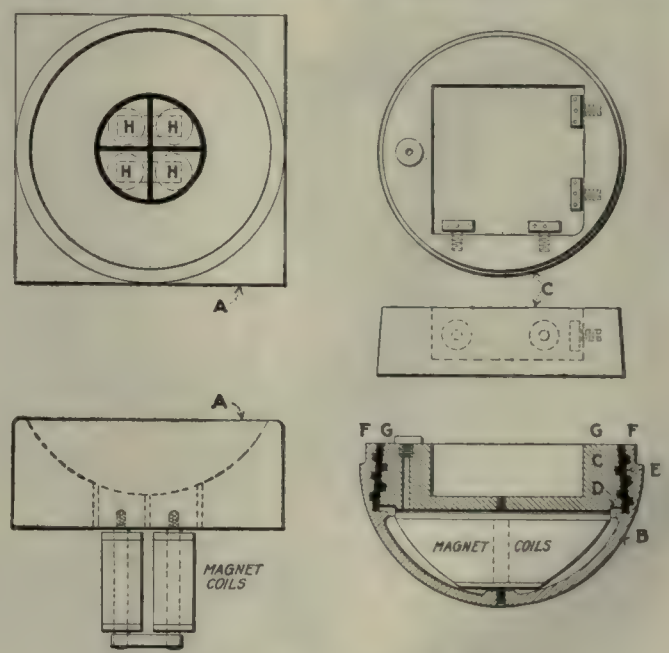


FIG. 2. SECTIONAL VIEW OF DIE BALL

and turns the convex surface to a true hemisphere; then chucking the ring he concaves it to fit the ball. The ease with which the ball may now be moved depends upon how well the work was done; that is, how nearly the surfaces in contact approach a truly hemispherical contour.

After using the tool in this form for a few weeks or months, the time depending upon his temperament, the worker puts emery and oil between the surfaces and proceeds to lap them together. If he is a good, conscientious workman he does a good job, and the result is a die ball or ball vise that is fairly stable and at the same time not hard to move. In fact if the lapping

has been nicely done the tool has reached its highest point of efficiency.

Now nobody ever was or ever will be satisfied with a die ball. It moves too easily for some parts of the work and not easily enough for other parts, so when an ambitious mechanic has reached the above-mentioned limit of perfection and found it not good enough he seeks some improvement, and this usually takes the form of a two-piece stationary member with some sort of clamping device; in other words, the thing becomes a ball-and-socket joint and for the first time in its evolution justifies the name of ball vise.

But it is still a two-handed job to move the ball, one hand being required to manipulate the clamp and the other to furnish the motive power, and while it can be done without laying down scrapers, riffles, etc., that may be in the right hand it is nevertheless inconvenient and delicate tools are sometimes broken in the operation.

Another bad feature of this form is that in order to make a ball-and-socket joint it is necessary that there be considerably more than a hemisphere, therefore the vise part must be away above the center of gravity and supported by a comparatively small neck, which makes the whole thing top heavy, liable to fall to its lowest position when the clamp is loosened, and is hard on the wrist if it is at all heavy.

Seeks New Device

The writer had reached this stage in the evolution of the ball vise, and finding none of them to his liking he cast about for possibilities of improvement, eventually deciding that electromagnetism furnished the medium through which it could be attained.

The final and satisfactory stage was reached only after an intermediate and unsuccessful step, and for the benefit of those who may desire to copy this device and who know little about electromagnetism we will make the illustration, Fig. 2, cover both the unsatisfactory and the satisfactory forms.

Our dies were all made on blocks of steel approximately 4 in. cube, and the vise part was made to accommodate this size. A base, shown at *A*, Fig. 2, was first made about 8 in. square with the concaved surface turned as accurately hemispherical as possible by using a tool in the compound rest of a lathe and leaving the clamping bolts just loose enough so that the upper slide could be swiveled about its stud by bumping it along with a ball of lead. This is not such drastic treatment as it sounds, and if done with care and judgment, with the tool taking only a light finishing cut, a very good result can be accomplished.

The radius to which the tool was set was 4 in. and the casting at this time was solid; that is, it did not have the inserted magnet heads as shown in the cut.

The convex surface of the ball *B* was turned in the same manner as the other casting, with the tool point back of the central stud of the compound rest instead of in front of it. Both of these turning operations were performed in a lathe much larger than was necessary to swing the castings in order that the compound rest could be used in this way without the interference that would have resulted if a smaller lathe had been employed.

The two parts were then placed together with emery and oil between them and carefully lapped to a full bearing. The motive power for lapping was a small boy, and to make the work easy a rod was screwed into the threaded boss at the bottom of the ball; the cavity was filled with small chunks of lead to give it weight. The rod reached 5 or 6 in. above the center of the ball and had a round wooden knob on its upper end. This work was, of course, done before the ball was finally assembled, as the manner of assembly renders it practically impossible to take the ball apart without destroying it, as the heat required to melt out the lead ring would burn up the magnet.

The ball was made in parts as shown in the sectional view. In this illustration *C* is the part which was arranged to hold the work by means of a square recess

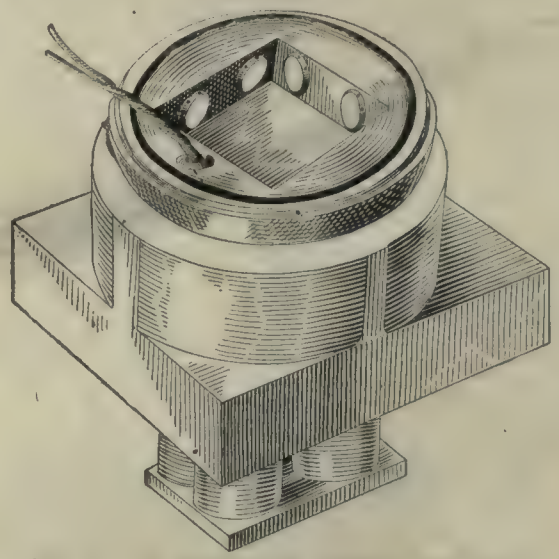


FIG. 3. AN ELECTROMAGNETIC DIE BALL

measuring 4 in. in either direction from the ends of the capstan-headed screws to the opposite wall. This recess was about 1½ in. deep, and as the bottom was about 1 in. below the center of gyration of the ball this left the top surface of a 4-in. cube (the die blocks to be worked upon) 3 in. above this center, much less than it would have been in the ordinary form of ball vise, and therefore less leverage was brought to bear to move the ball when work was to be done on the die.

Magnetic Insulation Necessary

D is a brass ring to bring the part *C* central without allowing it to come in magnetic contact with *B*. The largest diameter of *C* was a trifle smaller than the smallest part of the opening in the top of *B*, so that when assembled there was left the annular opening *E* with the recesses on each side which was afterward poured full of molten lead. A wrought-iron stud threaded at both ends was the "core" of the magnet, and a wooden spool slipped over it contained a sufficient length of No. 36 copper wire, silk insulated, to pass ½ amp. at 110 volts direct current.

It was an easy matter to draw parts *A* and *B* together by means of the magnet core, the snug-fitting brass ring *C* bringing them to their proper relation, and it was also easy to pour the lead ring *D* and peen it down. With the ends of the magnet wires pushed

back into the hole and the hole plugged with waste a facing cut was taken over the flat top of the ball by the simple expedient of setting the ball into the base casting, which was still bolted to the faceplate of the lathe, putting a piece of hard wood in the recess and setting the tail center against the wood.

The magnet lead wires were then fished out and soldered to the ends of a short piece of lamp cord, after which a hard rubber socket-bushing was slipped over the cord and screwed into place as indicated in the cut. An attachment plug was put on the other end of the cord, a wall socket properly connected to the service wires, and the contrivance was ready.

Trying It Out

I was quite proud of my "invention," and, calling all hands to witness the launching, turned on the "juice" and was astonished at the facility and alacrity with which the darned thing wouldn't work. The ball would move easily enough with the current off, but it would move quite as easily with the current on.

After receiving much gratuitous advice from my friends in which the words "junk" and "scrap heap" were freely used I sought to locate the error in my reasoning. I soon discovered by test what any competent electrician who has looked at the sketch already knows—the magnetism was all at the points *F* and *G*, there being none at all at the center.

There being no way to disassemble the ball without destroying the value of the wire, the magnet was left where it was, and the bushing hole plugged with lead. The center of the base was bored out and the segments *H* of cast iron were made and set in by blocking in position and casting lead around them. These segments had previously been tapped for the magnet cores, and the concaved upper face made to conform as nearly as possible to the contour of the piece of which they were to be a part before the lead was poured and peened into place; thus but a light cut over the whole concave surface was necessary to put the assembled base in condition for relapping.

A New Start

Before this second lapping the lead was scraped below the surface of the iron for a few thousandths in order to prevent the particles of emery from bedding in and cause the surface to be lapped unevenly.

Four magnets coils were computed to pass ½ amp. of current and were set in place to make two pairs of magnets as shown in the cut. A hole was cut in the bench on account of the projecting magnet spools, and as this located the tool definitely in one place it removed the previous objection to permanent wiring. The service was through a double-break switch located on the wall at the back of the bench where the diemaker could reach it without too much trouble. Under the bench the current was carried to the magnets through a single-break switch normally held closed by a spring and opened by a foot treadle.

In this latter form the die ball worked to perfection. With the current on it was held as firmly as if clamped, so that one could take quite strenuous cuts with chisel and hammer without moving it, yet a touch upon the foot treadle rendered it so mobile that it could be moved by the pressure of a finger.

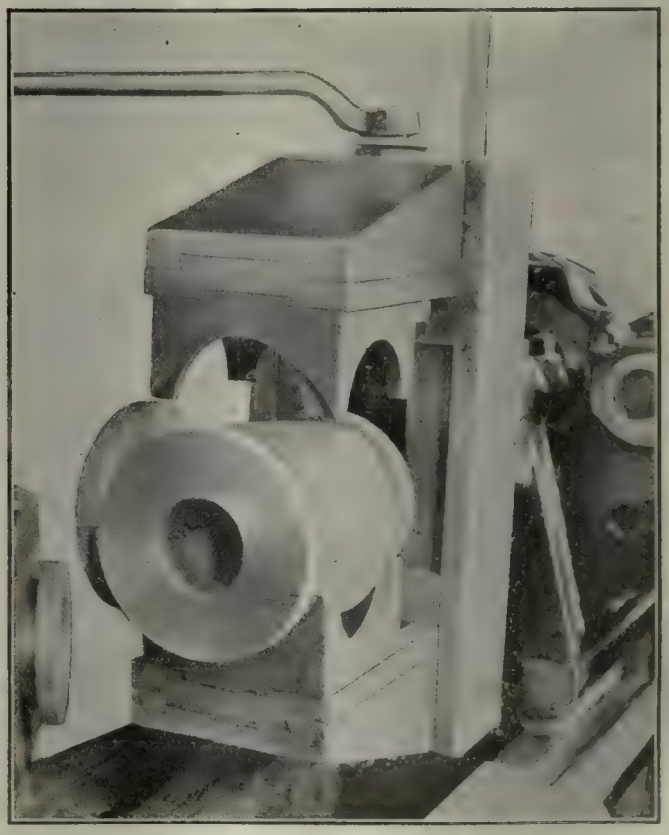
I have used die balls, ball vises, diemakers' clamps and various other devices to which tool and die makers resort to hold such work as they would hold in their hand if their hand and wrist were strong enough and have never found anything that was as rigid while being as easily controlled as this magnetic die ball, and though it is a number of years since I saw it last, if I had any quantity of small drop-die work to do, I should certainly make another.

Special Chuck for Large Pipe Fittings

By H. J. Ventner

Large flanged pipe fittings are faced off in a turret-head lathe in the plant of the Jarecki Manufacturing Co., Erie, Penn. It is important that this facing be smooth and true, so that the flanges will draw together and make a water-tight joint when the fittings are put into service.

A special chuck which this firm has designed and built for swinging these large fittings in the lathe is



SPECIAL CHUCK FOR FACING FLANGES OF PIPE FITTINGS

shown in the illustration. It is simple in design, but serves its purpose well. The 4-in. fitting shown in the chuck indicates its size, but chucks of the same design have been built to take fittings for 8-in. pipe.

It will be noticed that the blocks that hold the fitting are dovetailed into the chuck jaws in such a manner that they may be readily removed and blocks for holding different sizes and shapes substituted.

As will be seen in the cut a spacer is used between the chuck jaw and the holding block, and by using different thicknesses of these spacers the chucks can be adapted to a wide range of sizes.

The Human Element in the Machine Shop*

By JAMES HARTNESS
President, Jones & Lamson Co.

THE war has brought a new sense of fellowship and a new desire for coöperation, and while this is generally apparent in many phases of life, and particularly in the industries, there is imperative demand for a more complete awakening of all men in the industries. For, with a clear view of this situation, the great menaces of our present day will be eliminated. We will no longer have to tolerate unjust inequalities.

A study of the human element establishes beyond question the fact that specialization of individuals and industries is inevitable if we are to maintain the upper trend of civilization. It produces team work and a mutual esteem. It induces conservation of human energy and tends toward equality of division of the fruits of labor. It makes each man the fittest for his position, and it brings forward a correlative postulate that neither high nor low positions should be occupied by incompetent men; that the appointment of unqualified men is a crime against humanity that will be unthinkable after we have reached the point of full comprehension of the dependency of each interest on all other interests, and of the full and absolute right of each to demand of others a true fitness for the work or the office.

The workman in the old machine shop was known as a machinist and apprentice or a helper. The machinist trade required skill at the bench, vise, and forge and in the operation of the lathe and the planing machine. It also required a general knowledge and resourcefulness which enabled the machinist to make good with the meager facilities of the machine shop of that time. The large specialized shop of today was unknown.

The worker in the machine shop of today is no longer known as a machinist because that term does not cover the present range of positions. Even the term "all-round machinist" is no longer satisfactory. Specialization has made so many divisions in the work that it has resulted in developing men for special branches, so that today we have relatively few men who can skilfully operate, for instance, both the engine lathe and the planing machine. Even if there are those who ever had that ability, most of them have lost it through specializing on one or the other.

Team Work

The subdivision of machine-shop work has resulted in a division of interests, and while this division is between various kinds of work, it is becoming more marked between the executive and the worker—the one who directs and the other who executes—or, in the machine-shop parlance, the boss and the workman. This cleavage is greater because the executive's work is mostly that of the brain, for he seldom has opportunity to work with his hands. This exclusion of all phases of manual labor induces in the executive a point of view that is one-sided, and it is undoubtedly equally true that the worker's view is incomplete. It is for the executive to manage the affairs so that the worker will have a more comprehensive view, at least to have a feeling of fellowship and a readiness to accept the view of the executive. But neither will accept the view of the other until there is a more thorough mixing, which will give each one a chance to understand the other, and to realize that each must be ever ready to coöperate. This readiness to coöperate will grow out of our study of this so-called "human element."

The human view will make us all labor toward the complete elimination of degrading tasks by changing machinery and processes to fit the various types of men available. But through it all we must see that our scheme of work is true to the fundamental law of specialization, and that we recognize that there must be some division between the physical and mental tasks. We must recognize that this does not necessarily lead away from democracy but that in reality there are two extremes. At one end we find the ideal of a highly specialized organization in which the greatest value in quality of work and quantity of output is possible through a complete coördination of the work of all types of men, each set at his own kind of work in which he can excel. The other extreme is one in which we find a general disorganization which returns us to the primitive condition in which men's energies were most inefficiently used.

Machine Shop Produced the Wealth

The salvation of the world will be worked out if there is at least one well-disposed nation that stands firmly for specialized industrial organization. Such a nation could dominate all others and could ultimately check the disorganizing activities of the well-intentioned but shortsighted reformers. The one tends to a higher civilization and national security and the other is a direct step toward chaos.

The machine shop has produced the great wealth of the country. It has developed transportation, facilitated the most complete system of dissemination of knowledge, and brought the comforts and luxuries of life to an ever-increasing number of people. Many of our troubles of the past and present are due to our failure to give due heed to the human element in our industries. The purely mechanical problems are, after all, the minor elements, and while we must admit that they absorb nearly all of our energies, we know that it will be better for us to keep a broader view.

The Human Element Vitalizes Our Work

Our greatest engineers have been those who understood the human side. These men were successful in great constructive achievements, not merely because they possessed brains, unusual power and were untiring workers in the field of science and mechanism, but because they combined with these qualities a clear understanding of their fellow creatures. They knew the inner man as well as the physical man and each branch of their work was carried forward in keeping with that knowledge.

America's part in the great war as well as the thrilling achievements of the Allies was accomplished through the inner urge of the human element. The contribution of the machine shops would have been wholly lacking in effectiveness if it had not been for this energized human element. The consideration of the human element intensifies our interest in the details

*Abstract of a lecture delivered Mar. 5, 1919, at Johns Hopkins University.

of engineering problems, and makes it posible for us to interpret and coördinate the views of the various elements that must be dealt with in the machine shop.

Experience tells us that every creature has a knowledge that fits its environment. We would not go into the orchard and give the oriole drawings and specifications for the construction of its nest, and I am just as fully aware that if we understand our work we admit, to begin with, that we cannot direct the worker who is fitting the thread of the inner sleeve of the cylinder of the Hispano-Suiza motor. We can write specifications a mile long and present diagrams that cover the continent, and yet fail to equal the skill of the worker who has been at that place where those sleeves have been fitted and knows what kind of a fit will give good service and what kind will not be satisfactory. In other words, all the way through our work in the machine shop we must remember that experience and skill acquired in the work, even when not accompanied by the ability to give the scientific explanation of the operation, is essential to accomplishing results.

Inspiring a New Attitude

This recognition of the supreme importance of the worker inspires a new attitude toward the man who works with his fingers. It is an essential attitude if we are to understand that man. Do not let us be misled into the notion that a keen interest or even appreciation of the worker's importance will give us a full understanding, for unless we live with him and are subjected to the same conditions of his home and his work we may never understand him. Again, while it is not often possible to establish a full understanding, it is especially difficult when environment differs, so that we must do all we can to get the best possible understanding of the various people with whom we deal.

The allocation of men according to fitness is of supreme importance. No greater good could come to the machine shop and in fact to the whole industrial world than a rigid application of this doctrine. While our attention at present is centered on the problems of the machine shop, the far-reaching application of this principle is one that should be recognized by us as citizens. Just as the stockholders of a machine shop have a right to demand the fitness of each officer and worker for the duties of his office or job, so has the worker a supreme right to demand intelligent direction. Intelligent direction of a machine shop cannot be found in men who do not regard the human element; who do not appreciate that each man has a special fitness for some part of the work and that this special ability may be of supreme importance to its success. It would seem that the simple fact that each man should be qualified for the duties of his office would be a principle that would be recognized by everyone, but thus far it is not an item of our everyday practice.

Modern Conditions Require Team Work

We should see to it that a part of every man's education is a recognition that each mortal on the face of the globe has a special fitness for some place, that skill and ability for certain work are not acquired in a few weeks or months; that fitness for the job and office can only be acquired by years of continuous service. Each must recognize his own value and the value of others. Modern conditions make it necessary to have team work between the technical and the experienced man. In order to establish this team work we must get out of our heads the notion that the man with calloused fingers is of a lower order of humanity, and that his ungrammatical speech places him outside the holy of holies. Each must recognize the value of the other and the absolute need of coöperation.

The great doctrine of fitness for office will become a popular slogan, for it is a simple and effective measure by which we can determine our course in this world, both in and out of the machine shop. It is for the engineer to preach this doctrine and to see that positions are filled by those who are qualified by experience.

Some Final Suggestions

Realize that you have a training and vitality that is of great value; that a right attitude toward those under and over will win in the long run; that coöperation with a cordial and appreciative attitude toward everyone is the strongest asset you can have.

Know that if there are to be investigations of industries they must be conducted by industrialists, not by men who are incompetent to manage them. Know that it is a crime to appoint incompetent investigators. Know that an industry has a vitality the same as a man, and that its life can be destroyed by an ignorant investigator with a probe poking into every nerve and muscle.

Have faith in the honesty of the other fellow and know that there is no profession that has a monopoly of honesty and square dealing. Crookedness and unfair competition can be corrected without destroying the industry. The barn should not be burned down to kill the rats.

Know that the disturbance of an industry produces a great economic loss to each worker and to the country at large, and that the real enemy of our country is the incompetent who disturbs the worker, either by impressing some unnatural order of work, by resorting to the "hire and fire" plan of control, or any of the other false plans that are not in keeping with the human element. Fitness for office corrects many of the irregularities of reward or distribution of the fruits of labor.

Must Consider the Other Fellow

The war has taught all of us who are not too dense to receive impressions, that we must consider the other fellow. The war has taught us that we must exalt the man, rich or poor, in the degree in which he meets the demand, and each one must render service in some position for which he is qualified and deserving.

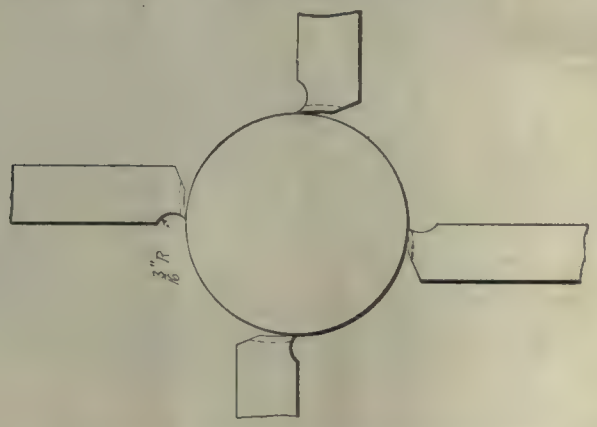
When we have fully grasped that this country is one vast machine shop that must be intelligently operated and that the service which each one of us can render will be in proportion to our comprehension of the demand for the human element, we will become energized by a dynamic force that will make our training and experience of greatest value to civilization and ourselves. Then we will see that there is a new standard of value; a new desire and opportunity for each to specialize and become fit; that there is a new measure of service and a new penalty for idleness, incompetence, wastefulness, and interference with industrial life. Then we shall stand firmly for all those things that the study of the human element in the machine shop has shown to be most vital to our success as individuals and to the security of the nation. This firm stand, coupled with the power of the ballot, makes us one of the most important factors in shaping and stabilizing our new civilization.



A Threading Die With Top Rake

By H. W. Woolums

Some time ago I had a number of machine-steel studs to thread 1 in. in diameter, 14 threads, 5 in. long, the threads having to be smooth and to close limits. I tried several sets of dies without success. The stock would roll up on the die and tear out in chunks half way around the stud. I tried turning the stock 0.015 in



TOP RAKE GROUND ON THREADING DIE

small, and also tried making a rough and finishing cut with the die, but still the job was not satisfactory.

As a last resort I ground the dies as shown in the sketch so they would have a shearing cut and found that my trouble was over. I finished the job in good time, making but one cut for each thread. I have since used dies ground the same way for threading tubing with excellent results.

Machine for Drilling Chaser Blanks

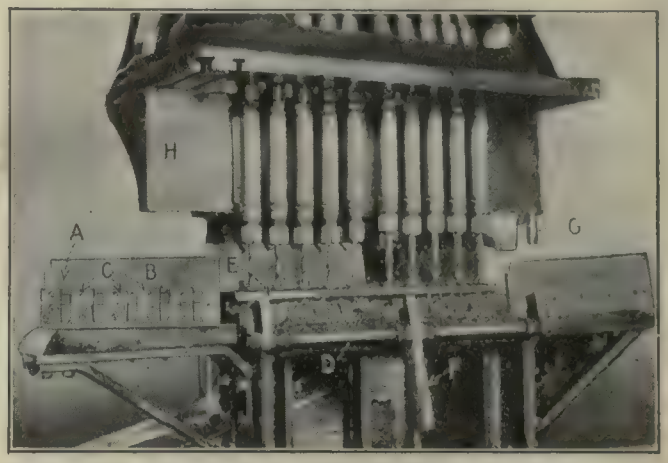
By J. B. Smith

To drill and counterbore the chaser blanks for their self-opening die heads the Modern Tool Co., of Erie, Penn., has arranged a Natco drill in the manner shown in the illustration.

These chaser blanks must first be drilled through and then counterbored to a certain depth on one side. Five chaser blanks at a time are placed in the holders *A* and clamped by tightening the screws *B*, which hold the locking blocks *C* in position. Five of these holders are provided, so that at least one will always be available for filling by the operator's helper.

The holders when filled are slipped into position *D* underneath the drill guide plate *E* and held against a back stop by raising the lever *F* when it is ready for drilling, this being accomplished by the five spindles to the left.

After drilling, the holder is moved to the right into position beneath the other five spindles where the blanks



TEN-SPINDLE MACHINE FOR DRILLING AND COUNTERBORING CHASER BLANKS

are counterbored to a depth determined by the micrometer adjustment screw *G* at the right of the machine. At the same time a freshly filled holder is put in place under the drilling spindles.

The special arrangement of the machine for this purpose is of interest. The head has been provided with a special heavy angle plate *H*, on which a set of brass bearing sleeves has been mounted to carry the 10 spindles. In operation two men are constantly employed on the machine, one operating it and removing the work from beneath the jig plate, and the other at the bench removing the finished pieces and filling the holders with blanks.

Machine for Grinding-in Large Cocks

By H. J. Ventner

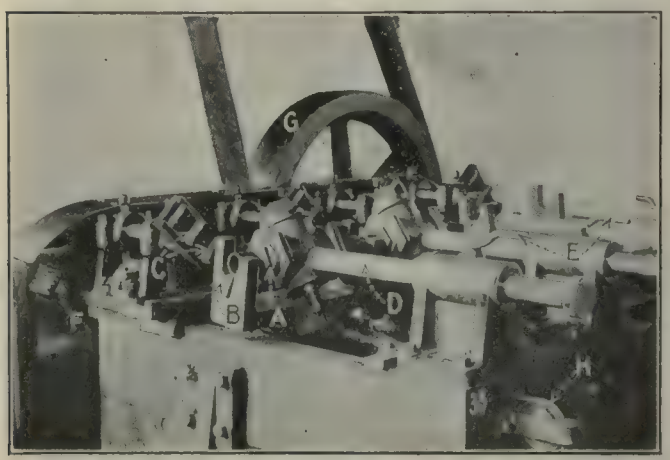
The machine shown in the illustration is for grinding-in cocks, and was built by the Jarecki Manufacturing Co., Erie, Penn., for its own use. Different sizes of the machine have been built to accommodate the several sizes of cocks which they manufacture. The one shown has four spindles and is for grinding-in 3-in. cocks, but a larger size has been built and also a smaller size which will grind six cocks at the same time.

The motion imparted to the work during the grinding-in process is the same as that used for grinding in

the valves on gas engines. The machine is so designed that it gives nearly a complete revolution to the plug, which at the moment of reversal is automatically removed from its seat for an instant, to prevent the grinding material from cutting grooves, being replaced for the remainder of the return stroke.

The illustration shows the machine just being filled for starting the operation on a set of cocks. In mounting the work in the machine, trunnions, one of which is shown at *A*, are screwed into the ends of the cocks, and they are hung in the bearings *B*. When the cock is turned over to the left the square head of the plug will fit into the jaws *C* on the end of the operating shaft.

The center on the small end of the plug is held on



GRINDING-IN MACHINE FOR PLUG COCKS

a center point on the bar *D*, and a center point inside the jaws insures the proper locating of the large end. The bar *D* may be adjusted so that the center fits snugly into the center hole in the plug by loosening the hand nut *E*, which permits the bar to be shifted in or out as desired.

The reciprocating motion is imparted to the operating shaft by means of the gear-segment *F* at the rear of the machine, there being one of these for each shaft, and a reciprocating motion is imparted to them by means of a connecting-rod from a crankpin on the belt-driven pulley *G*. This gives sufficient stroke to the segment to rotate the pinion which meshes with it through a nearly complete turn in either direction.

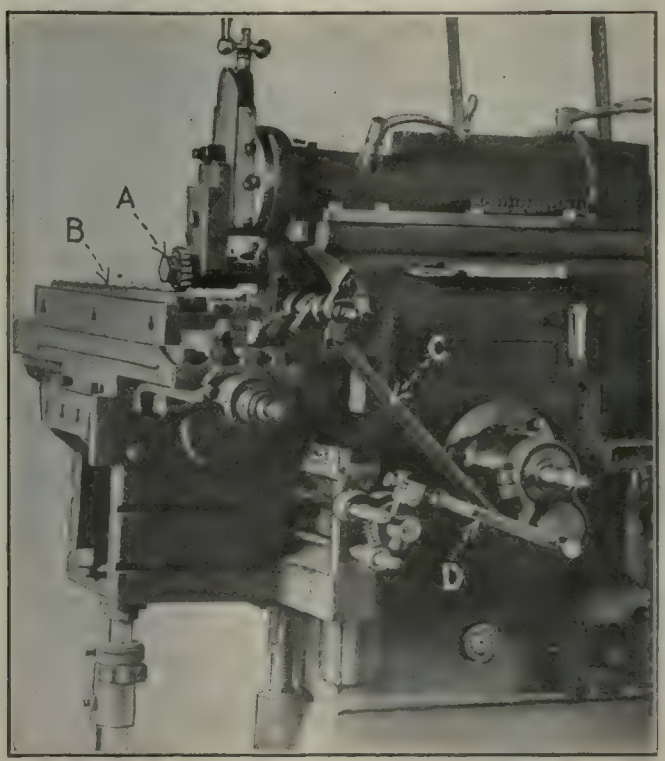
The withdrawal of the cock body at the instant of reversal is accomplished by a small device underneath the machine which pulls back the bearings *B* about ¼ in.

The bearings *B* are in the top end of a lever which is pivoted on the frame of the machine, and to the lower end of this lever is attached a weighted cord *H* which serves to hold the cock body up to the work. By changing the weight on the cord the amount of pressure applied can be varied to suit different conditions.

Generating Racks in a Shaping Machine

By E. A. Thanton

Generally when cutting racks on a shaping machine it is customary to use a single-point tool of the proper shape, feed it down to full depth and, after elevating the tool, feed the table along the proper distance for the next tooth. Having a large number of racks to cut we have rigged up our Smith & Mills shaping machine to generate the racks. The big advantage of our method is that once properly started the machine needs no further attention until the rack is completely finished. There is no feeding down of the tool by hand for each



A RACK-GENERATING ATTACHMENT

tooth nor any indexing or spacing device to operate each time a tooth is finished.

On the table of the shaping machine a table like that of a milling machine is bolted as shown. This table is connected to the shaping-machine feed so as to feed along continuously while the cutter *A* is operating on the rack *B*. The feed connecting-rod *C* operates a gear and worm mechanism so that the cutter *A*, which is like the cutter of a Fellows gear shaping machine, rotates in unison with the feeding along the rack. In starting the cutter is first fed down to depth on the first tooth of the rack, then the feeds for the table and cutter are thrown in and the rack teeth are generated automatically until a stop throws out the feed. In order to insure the feeds for the cutter and the work operating in unison the two are geared together and both are operated by means of the connecting-rod *C*. The rod *D* is the table feed rod and is not used in this work.

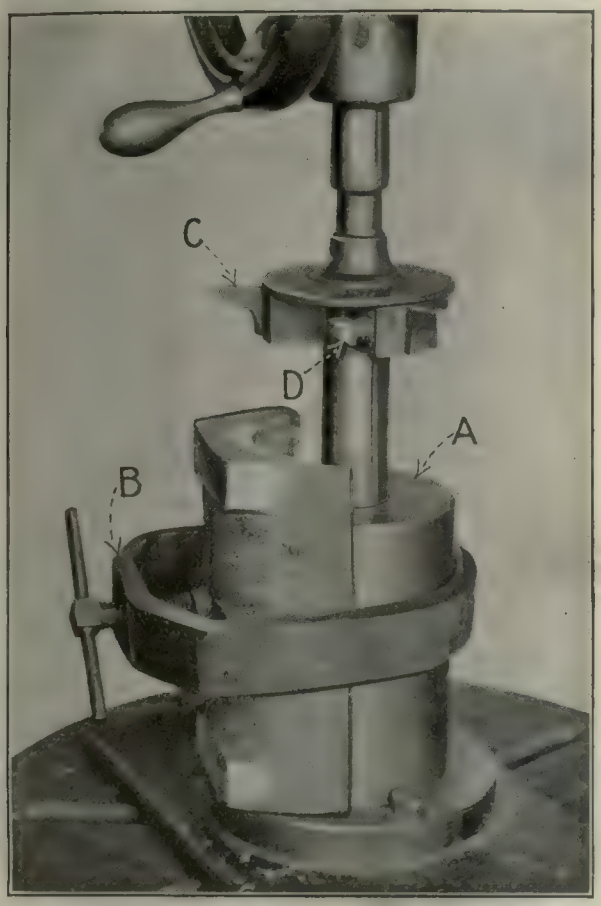
Cutting Round Corners on Car-Journal Brasses

By J. Wright

Most journal bearings require a round corner to be cut on the babbitt lining to meet the fillet on the journal of the car axle. In the Wilson Ave. shops of the Northwestern Elevated System of Chicago a device has been rigged up as shown in the illustration for cutting this round corner by using a drilling machine.

The brass is clamped in an upright position on the mandrel *A* by means of the clamp *B* surrounding it. A special head carrying three fly cutters has been fitted into the drilling-machine spindle with an extension ar-

bor end which gives it a bearing in the work-holding mandrel. The fly cutters *C* have a round contour to take off the corner, and at the same time extend far enough outside of this corner so that they will serve to face off the ends of the bearing at the same time. Adjustment of these cutters is accomplished by means of the individual clamping screws *D* on each cutter.



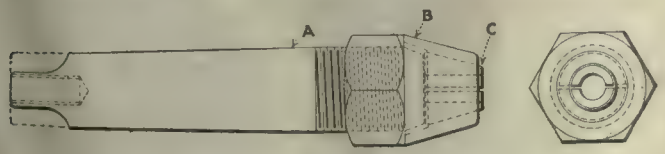
CORNER-ROUNDING DEVICE FOR CAR-JOURNAL BRASSES

Chuck for Holding End Mills

By P. DeCourcelles

In making some dies for Bakelite products recently I had trouble by reason of endwise movement of the mills and cutters used which had parallel shanks and were held in a spring collet. To overcome the difficulty I made the chuck here shown.

The chuck consists of three principal parts; the shank *A* being made of machine steel, which is afterward packhardened and ground; the sleeve *B*, and the split bushing *C*, both of which are of tool steel carefully hardened and ground.



A CHUCK FOR HOLDING END MILLS

The sleeve is made hexagonal on the outside to fit a wrench. It is threaded to the shank and the interior conical surface is made 15 deg. It is this conical surface that is ground.

The bushing *C* is made to correspond to the angle of the sleeve, has a hole to fit the shank of the mill to be used and is split so that there will be no resistance to its closing on the shank of the mill.

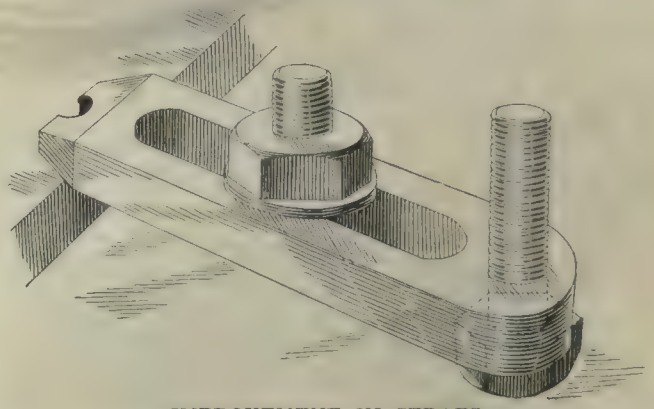
I have found this chuck to be entirely satisfactory in respect to its holding power.

A Good Way to Make Straps

By S. L. St. John

On page 118 of the *American Machinist* M. L. Lowrey shows a strap which he considers an efficient and time-saving appliance, an opinion with which I can cheerfully concur as I have been using such straps for 10 years.

A further improvement that I have incorporated in these straps is to forge the strap so that the material at the bend is wide enough to stand a ¾-in. tapped hole. A hexagon-head capscrew, the head of which has been flatted off to provide a good bearing surface, is screwed into this hole, as shown in the sketch, and relieves the workman of the necessity for hunting up odd pieces of scrap material to serve as blocking.



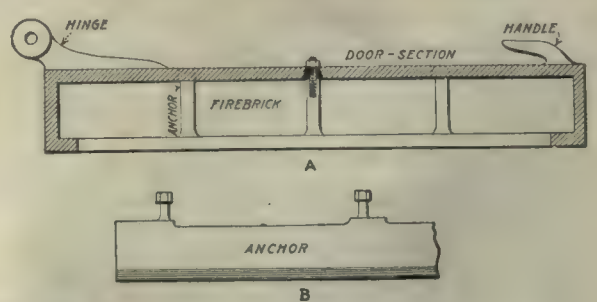
IMPROVEMENT IN STRAPS

Saving Machine Work in the Foundry

By M. E. Duggan

The other day I saw a man at work in the machine shop drilling 46 holes in a large furnace door and a like number of holes in the anchor ribs, which are cast pieces drilled and fastened with bolts to the inside of the furnace door to hold the fire bricks in place.

The joint face of the anchor ribs was made straight —for what reason I do not know, except perhaps to



TWO WAYS OF BUILDING UP A FURNACE DOOR

make more work for the machinist. The job is shown at *A* in the illustration.

The man on the job was a machinist and the drilling machine a large radial. The job required, say, from 15 to 25 hours. A few hours one way or the other makes little difference, however.

All this work in the machine shop could be saved and the job done right in the foundry. Cast the stud bolts in the anchor ribs and make a clearance on the joint face as at *B*. Cast the holes in the door and the parts can be assembled just as they come from the foundry.

A still cheaper way would be to send the fire bricks along with the pattern to the foundry and the molder will ram the pattern in the usual manner, withdraw it, place the fire bricks in the mold, pour the casting and return to you a door all lined with fire bricks and ready to put in place on the furnace.

Points for Spot Welding

By A. A. Karcher

The form of spot-welding points shown in Fig. 1 has been developed by the Challenge Machinery Co., Grand Rapids, Mich., with gratifying results. Fig. 2 shows a typical weld and indicates the neatness, slight discoloration of the metal and entire freedom from flash either on the outside or between the parts. In one view the discolorations give an erroneous impression of the

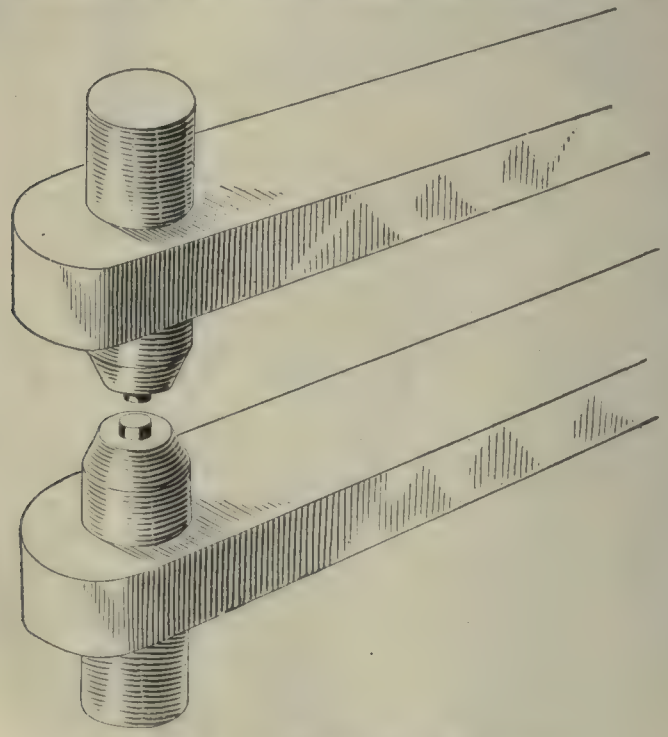


FIG. 1. FORM OF POINTS FOR SPOT WELDING

existence of bosses on the face of the metal, which is actually flat except for the depressions at the points of the welds.

The shape of the points would lead one to expect that the small projections would require a lot of attention to keep them in shape. Experience shows, however, that this is not the case, as the points actually lengthen slightly and occasionally have to be filed down.

Even when a weld is made close to the edge the

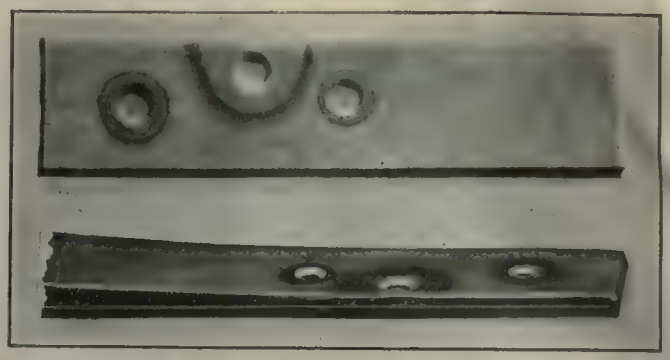


FIG. 2. SPOT WELD SHOWING SLIGHT DISCOLORATION AND FREEDOM FROM FLASH

operation is quicker and consumes less current. A little practice in determining the correct amount of current to use is all there is to learn in handling these points.

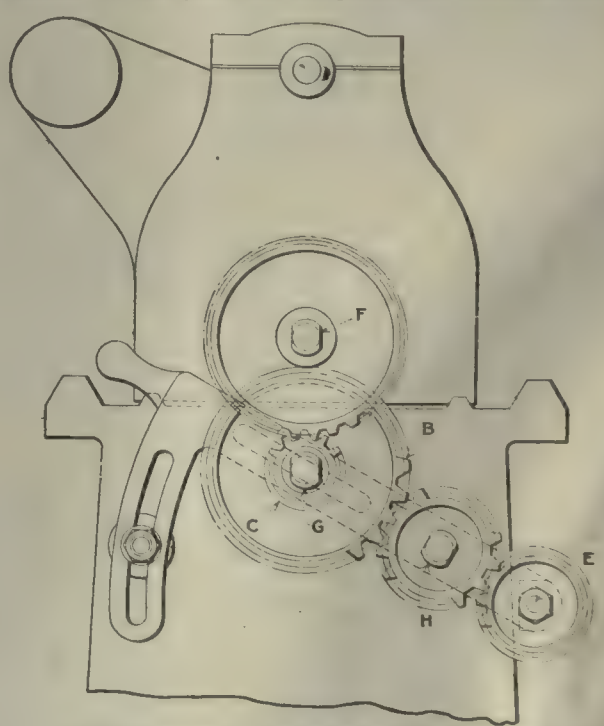
Changing a Simple Lathe Into a Compound-Geared Lathe

By Nelson Atterberg

The illustration shows the modification of a simple-geared lathe so that it was capable of cutting a double-threaded worm with a lead of 0.900 in. Special studs had to be made at *F*, *G* and *H* to give the required distances between centers.

In this instance two similar sets of gearing were available, ranging from 20 to 96 teeth by intervals of four. The lead screw had six threads to the inch and calculation showed that with a 54-tooth gear on stud *F*, a 20-tooth gear at *E* and a 2 : 1 reduction on the quadrant (*B* and *C*) the desired result would be obtained. When this was tried it was found that centers *G* and *E* were so far apart that the gears would not mesh.

Stud *H* was added and 40-tooth gears mounted on *H* and *E*. Then 72-tooth gears on *F* and *G* with a 3 : 1 reduction on the quadrant completed the combination.



COMPOUNDING A SIMPLE-GEARED LATHE

US
ARMY ORDNANCE NEWS

How Ordnance is Inspected—III

BY FRED H. COLVIN

After the explosion at Morgan extensive investigations were made into the value of damaged shell with a view to determine when it would pay to reclaim and when to scrap the shell. With scrap values of steel at $29 *a ton, lead* 6.5c., *copper* 18c. *and brass* 11c. *a pound the* 75-*mm. shell is worth approximately* 16c. *as scrap as against* $3.50 *for a completed shell. This varies for different sizes, the* 240-*mm. shell costing* $61.50 *with a salvage value of only* $5.50. *These figures show how much work can be profitably spent on each shell.*

JUST to show in detail the duties of one section we give in the following an outline of the requirements for the inspection of time fuses:

1. Installation of Inspection System. (a) Hiring of competent help; (b) handling office and shop routine and records; (c) enforcing and maintaining an adequate inspection system by the contractor; (d) coöperation with contractor to obtain results consistent with Ordnance Office drawings and specifications at lowest possible cost and with no loss of time.

2. Inspection proper. (a) Proper care and responsibility for the checking of all gages and measuring instruments; (b) sequence of gaging operations to enable desired results to be accomplished without interfering with production; (c) shop-control inspection (inspection at each battery of machines to prevent accumulation of poor and faulty work).

3. Technical liabilities (general). (a) Familiarity with testing of material to destruction to determine elastic limit, elongation, etc., and to calculate modulus of elasticity, plotting of curves, etc.; (b) proper use of laboratory (recording and measuring machines and instruments, such as tensile and compression test machines, endurance-testing machines, extensometer, planimeter, etc.); (c) metallurgical understanding of metals to determine reasons for various types of fractures and flaws; (d) general book knowledge of higher mathematics and graphical problems as applied to shop use.

4. Technical ordnance knowledge. (a) Clear understanding of the requirements necessary to produce proper functioning fuses; (b) ability to locate and correct rejected lots to insure their passing a retest to prevent final rejection; (c) static, laboratory tests to determine rate of burning of elements, familiarity with the reasons for incorrect, slow or fast burning; (d) proper understanding of the relation between the permitted time dispersion and the actual burning of timing elements; (e) the use of hand fuse setters—ability to set fuse and check error in graduations or other errors in contractor's workmanship.



FIG. 1. INSPECTING RING AND PROFILE GAGES

The work of the Motor and Carriage Branch of the Inspection Division is quite varied and includes 22 types of gun carriages, six types of artillery tractors, four types of tanks, twelve kinds of motor equipment and a goodly list of miscellaneous artillery vehicles. The work of this branch has been made particularly difficult for several reasons, for in order to properly inspect such a complicated piece of mechanism as a gun carriage it is necessary not only to check carefully all the measurements but the inspector must have a knowledge of machine tools and of machinery building, and be conversant with steel and bronze castings, steel forgings, pressed-steel and riveting work. It should further be remembered in order to thoroughly appreciate the task confronting the inspector of artillery carriages that very few of the present mounts have ever been produced in quantity. In other words their manufacture had never been carried on under a production schedule. The emergency of the situation did not allow a model of these different types to be built and thoroughly tested, which made it necessary to start manufacture and to make numerous changes to overcome defects developed during manufacture and test. The more or less experimental nature of the product and the absence of authentic drawings and specifications made it necessary to depend to a large extent upon the judgment of the individual inspector in many cases.

In spite of the handicaps the finished vehicles have functioned without developing more than minor defects, which speaks volumes for the technical ability, character and devotion to the work of the officers of this branch. It is of interest to note that the value of the material which had been inspected and accepted by this branch up to the end of the last fiscal year amounted to approximately $65,000,000. This volume of inspection was handled with a force of never more than 12

ARMY ORDNANCE NEWS

commissioned officers in the Washington office and approximately 140 commissioned officers in the field.

The Trench-Warfare Section handles trench mortars from 3 to 11 in. in diameter and their ammunition. The 3-in. trench mortar is used to a large extent in short-range bombardments, while the 4-in. trench-mortar bomb is mostly used for throwing gas into the enemy's lines. Then comes the 6-in. mortar, the 240-mm. mortar and the 11-in., which is a rifle having a range of from three to four miles and carrying nearly 100 lb. of high explosives. Some idea of the rate at which the 3-in. trench mortar bombs were being made can be had from the fact that one factory alone turned out over 30,000 a day.

Although the trench mortar has been facetiously referred to as a piece of glorified sewer pipe it was nevertheless one of the most important pieces of ordnance in trench fighting, and while it is not highly finished or polished it must have a smooth bore and the bomb must have an even smaller tolerance on its bourrelet than a 75-mm. shell. This is because its propelling charge is comparatively low and its proper range depends upon not allowing gas to escape between the mortar and the bomb.

Gas Projectors

The Liven gas projector is a simple and at the same time interesting piece of mechanism, consisting primarily of a heavy baseplate with a rounded depression which carries the rounded end of a seamless-drawn tube about 9 in. in diameter. The baseplates are sunk in the ground to the required depth so that the gas projectors will be practically flush with the ground. The seamless-drawn tubes are then put in position, inclined to the proper angle to give the desired range and the earth filled in around them. These are set in long trenches a short distance apart and electrically connected so that all may be fired simultaneously.

In this way several hundred or several thousand of them can be fired at the same time, projecting a huge number of gas shells into the enemy's lines along a wide front. The gas bombs used in these Liven projectors are also interesting from a mechanical point of view. They are made up of sheet metal stamped in halves and electrically welded their whole length on both sides. This requires excellent holding devices for bringing the two edges together in their proper position, and a heavy current is also necessary to weld the whole area simultaneously, as the length of the shell is 28 in.

The difficulties of manufacture also increase the task of inspection which is constantly presented to the officers of this division. In addition to the projectors, their baseplates and bombs it is also necessary to provide carriages or trucks by which they can be easily transported, and which in turn require many inspections.

When we read of hand grenades being used as freely as they were we do not stop to think of the somewhat complicated mechanism necessary to make them effective or the care which must be exercised by the Inspection Division of Ordnance to insure their functioning at the proper time. They are comparatively small, being approximately the size of a healthy lemon, and weigh about 1 lb. each, but they require great care in the firing mechanism, and as we were making over 100,000 a day, the amount of inspection required can be imagined.

It must also be remembered that there are several kinds of grenades such as the offensive, defensive, incendiary and gas. The defensive grenade, as it was originally called, is the metal body which is blown into small fragments by explosion and was originally made of malleable iron but is now being manufactured of a good grade of cast iron.

Grenades and Bombs

Then there is the detonating bomb, with a paper cover, which does its damage by concussion or shell shock. Gas grenades are thin sheet-metal bodies and are closely related to the stink pot of ancient warfare, while the incendiary grenades contain some sort of oily filling which maintains combustion and spreads the flame to adjoining objects. There is also the Thermit grenade, used only on rare occasions. It is reserved for destroying cannon and similar objects, either captured or belonging to ourselves, which it is desired to put out of commission whenever necessary. One of these grenades dropped into the muzzle of a gun has the effect of a pound of iron at fusing temperature, by which the breech block of the gun is effectually welded to the breech thus rendering it entirely useless to the enemy.

Although the grenade seems like a simple piece of mechanism it has in reality quite a number of gaging points that must be carefully looked after. The head is a die casting which screws into the cast-iron body and is not a particular job in any way. The handle must be held against accidental release and is held in place by an ordinary spring cotter. The end of this cotter is spread, however, so as to require a definite pull to release it, and this must be very carefully done. The soldier must know about how strong a pull will be necessary to release it so as to be able to pull the pin rapidly and at the same time not have it come out unexpectedly at too slight a pull. The spread of the cotter pin is so designed as to pull at from 10 to 25 lb., and this must be carefully watched. The ring which goes through the eye of the cotter pin must stand a 40-lb. pull without flattening, as there must be no hesitation or uncertainty when it becomes necessary to use hand grenades in actual warfare.

The Instrument Division

There must be free play of the striker between the wings of the handle, yet the striker tolerance is only 0.006 in. The striker point must land centrally on the primer and there are a number of other interesting points which must be carefully looked after. When we realize that in one plant alone these grenades were being turned out at the rate of over 100 per minute we can get some idea of the number of inspections necessary.

The Instrument Division handles perhaps the greatest variety of manufactures, including optical instruments, machine tools and nail kegs. Emphasizing the last item first, it is interesting to note that between May 1 and

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Nov. 15, 257,000,000 packing cases were passed by them.

It was a most difficult division to handle, owing to the wide variety of the work and the difficulty of obtaining men versed in the different branches which it covered. The division, for example, handles 38 instruments containing optics, including aiming circles, anti-aircraft sights, spheroscopes, range finders and telescopes. It was also responsible for 143 different kinds of fire-control instruments, such commercial and special material as batteries, binoculars, chronographs, optical glass, speedometers, thermometers, watches and voltmeters.

An idea of the variety of material handled by this division may be had by noting that their list contained over 200 anchors, 25 spark arresters for locomotives, over 1,000,000 dry batteries, several thousand suits of body armor, over 3,000,000 caps for smoke-bomb outfits, drill and lathe chucks, over 400,000,000 cartridge clips, 35 power cranes, 700,000 quires of emery cloth and paper, over 15,000,000 rope grommets, over 8,000,000 helmets, over 1,000,000 incandescent-lamp bulbs, two locomotives, many lathes and milling and grinding machines, 27,000 pairs of pliers, over 6,000,000 rivets, over 300,000 screwdrivers, 3,000,000 lb. of soap, 75,000 grindstones, five tractors, 3,000,000 washers, 140,000 wrenches, and numerous other articles.



FIG. 2. THREAD-DIAMETER WORK

The Division of Instruments, Machinery and Containers had a difficult task on account of their great variety of products and because many of the articles were new to our manufacturers. This necessitated a high grade of inspector, for if cordial relationship is to be permanently maintained between the manufacturer and the Ordnance Department and the rights of both protected the inspector must be a man of considerable diplomatic ability.

In addition he must have sufficient insight of the work going on at the plant in order to provide the weekly progress reports on which projects for various materials are based. He must be able to supply such technical information, often condensed into a telegram, as will enable the Inspection Division at Washington to render immediate decisions or to lay the matter before the Engineering Division. The inspector must be a man of versatile attainments, and the task was made much greater for two reasons:

1. Due to the emergency the drawings delivered to the manufacturer were in many cases simply tracings of drawings received from France. The difference in shop practice in the two countries called for minor but necessary changes in details, and the changing to English standard sizes of drawn stock, threads, etc., from the metric sizes called for a great deal of detailed correspondence between the inspector and the Washington office.

2. In many cases the manufacturer was without previous experience in making precision instruments and many difficulties arose which experienced instrument makers would have solved as a matter of course. For example, two of the most intricate instruments were manufactured by a firm which previously made street-car registers. The specifications for instruments have called for complete interchangeability between parts and completed instruments. This necessitated the use of a large number of gages. The gage-making industry was taxed to its capacity. The delay in the making of gages caused considerable delay in the manufacture of instruments. The only solution for this problem was to endeavor to eliminate a large number of the gages required by the Engineering Division. A study of the problems indicated that many of the parts could be assembled in the instrument and the interchangeability factor waived, as these parts, in most cases, functioned in groups and not individually. A careful study has been made in order to group together essential units, and interchangeability has been adhered to in the making up of these groups of parts, and the interchangeability as regards the components of a group has been eliminated.

As a result of this policy it was possible to take an instrument which would require for complete interchangeability the gaging of as many as 200 different parts and have it made sufficiently interchangeable by cutting down the number of gaging points to 10, thus eliminating a great deal of gage and tool work and saving a corresponding amount of labor and time.

An effort has been made throughout all the work on instruments to insure the components being made up in such a manner as will secure an instrument which will function in every way and come within the tolerances required. By using preliminary test fixtures to test the accuracy of group assemblies, and by final test fixtures which test the functioning of the instrument, very satisfactory results as regards functioning and accuracy of instruments were obtained. The test fixtures made up for these uses were simple devices which would in the case of sights perform the func-

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tion of a dummy trunnion or dummy gun mount, and the operating of the instrument or sight in this fixture would correspond to the operation or actual work for which the instrument or sight was made. In order to minimize the repetition of difficulties or errors on instrument work an effort was made by this branch to coördinate all past and present work. This was done by inspection supervisors, who were selected for their special skill and knowledge of instruments. From time to time instructions and sketches, inspection manuals, etc., were issued by this office to resident inspectors.

It was the aim to assist the contractor in every possible way. To that end the supervisor would visit the contractor as soon as the contract was given him. He would immediately begin to coördinate all efforts in order to obtain quick delivery of instruments. The supervisors assisted the contractor in securing the proper drawings, gages, test fixtures and materials. In this way the product of a contractor who had been working on one type of instruments was reviewed in an effort to obtain his experience and advice in aiding a new contractor. The shop practice and methods of the experienced instrument maker were given, at least in part, to the new contractor in order to eliminate delay.

Consultations Necessary

It was found that by acquainting a new contractor with the actual field use of an instrument the work progressed in a much more satisfactory manner. By illustrating and explaining the field use and the results obtained by the instrument in question many contractors became intensely interested; it gave the work a new life and it assured the earlier delivery of much needed instruments for the army.

This method of having the supervisor train the local inspector and the contractor, indicated to contractor, inspector and workman just what features needed to be given particular care with the object of obtaining the best results which will be required in the field. This work necessitated consultation with both the users and designers of the instruments, and it was an important factor in obtaining quicker results. By beginning as early as possible and collecting information in regard to a new contract, coördinating it with past work or, if entirely new work, collecting all necessary information on the instrument as regards design and field use, many obstacles that would otherwise cause serious delays and sometimes complete loss of work were smoothed out and production obtained with a minimum amount of effort. It must be remembered that during this emergency inexperienced men and contractors were compelled to go into production of very important precision instruments on which little design or development had been done. It was the endeavor of this division to get the contractor started on production and follow the work very closely until the quantity production stage had been reached. After that it became a comparatively simple inspection matter to obtain a product of high standard.

In order to utilize the manufacturing capacity of the country to the best advantage it was necessary in many cases to purchase the optics on a prime contract from one firm and deliver them to another, which made the mechanical parts and did the assembly. This led to the necessity of establishing the tolerances sufficiently elastic to avoid limiting production and at the same time so rigorous that the inspector might be sure that all optics passed would be capable of assembly. Otherwise difficulties are certain to arise between the two firms manufacturing the parts, each of course attributing the trouble to the other. There is no literature dealing with tolerances in such cases and it is a technical problem calling for an extremely close balancing of decisions and continual adjustment.

Difficulties due to manufacturers entering upon a new field of work without previous experience were nowhere more apparent than in the case of optical instruments. All the experienced men in this line of work were, when the war broke out, employed by a few old firms. Furthermore trained mechanics in instrument making were very scarce in this country, those that were here being to a great extent enemy aliens. As a result new firms entering this field at the request of our Government had great difficulty in getting suitable men, and yet instruments had to be made.

Scarcity of Instrument Making Mechanics

In many cases resident inspectors, as a result of their previous technical or university training, were able to materially help the manufacturer. New instruments developed abroad were manufactured and it was only with the greatest difficulty that knowledge of service conditions could be obtained and the necessary tests and tolerances devised to be used in the inspection of the instrument in question. This information was continually collected and kept in the Inspection Manual and forwarded to the inspector for his use. Inspectors at plants where optical glass was manufactured were charged with the shipping of glass to all manufacturers and were obliged to solve numerous problems which arose because of a number of developments of entirely new technique.

The Testing and Inspection of Gages

The Inspection Division designated the Bureau of Standards as the authority for the establishment of all dimensions and the verification of all master gages used by the department in the inspection of war material. Gages not immediately required for field use are placed in storage in a fireproof building to be shipped at a later date; salvaged, if need be, or reclassified for future uses. The salvage of such master gages as have been rendered obsolete by the revisions of component drawings is made in the shop at the Bureau of Standards established for the use of the Inspection Division.

With the inspection, salvage and shipment being performed by the Bureau of Standards instead of by several departments that might be located at widely separated points the matter of placing master gages at the disposal of inspectors at manufacturing plants is greatly facilitated. Before the gage shop at the Bureau of Standards was organized difficulty was experienced in obtaining gages required in a rush to prevent the stoppage of production. The Bureau of Standards gage shop furnished to various district of-

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fices and manufacturing plants such inspection gages as concentricity thread gages for the TNT hole and the shell nose, and serious delays in the shipment of ammunition was thereby prevented.

The test of master gages for the Inspection Division were made by the Bureau of Standards promptly and without delay since the beginning of the war program for the production of munitions. The first lot of munition gages on account of the Inspection Division was submitted on July 16, 1917. Practically all of the various lots of gages were completed and shipped within three or four days from the date received. In many instances, gages were received and tested on the same day. Up to Oct. 15, 1918, there were submitted for test at the Bureau of Standards in Washington and branch laboratories in New York City, Cleveland and Bridgeport about 40,000 gages, of which about 90 per cent. were master gages, the remaining 10 per cent. being inspection and working gages. Of these master gages about 60 per cent. could be classified as plain gages (plain plug, snap and ring gages); about 20 per cent., as chamber and fixture gages, and about 20 per cent. thread gages. The Gage Section at the Bureau of Standards had an organization of about 100 men for testing and certifying all kinds of munition gages. The apparatus is available for all classes of test, from precision-sizing blocks, where tests are sometimes made to within an accuracy of a few millionths of an inch, to plain micrometer calipers for measuring plug gages requiring an accuracy of about a few ten thousandths of an inch. There was developed and constructed at the Bureau of Standards many special machines for the measurement of thread, profile, end standards and other types of gages. The general arrangement of the laboratory for test of plain and profile gages was shown in Fig. 1. The report department handles the comparison of the results of test with the drawings and specifications of the Engineering Bureau and prepares the necessary reports and shipping instructions for the gages tested. Fig. 2 shows that part of the thread-gage testing laboratory where diameter measurements are made. Then there is a lead-testing room and a lantern room in the thread-gage laboratory.



FIG. 3. A CORNER OF THE GAGE SHOP

A gage salvage and manufacturing shop was organized at the Bureau of Standards at the request of the Inspection Division about May 15, 1918. This shop organization was formed around the nucleus consisting of the original gage shop, started by the Bureau of Standards for the purpose of manufacturing its apparatus in June, 1917. The shop personnel consisted of about 50 men, not including the men who were employed in the construction of the gaging apparatus for the Bureau of Standards or other Government departments. Machine tools, equipment and supplies were purchased to enable the present salvage and manufacturing shop to employ from 150 to 200 men. Up to Oct. 1, 1918, about 1000 gages were salvaged and manufactured.

Fig. 4 shows a corner of the gage salvage and manufacturing shop.

The Bureau of Standards is recognized as the legal authority for the establishment and verification of all standards and other standards of measurement, and therefore the authenticity of gages tested, salvaged or manufactured is above question by any Government department, manufacturer or user of gages. This, together with the excellent records which the Gage Section of the Bureau of Standards established for rendering prompt and efficient service, has greatly facilitated the entire program. As there are differences of opinion regarding the names and uses of gages, the practice of the Inspection Division may be of interest. The inspection gages are those handled by the Government inspectors to enable them to determine whether or not the part being examined is within the plus or minus limits that have been determined as necessary. Working gages are used by mechanics who are performing operations of the various parts. Master gages are those furnished by the Government to the different Army inspectors of ordnance for reference and checking purposes, that is to say each set of inspection gages is checked approximately every two weeks to determine whether or not the gages have become so worn as to be unfit for further use. Inasmuch as master gages are used only for reference purposes they are not subjected to wear, and unless revision is made in the component drawing they last almost indefinitely.

The Engineering Division has laid down designs for more than 5000 different styles of gages, and while all of these types are not in present use the existing number is large. It has been roughly estimated that more than 75,000 master gages were purchased and, as there are roughly 10 inspection gages to each master gage this would therefore make 750,000 inspection gages.

In the matter of shells it is estimated that an inspection gage is good for service on about 5000, after which it becomes so worn that its replacement is necessary.

The cost of the gages will average $40 each; therefore, showing as nearly as can be estimated the expenditure for gages alone was over $32,000,000. This cannot, however, be stated as correct, for gages were purchased by the various arsenals, and these did pass through the gage branch of the Inspection Division. The Frankford Arsenal alone purchased more than 6000 gages on its own account, while 40,000 additional head

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space gages were procured for use overseas on one order.

At the outbreak of war many munition manufacturers had to learn accuracy when they began manufacturing ordnance material, and particularly shells, for the Allies in 1916. It is revealing no secret to say that one of the largest munition manufacturers was obliged to scrap $18,000,000 of shells in less than six months because of the lack of proper gages for inspection.

The gage branch of the Inspection Division maintained a supervisor in each of the 13 inspection districts, and each supervisor had his individual office force as well as gage checkers. The gage checkers in the field numbered over 200.

Educational Branch

The great demand for personnel in the field inspection forces made it necessary to organize courses for training men and women in this work. Schools were started at loading plants, at arsenals and at technical schools, as shown in the following list, although the last three were discontinued before the Educational Branch as such was organized:

Loading School for Inspectors of Artillery and Trench-Warfare Ammunition.—T. A. Gillespie Loading Co., Morgan, N. J.

Shell-Loading School.—The du Pont Engineering Co., Penniman, Va.

Fuse and Primer Loading School.—The du Pont de Nemours Co., Pompton Lakes, N. J.

Technological School for Inspectors, Chemists and Linemen.—The du Pont Powder Co., Carney's Point, N. J.

School for Gage Checkers.—Bureau of Standards, Washington, D. C.

Box Inspection School.—Forest Products Laboratory, Madison, Wis.

Small-Arms Ammunition Inspection School.—Winchester Repeating Arms Co., New Haven, Conn.

Army Ordnance School for Engineers of Tests.—Carnegie Institute of Technology, Pittsburgh, Penn.

School for Instruction of Gun-Carriage Inspectors.—Bethlehem Steel Co., Bethlehem, Penn.

School for Training of Civilian Assistant.—Inspectors of Cannon and Artillery Ammunition Steel, Watervliet Arsenal, Watervliet, N. Y.

School for Small-Arms Ammunition Inspectors.—Frankford Arsenal and various plants.

Student Officers' Training Battalion.—Erie Proving Ground, Ohio.

School for Ballistic Engineers.—Hercules Powder Co., Kenvil, N. J.

In addition to the military training at the recruiting grounds the officers also received instructions on how to test guns and carriages; on the manufacture, properties and tests of smokeless powders and propelling charges; on timers, projectiles, shrapnel, armor, combination and detonating fuses, high explosives, velocity instruments, chronographs, pressure gages, ballistics, sights and aiming instruments, construction of guns, star gaging, breech and recoil mechanisms, carriages and their stability, theory of recoil, factors affecting the energy of recoil and problems on energy and velocity relations. These were taught in connection with the 75-mm. and 155-mm. and the 4.7 field gun, the 155-mm. and 240-mm. howitzers, trench mortars and fuses, drop bombs and grenades.

Special training was given in ballistic testing of propellant powders, together with an understanding of the instruments used in this connection. It also embraces the different steps in the manufacture of gun powder and high explosives, which includes the chemical laboratory as well as the actual manufacturing.

The training of men to inspect high explosives was not devoid of danger, as the instruction was given near the large loading plants, as in no other way could the practical application of the information obtained be put to the test. An example of this is shown at the school at the Morgan plant, this being blown out of existence on the night of Oct. 4, 1918, when the plant was destroyed. These illustrations of the methods used are largely due to Major Field and are carefully explained in connection with that branch.

While the work of the various schools necessarily had considerable similarity, there is considerable difference in the individuality of the instructors and in the way the courses are laid out. At the du Pont plant in Penniman, Va., for example, the four-weeks' course was divided into 26 parts, which included the shell and its component, the different varieties, constituents, functions and methods of handling powder, the handling of shells in battle, the raw materials and the methods of manufacturing powder, loading, extrusion process, assembly, adapters and boosters, fuses and primers, projectiles, nonfixed ammunition, artillery, plant layout, plant organization, Ordnance department organization, precautions against industrial disease, general sanitary measures, safety, receiving and checking material, specifications and instructions, including methods of detecting defects and dealing with operators, specifications and instructions; receiving, accepting, storing and shipping high explosives; shell loading, and instructions to inspectors. This, as will be seen, made a very complete course, and one that cannot fail to assist men of the right caliber.

What the Courses Include

As a further example of the thorough instruction given, an outline of the courses of study of the Technological School for Inspectors, Chemists and Linemen at Carney's Point, N. J., is given. It includes general inorganic chemistry, organic chemistry, aliphatic compounds, aromatic compounds, chemistry of explosives, detonators, physics, drawing, official duties, special topics and ethics. The laboratory courses included the physical and chemical properties of the various explosives, such as amatol, ammonium nitrate, picric acid, ammonium picrate, trinitrotoluene, tetryl, alcohol, ammonium sulphate, ether, diphenylamine, raw cotton, picrocellulose, smokeless powder, mixed acids, toluene, benzene, black powder, nitro starch, mercury fulminate, phenol, tetranitroaniline, ammonia liquor and sodium nitrate. This course included instruction in actual factory methods, which were shown by periodical trips through the factory, and gave an exceptional education in this kind of inspection.

Another interesting school was located at Madison, Wis., for training box inspectors and was held at the Forest Products Laboratory. The course included an analysis of the various qualities of the different woods, wood structures, grain; the methods of grading and measuring, weights for air-dry woods, shrinkage and

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swelling, warping, shaking; collapse and mechanical properties, such as shearing strength, and also the factors that affect the strength of wood in general; the nail-holding power of different woods; veneers, factors affecting the strength of boxes, and deterioration of lumber in storage. There was also a course in shop work, and any large manufacturer of machinery might well pay the expenses of a bright young man in his shipping department to take such a course, as it would probably save many hundreds of dollars not only in boxes and crates themselves but in the avoidance of delivery damaged machines at the customer's end of the route.

There was also a small-arms ammunition-inspection school at the plant of the Winchester Repeating Arms Co., New Haven, this being thorough in all its details, as well as very necessary, as the inspection of cartridges, especially for machine guns for use in airplanes, is an important and delicate job. These outlines give but a faint idea of the care taken to train men for various kinds of inspection work, and one cannot but admire the energy and the perseverance which made it possible to organize and maintain such schools in the face of many difficulties and in the comparatively short time we were engaged in the war. Those who are responsible for the Educational Branch deserve great credit for the work they were able to accomplish.

Colonel Thompson Has Been Awarded Distinguished Service Medal

Col. John T. Thompson, U. S. Army, who during the war and before his retirement held the rank of Brigadier-General, has been awarded the D. S. M. for exceptionally meritorious and conspicuous service. As chief of the Small Arms Division of the office of the Chief of Ordnance, he was charged with the design and production of all small arms and ammunition supplied to the U. S. Army. The results he achieved were of such signal success that serviceable rifles and ample ammunition were at all times available for all troops ready to receive and use them. Colonel Thompson's permanent address is the Metropolitan Club, New York City.

Brig.-Gen. George W. Burr Succeeds Maj.-Gen. George W. Goethals

Brig.-Gen. George W. Burr assumes his duties as Assistant Chief of Staff and Director of Purchase, Storage and Traffic, to succeed Maj.-Gen. George W. Goethals, retired, who has returned to civil life.

General Burr is a Missourian and a graduate of a military academy. He served in the field artillery for a short time, and then received a permanent appointment in the Ordnance Department in January, 1893. The tours of duty included the arsenals at Rock Island, Watervliet, Augusta and Manila, during which time he was actively connected with the design, manufacture and issue of all types of light and heavy ordnance equipment. When war was declared he was Commanding Officer of the Rock Island Arsenal, which command he held for six years, and as this post was the largest in the United States for the manufacture and issue of ordnance material, he was during the following 10 months closely identified with the initial equipment of the United States forces.

In February, 1918, General Burr was ordered to the A. E. F. as Chief Ordnance Officer for England. He represented the Ordnance Department in large purchases from the British Government of heavy artillery and other supplies. This work necessitated going to the front to inspect various activities at supply depots, etc., and also to the larger manufacturing plants in England and Scotland to make a study of their methods and capacities.

In October, 1918, he was ordered back to the United States and assigned as head of the Engineering Division of the Ordnance Department in Washington. He served in this capacity until December, 1918, when he was detailed for duty on the General Staff and appointed Assistant Director of Purchase, Storage and Traffic. General Burr's desgnation as Assistant Chief of Staff took effect on Mar. 1.

Lieut.-Col. A. Perry Osborn Resumes Law Practice

Lieut.-Col. A. Perry Osborn, who received his honorable discharge from the service on Dec. 31, has resumed the practice of corporation law and made connections with the firm of Beekman, Menken & Griscom, with offices at 52 William St., New York. Colonel Osborn was commissioned Captain in the Ordnance Reserve Corps, May 29, 1917, and called to active duty on June 28, 1917. His first assignment was in the Finance Division, and he was then transferred to the office of the Assistant Secretary of War on Jan. 2, 1918. On Jan. 15, he was promoted from Captain to Lieutenant-Colonel, and on Mar. 17 sailed from this country for foreign service, which continued until his return on Dec. 17, 1918. Colonel Osborn was recently retained by a large banking firm in New York to undertake the settlement of a business dispute in Paris, and sailed for France during the early part of February.

PERSONALS

Capt. James W. Dowling has left the service. In civil life he was with the Harbison Walker Refractories Co., of Pittsburgh, Penn., as sales manager.

* * *

Capt. Eugene G. Smith has left the service. He is a graduate of Dartmouth, and before entering the service was engaged in the practice of law in Boston.

* * *

Capt. Warren B. Hood has been discharged. He is a mechanical engineer and a graduate of the University of Pennsylvania and was formerly with the Canadian Railway at Montreal.

* * *

Capt. George H. Hall, who in civil life was employed by the Sprague Electric Works, New York, has been discharged. He is a mechanical engineer from the University of Maine.

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First Lieut. William H. Martin, who was commissioned as Second Lieutenant in December, 1917, has left the service. He is a graduate of Rutgers University and a mechanical engineer.

* * *

First Lieut. George H. Baker, who was commissioned in June, 1917, and was recently discharged, is a graduate of Yale. He was employed by Bonbright & Co., 25 Nassau St., New York City.

* * *

Maj. William T. Hensley has left the service. He was commissioned in February, 1918, and in civil life was a consulting engineer. His home is in Indianapolis, Ind., and he is a graduate of Purdue.

* * *

Second Lieut. Chester F. Idema has been discharged. Before entering the service he was with the Elliott Machine Co., Grand Rapids, Mich., and held a degree from the University of Michigan.

* * *

Second Lieut. F. A. Chase who was commissioned in January, 1918, has been discharged. He is an auditor and was employed by various firms. His home is at 2821 Eleventh St., N. W., Washington, D. C.

* * *

Capt. Arthur Whitcraft, who has been on duty with the Inspection Division at various stations, has been discharged. Before being commissioned he was employed by the American Manganese Steel Co., Chicago, Illinois.

* * *

George E. Harris, for the past year First Lieutenant, U. S. A., assigned to the Bureau of Aircraft Production, Finance Department, has become director of sales of the Hawkridge Corporation Co., 303 Congress St., Boston, Mass.

* * *

Maj. John H. DeVisser, who was commissioned in November, 1917, has been discharged. He is a graduate of the University of Michigan and a mechanical engineer. He is treasurer of the Koon, DeVisser Co., Detroit, Mich.

* * *

First Lieut. August H. Miller was discharged after 13 months' service. He is a graduate of Massachusetts Institute of Technology and is a mechanical engineer. He was formerly employed by the Norton Grinder Co., Worcester, Mass.

* * *

First Lieut. Nathan S. Sharp of Waterloo, Iowa, has been discharged. He is a textile engineer and a graduate of North Carolina University. In civil life he was employed by the Amoskeag Manufacturing Co., Manchester, N. H.

* * *

First Lieut. Furman South, Jr., who was recently discharged, was commissioned in September, 1917. He is a graduate of Cornell University and a mechanical engineer. He was formerly employed by Carnegie Steel Co., at McKees Rocks, Penn.

First Lieut. Prentice M. Hatch, who is an electrical engineer, and a graduate of Tufts College, has been discharged after thirteen months' service. Before he was commissioned he was employed by Stone & Webster Co., 147 Milk St., Boston, Mass.

* * *

Capt. O. Jacobson who has been recently discharged from the service is a graduate of Porsgrund, Norway, and is a mechanical engineer. Before he was commissioned Captain Jacobson was employed by the Union Iron Works, San Francisco, Calif.

* * *

Capt. Edwin Leedon, who was commissioned in November, 1917, has been discharged. He is a mechanical engineering graduate of the University of Pennsylvania. He was formerly employed by the Midvale Steel and Ordnance Co., Wilmington, Del.

* * *

First Lieut. John M. Page has received his discharge. He entered the service as Second Lieutenant in November, 1917. He is a civil engineer and was graduated from Baltimore Polytechnical Institute. He was formerly employed by the Virginia Highway Commission.

* * *

Capt. H. P. Gant, recently discharged, was formerly a partner in the firm of Lewis, Robinson & Gant, Philadelphia, Penn. He is a graduate of the University of Tennessee and an electrical engineer. Captain Gant has been on duty with the Supply Division since entering the service.

* * *

H. P. Pope, until recently in the machine-tool department of the Neville Island Ordnance plant, and previously with the Savage Arms Corporation, Sharon, Penn., has joined the Thomas Spacing Machine Co., Pittsburgh, Penn., in charge of one of its manufacturing departments.

* * *

George W. Hite, for 10 years a member of the sales force of the Pittsburgh Iron and Steel Foundries Co., Pittsburgh, who relinquished that position Aug. 1, 1918, to enter the Ordnance Production Division of the War Department at Washington, has retired from the Government Service.

* * *

First Lieut. Paul M. Hart has been discharged. He is a graduate of the University of Illinois and is an electrical engineer, and was formerly employed by Illinois Traction Co., Peoria, Ill. Since being commissioned Lieutenant Hart has been on duty at the Aberdeen Proving Ground.

* * *

Second Lieut. I. Schultheis was discharged recently. He was commissioned in January, 1918, and is a graduate of Cornell University and a mechanical engineer. Before entering the service Lieutenant Schultheis was employed by the American Machine and Foundry Co., Brooklyn, N. Y. Since being commissioned he has been on duty with the Inspection Division.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Blanchard No. 10 Vertical Surface Grinding Machine

The Blanchard Machine Co., 64 State St., Cambridge, Mass., has just placed on the market the new No. 10 vertical surface grinding machine shown in the illustration. This machine is made in either motor or belt-driven style as desired and has a range of work up to 18 in. in diameter and 6 in. high under a new wheel. The machine is intended particularly for use on flat work that does not warrant the purchase of a larger machine; for work less than 18 in. in diameter which must for any reason be ground one piece at a time for dies, punches and other small tools that are ground in small lots, not enough pieces of the same height being ground at one time to utilize a machine with a larger chuck; and for surfacing directly from the rough forging or casting, the parts of small jigs and fixtures preliminary to laying out. Surfaces parallel or at right angles can be quickly ground, removing from $\frac{1}{16}$ to $\frac{1}{8}$ in. of stock if necessary, the entire operation being completed with great rapidity as compared with other methods of handling the work.

Fig. 1 shows the front view of the complete machine. Fig. 2 a close-up view showing the water guards closed, while Fig. 3 is a diagrammatic view showing the water guards in open and closed positions and illustrating the method of operation.

The frame is said to be unusually massive and stiff, the bed being of box form cast in one piece and webbed to increase the stiffness. The column and wheel head are heavy, giving the rigid support to the wheel that is essential for accurate work and for the economical use of soft, free-cutting wheels. The column bears on the base at three points and a convenient means is provided for adjusting the spindle square with the table. Another feature of the three-point suspension, which it is claimed to be found on Blanchard machines only, is that the spindle may be inclined and thus produce concave or convex work.

The spindle is made from a steel forging of 40 to 50 point carbon and is mounted on two large ball bearings taking both thrust and radial loads. The main bearing next to the wheel has 11 balls $1\frac{1}{8}$ in. in diameter. A spring take-up is incorporated which automatically removes all backlash and compensates for temperature changes. Both bearings are lubricated with oil, which is retained in the housings and positively circulated while the spindle is running, a gage, filling opening and drain being provided for each

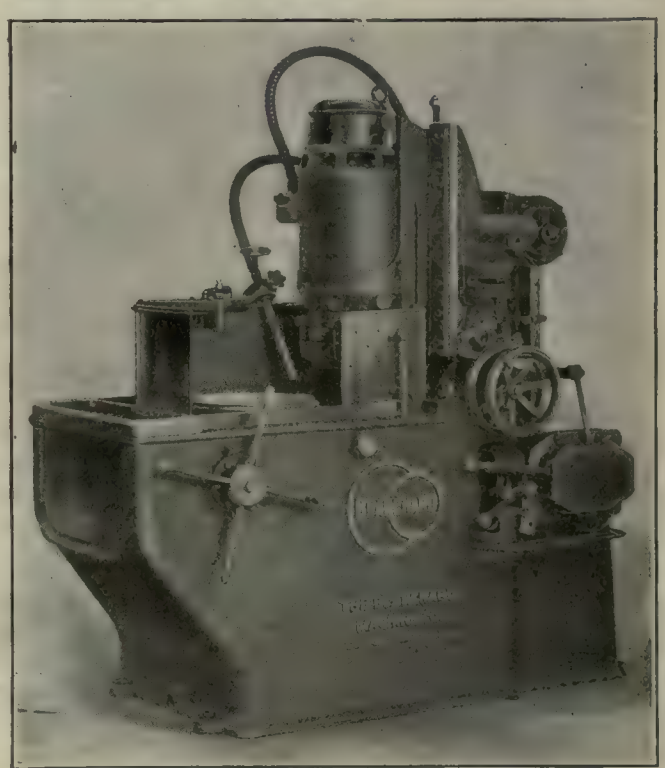


FIG. 1. BLANCHARD NO. 10 SURFACE GRINDING MACHINE

Capacities, work up to 18 in. in dia. and 6 in. high under a new wheel; work table, one-piece steel magnetic chuck, 16 in. in dia. with finely divided face, suitable for all sizes of work, 1 in. center hole, $8\frac{1}{2}$ in. tapped holes for securing stops or fixtures, 125 watts required; wheel, 10 in. in dia., 4 in. deep, with rim 1 in. thick; wheel speed, belted machine, 1800 r.p.m., direct motor-driven machine, 1740 r.p.m.; chuck speeds, four, 10, 17, 29 and 50 r.p.m.; feed, hand or power, with variations in the power feed from 0.0002 to 0.004 in. per revolution of the chuck, in steps of 0.0002 in.; capacity of water tank in base, 52 gal.; pump, submerged centrifugal with 8-in. runner and $1\frac{1}{4}$-in. discharge pipe; connections to wheel and outside nozzle, $\frac{3}{4}$ in. pipe; floor space of direct motor-driven machine, 6 ft. 5 in. x 4 ft. 2 in.; floor space of countershaft-driven machine, 6 ft. 10 in. x 4 ft. 2 in.; weight of direct-driven machine, 6000 lb.; weight of countershaft-driven machine and equipment, 5800 pounds.

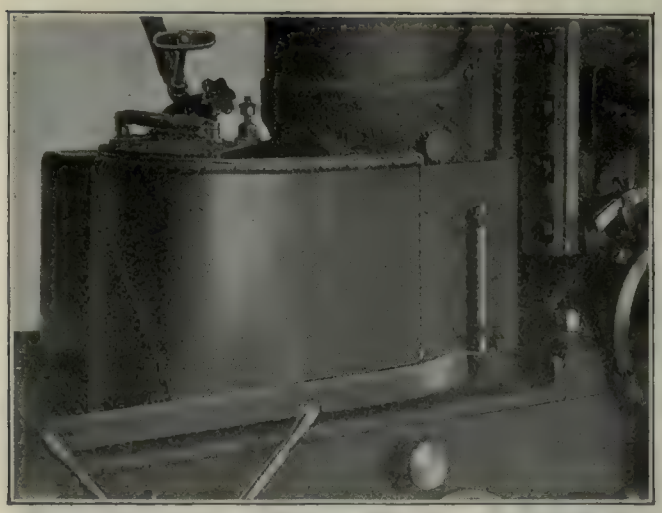


FIG. 2. A CLOSE-UP VIEW SHOWING THE WATER GUARDS CLOSED

bearing. The housings themselves are of such form as to retain the oil and exclude the dirt without the use of stuffing boxes, felt packings, or similar devices. All spindles, whether for belt or motor-driven machines, are dynamically balanced.

On the direct motor-driven type machine a 10-hp., 1740-r.p.m. induction motor for any standard alternating current is built into the wheel head, the motor being mounted directly on the wheel spindle, which also carries a multiblade fan for forcing air upward through the motor and out between the back of the wheel head and column, discharging upward at the top of the machine. The chuck and water pump are separately driven by a smaller motor at the rear of the machine, the two motors being wired to stop and start together. All wiring and electrical connections are fully inclosed but accessible. The control equipment for the direct motor-driven machine comprises a hand auto-starter with no voltage release and overload relays. Either General Electric or Westinghouse motor and control can be furnished as desired.

The belt-driven machine has an 8¾-in. pulley on the spindle, which, together with the 4-in. double belt, is entirely inclosed. The belt passes through openings cored in the column, so that the appearance of this machine is very similar to the one illustrated. Two ball-bearing guide pulleys are mounted on universal brackets at the rear of the column, these brackets suiting belt drives from either a floor motor, overhead motor or countershaft. The countershaft is equipped with Hyatt roller bearings and one of the guide pulleys has a screw adjustment for tightening the belt while running, this being available for any one of the three types of belt drive.

Both hand and power feeds are provided, the latter being adjustable from 0.0002 to 0.004 in. per revolution of the chuck. The feed is said to be very accurate and sensitive to the slightest motion of the feed handwheel. The graduations are placed on a large ratchet wheel, five notches or about ½ in. on the rim of the wheel being equivalent to a movement of the grinding wheel of 0.0001 inch.

The chuck is one-piece, steel, magnetic, made from forgings and has no joints in the working face. Narrow ring poles are used, and it is claimed these hold the smallest work securely. The face is of steel and brass and is said to be hard enough to prevent charging with grit. The chuck is built into the machine, is waterproof and is provided with tapped holes so that nonmagnetic work may be clamped in position. The chuck rotates on a flat large-diameter bearing and is held central by a spindle. The bearing surfaces are of cast iron scraped to a fit and run submerged in oil to insure lubrication.

Chuck bearings, driving mechanism and electrical connections are all inclosed in a casting which slides horizontally on the base, being operated by a pilot wheel and rack. This motion is not used during the grinding operation but allows the chuck to be moved clear of the wheel for placing and removing the work. The chuck is driven from a horizontal shaft at the rear of the machine connecting the chuck speed-gear box and the water pump, this shaft itself being driven by means of a belt from the auxiliary motor in the case of the direct motor-driven type, or from one of the guide pulleys for the spindle belt in the belted type. The gear box provides four geared speeds, any one of which is instantly available but so arranged that it is impossible for the operator to engage more than one speed at a time. Lubrication is by splash, and a gage indicates the oil level in the box. The splined shaft from the chuck carriage slides through a hollow shaft in the gear box and is protected against dirt and water by telescoping covers. It connects with a large worm mounted on ball bearings, in mesh with a worm gear at the lower end of the chuck spindle. The worm and worm gear are completely inclosed and submerged in oil, a gage indicating the oil level. The supply of oil is automatically replenished from the oil reservoir of the chuck bearing.

A submerged pump supplies water through separate pipes to the inside of the wheel and to the outside nozzle, this construction allowing the work to be flooded with water, while at the same time the water inside of the wheel is forced by centrifugal action under and through the wheel face, thus absorbing the heat as fast as it is generated. It is stated that dies and other hardened tools can be ground at extremely rapid rates without softening the edges or causing surface cracks. The base of the machine, which also serves as the water tank, is entirely open except for stiffening webs, and the water falls directly into it after leaving the work on the chuck. The mud and sand are deposited in the base, and as this is provided with a slanting front end and a large opening closed by a swinging steel door

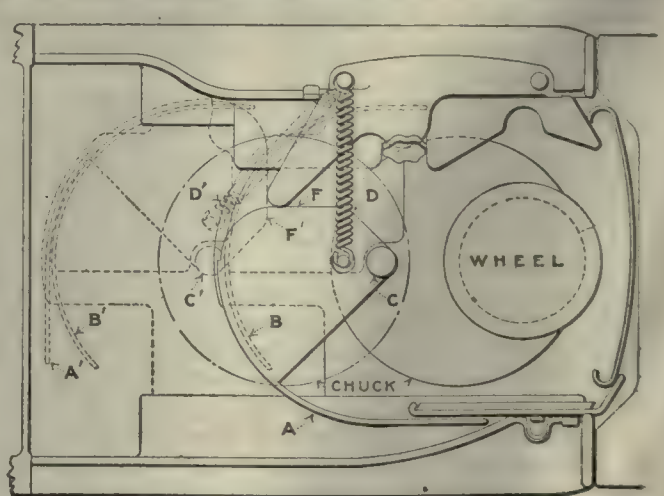


FIG. 3. A DIAGRAMMATIC SKETCH SHOWING THE METHOD OF OPERATION OF THE WATER GUARDS

it is very easy to hoe out the mud into pails or other receptacles. A suitable hoe is part of the machine equipment, and the cleaning can be done while the machine is in operation. The slanting end of the base is very useful in that it allows the hoe to be drawn from the back corner to the opening at the front without at any time being out of contact with the bottom or side, and, in consequence, allowing part of the mud to slip back into the box. Between the main tank and the pump tank is placed a removable partition over which the water flows on its way to the pump.

Heavy enameled steel guards surround the chuck and wheel while grinding is being done and effectually prevent the escape of water or dirt. A close-up view showing these guards closed is shown in Fig. 2, while Fig. 3 explains the method of operation. The sliding table, which carries the chuck, also carries two curved steel guards; one marked *A* is pivoted at *C*, the other *B* is fixed to the table. The guard *A* tends to rotate under the action of the spring *D* but is controlled by the cam *F* which forms part of the upper frame of the guard *A*. This cam bears against a fixed projection on a casting at the rear. The solid lines show *A* and the chuck in grinding position, where guards *A* and *B* lap by the fixed straight guards at the sides of the machine, forming in combination with the guard behind the wheel a complete inclosure around the wheel and work. This position is also shown in Fig. 2. When the grinding is completed the chuck is moved out to the position shown by the dot and dash line, the pivot *C* moving to *C'* and the guard *B* to *B'*. The guard *A*, controlled by the spring *D* and the cam *F*, swings around to position *A'* leaving a wide opening for removing and placing work. This is the position shown in Fig. 1.

All control handles are so grouped as to be convenient to the operator and all important bearings and gears are lubricated by oil baths, the reservoirs containing sufficient oil to lubricate the machine for a week or longer without replenishing, and being fitted with gages showing the level of the oil.

Standard equipment includes a 16-in. Blanchard, one-piece steel magnetic chuck; water guards, pump and piping; two 10 x 4 x 8-in. grinding wheels mounted in rings with four extra rings for mounting wheels; two chuck rings, one outside and one inside to hold small work from sliding; wrenches; wheel truing device; hoe for cleaning tank; and either countershaft or motor, depending upon the type of machine.

Electric Brazing Machine

The machine shown in Fig. 1 has been developed by the Electric Brazing and Welding Co., 30 Church St., New York City, for brazing parts by application of heat through the medium of electricity.

The process is not in any sense welding, but the joint is secured by molten spelter in exactly the same manner as in more common forms of brazing apparatus without the more or less undesirable accompanying effects due to gas or whatever heating medium is used.

In Fig. 1, a piece of copper tube with several brazed-on branches is shown lying in the opened clamps. Current is supplied through a transformer in the cabinet which forms the body of the machine.

Fig. 2 shows several samples of brazing that have been done on the machine, all of which with the exception of the copper rod in the foreground are parts of the Rolls-Royce engine. These examples include copper, copper to steel and steel to steel, satisfactory joints being secured on all of these combinations.

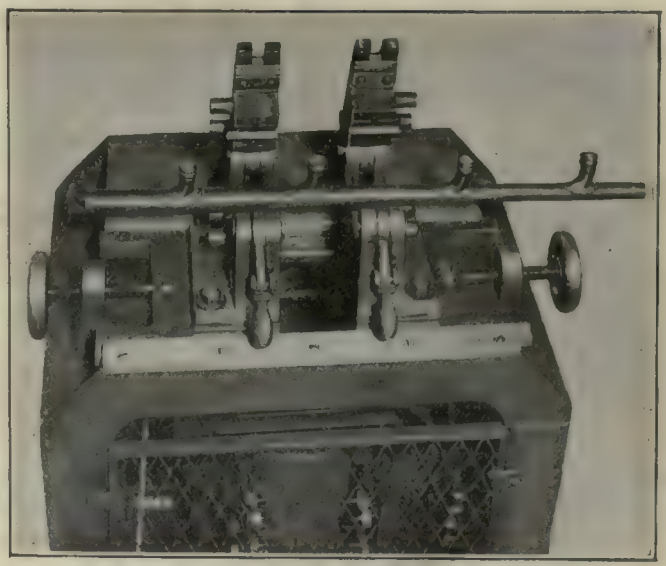


FIG. 1. THE BRAZING MACHINE

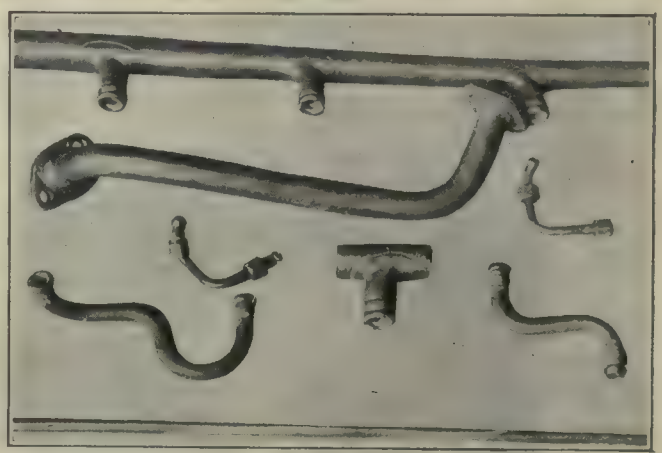


FIG. 2. SAMPLES OF BRAZED JOINTS



FIG. 3. ENLARGED VIEW OF JOINT

The manner in which the spelter is applied depends upon the physical nature of the joint to be made. In some cases the spelter is granulated, mixed with the flux and applied in the form of a paste; in others spelter wire is wrapped around to joint.

Fig. 3 shows an enlarged view of a brazed joint just as it came from the machine. It will be noticed that this joint is much cleaner than usual.

The rod in the foreground of Fig. 1 is an example of the ductility of these joints. A copper rod $\frac{5}{16}$ in. in diameter was brazed and afterward drawn to about No. 16 gage wire, the joint showing no sign of distress. It is claimed that with welded joints difficulty is experienced from brittleness or lack of cohesion of the welded metal when such reduction of area is attempted.

The machine weighs approximately 800 lb., is 28 x 38 in. by about 30 in. in height. It can be adapted to any commercial supply of alternating amount up to 440 volts and has a capacity of 8 to 10 kilowatts.

Westinghouse Foot Warmer for Outdoor Service

The electrically-heated foot warmer shown in the illustration has just been placed on the market by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., and is intended for the use of watchmen, gatemen, or other persons where it is necessary for them to stand for long intervals of time in one position in winter weather. The warmer is water-



WESTINGHOUSE FOOT WARMER FOR OUTDOOR SERVICE

proof, and in order to supply the proper amount of heat for moderately cold, cold, or extremely cold weather, is provided with a three-heat control. A three-heat control snap switch is used to connect two equal circuits of 100 watts each in parallel, thus using 200 watts; 100 watts by using one circuit only, and 50 watts by connecting the two circuits in series. The resistance is of the slotted ribbon type distributed uniformerly over the entire surface, the ribbons being assembled between two plates of built-up mica, 0.025 in. thick, cemented together to form a unit. The heat is of low temperature at all times in order to prevent the possibility of chilblains. The entire device is 14 in. wide, 20 in. long, and 2½ in. high, and is constructed either of cast iron or copper and made in one piece. The top surface is diamond treaded and feet are provided at the four corners to raise the warmer 1 in. above the floor. The heater unit is clamped against the under side of the main casting by a ⅛-in. steel clamping plate, and a bottom sheet-steel plate sealed with gum covers the heating element. The cable, which is of the rubber insulated type, triple conductor, enters the warmer through a bell-mouth waterproof fitting mounted on the center of one of the short sides.

Westinghouse Electrically-Heated Dry-Type Glue Pots

The illustration shows the three new dry-type electrically-heated glue pots that have just been placed on the market by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn. The advantages claimed for these pots over the old wet type with a water bath are that there is no water to evaporate and



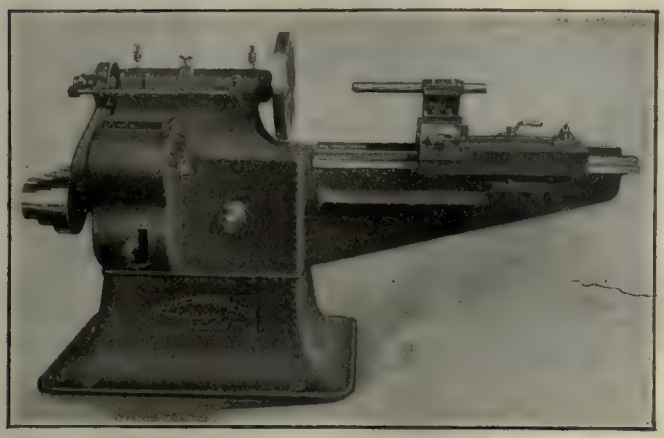
WESTINGHOUSE ELECTRICALLY-HEATED DRY-TYPE GLUE POTS

cause the heater to burn out or the glue to burn; the entire elimination of the necessity for the addition of water to the bath, and the consequent inconvenience and sloppiness; with the dry type it is possible to use a single-heat constant input heater, there being no need of having two heats, one for high and one for running; the dry glue pot is more efficient, as none of the energy is required to heat the water bath; and the dry-type heater also saves time, as there is no water bath to be heated. The glue pot itself is of spun copper fitting snugly into the sheet-steel outer jacket in such a manner as to make good thermal contact with the heating element, which is an integral part of the sheet-steel bottom plate. An extra sheet-steel plate is placed beneath the heating element with a dead-air space between to prevent the escape of heat downward. The heater is designed to take the proper electrical input to maintain the glue at the correct working temperature, whether the glue is being used or not, and there is no danger of overheating. The time taken to heat the glue to working temperature is approximately 15 minutes. The glue pots are at present made in three sizes, 1 pint, 1 quart, and 4 quarts, and the power used being 60, 80, and 140 watts respectively.

Fischer Oil Grooving Machine

The oil-grooving machine shown in the illustration has just been placed on the market by the Fischer Machine Co., 310-316 North 14th St., Philadelphia, Penn., and is known as the company's No. 2 machine. The machine is for operations on bearings up to 15 in. in diameter and 15 in. long. The bearings in which the oil grooves are to be cut are mounted on a revolving chuck or faceplate while the boring bar is carried on a block mounted upon the slide. This construction

allows any type of oil groove to be cut, varying from a straight groove parallel with the axis of the bearing, which is cut by holding the work stationary and moving the tool slide, to a groove in a plane perpendicular to the axis, which is cut by holding the slide stationary and revolving the work. For starting and stopping the movement of the faceplate the handle at the front of the spindle, mounted on the rod connecting with the clutch in the rear of the spindle, is incorporated. When it is desired to hold the work stationary, and cut in a plane perpendicular to the axis, the spindle is held in position by means of the clamp projecting above the spindle between the two oilers. Three speeds for the spindle are provided by means of gears changed by the lever at the front of the machine. An adjustment is provided for the length of stroke of the boring bar, and a cross-slide mechanism allows work of varying diameters to be handled. A locking device secures the boring bar permanently in position when grooves in a plane perpendicular to the axis of the bearings are being cut. The grooves cut may be either external or internal, depending upon the work in hand. An attachment is furnished to allow the grooving of tapered bearings.



FISCHER 15 x 15-IN. OIL GROOVING MACHINE

Hole in spindle, No. 4 Morse taper; thread on spindle, 2⅜ in.; pitch of thread on spindle, 6; length of groove cut, 15 in.; swing over bed, 19 in.; dia. of faceplate, 18 in.; length of machine, 8 ft. 3 in.; dia. of cone steps, 11, 13 and 15 in.; width of belt, 2½ in.; speed of countershaft, 300 r.p.m.; hp. required, 2; height of spindle above floor, 3 ft. 8 in.; height of ways above floor, 2 ft. 10½ in.; floor space, 8 ft. 3 in. x 2 ft. 8 in.; size of base, 2 ft. 7¾ in. x 4 feet.

Edlund Milling Vises

The Edlund Machinery Co., Cortland, N. Y., has recently placed on the market two new types of milling vises shown in the illustrations. The vise shown in Fig. 1 is equipped with side bars which take the clamping strain, these bars being dropped under the opening of the vise jaws in order that long work may be held. It will be noticed that the sliding jaw is on the opposite end from the clamping handle. The jaw faces are removable and replacable and the advantage claimed for the type of construction used is that the pieces of work are gripped in such a manner that there is no tendency for the jaws to spring upwards, allowing the work to loosen. Fig. 2 shows a milling vise for heavy work. The solid jaw is reinforced to prevent breakage and the screw is protected so that chips cannot accumulate around the working parts of the vise. The crank is said to be extra long to give a greater purchase for gripping. The jaws are hardened, ground and drilled to fit the standard vises. Both types shown are made in three sizes, 6, 7 and 8 in.

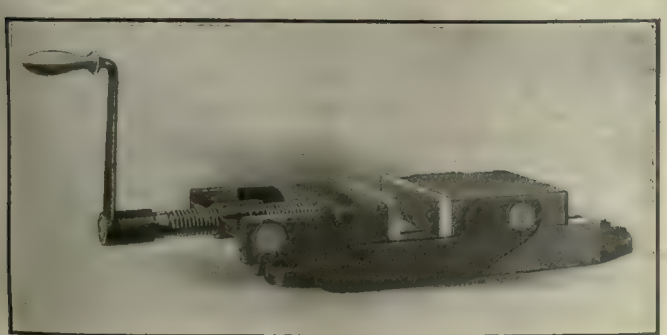


FIG. 1. EDLUND MILLING VISE WITH SIDE BARS

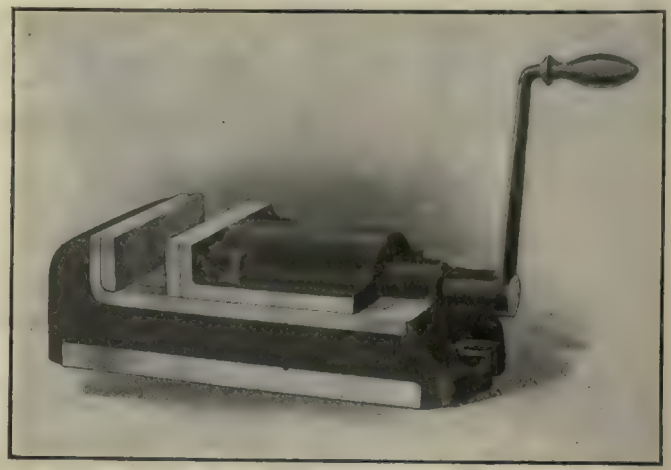


FIG. 2. EDLUND HEAVY-DUTY MILLING VISE

Navy Department Begins Sale of Surplus Materials

The Navy Department has begun the sale of surplus material in its possession consisting of lumber, chemicals, machinery, etc., and an explosive plant at Mt. Union, Penn. Sealed proposals have been asked for on a small quantity of condemned stores and the balance will be placed on sale as fast as it is released. The disposition of the material is being made through the Bureau of Supplies and Accounts, Navy Department, of which Rear-Admiral McGowan is chief, under the direction of Lieut. C. G. Peterson.

The property being offered for sale by the Navy Department is small compared with the surplus material of the War Department. The largest item is the explosive plant at Mt. Union which is valued at $1,500,000. Only the T.N.T. unit will be placed on sale, the powder section having been disposed of to the Aetna Powder Co. The Navy Department announces that the purchaser will have the option of placing the plant in operation or of scrapping it. A large quantity of copper purchased by the Navy Department at high prices will not be sold but will be stored for the future use of the Navy.

Sales by means of sealed bids as used by the Navy Department differ from the plan adopted by the War Department, the latter having organized a sales force such as has been developed by American commercial interests, the material being sold in the open market.



Sparks from the

France in Great Need of Many American Products

High Commissioner from France Says That His Country Looks to the United States for Help in the Reorganization of Her Industrial Life

FRANCE is in desperate need of many American products, but she is taking steps to protect her own business men during the rehabilitation of her industries. American exporters or those in other countries will not be permitted to ship products into France which can be produced in that country in the near future. This in substance was the message given to American business men by Lieut. Raymond D'Aiguy, of the French High Commission in this country, who spoke at the Bush Terminal Sales Building on Mar. 12.

"The greatest need in France at the present time," said Lieutenant D'Aiguy, "is food and agricultural implements, and she is looking to America for both of these. The import duty on agricultural implements has been temporarily suspended as an inducement for American manufacturers to ship their products to France. During the war France lost 300,000 agricultural implements."

The speaker sketched quickly and precisely the far-reaching effect of German destruction in France. According to figures he quoted, the destruction includes 27,000 factories, representing an investment of $5,000,000; 440,000 homes, 3000 miles of railway track, 1000 bridges and 400 tunnels.

To aid in the reconstruction of these France will have to import quickly 7,000,000 tons of metals. The requirements for the next year are estimated at 1,500,000 tons of iron and steel, 80,000 tons of copper, 40,000 tons of lead and 90,000 tons of raw cotton for textile plants.

"France looks to America to help in the reorganization of her industrial life," said Lieutenant D'Aiguy. "We need American engineers to help reconstruct our plants and American business experts to help us reorganize French business. I believe that France will become more of a modern machine-using nation than before the war. America can help in showing French business men the advantages of machine production.

"France is suffering from a shortage of machine tools now, but in order to assure a certain amount of profit for France in any importations they must be bought through a special government body, which exacts a 16 per cent. profit for France as well as an extra 2 per cent. for the upkeep of this special organization.

"Above all things France needs ships, and we hope to be able to place orders in American shipyards for about 1,000,000 gross tons of shipping.

"France is not bankrupt, but she has lost much through the war. In making our purchases in America we will be able to pay for about half of the merchandise we buy. American business men will have to extend us credit for the other half.

"American business men who want to do business in France should conduct negotiations through a Frenchman of a French firm," Lieutenant D'Aiguy insisted. "The French and American people are not at all alike. It takes a Frenchman to understand his own people."

* * *

The Machine-Tool Trade in Great Britain

The Machine Builders Are Confronted With Similiar Problems As Those In America

The problems confronting machine builders are presumably somewhat similar in both Great Britain and the United States, and for that reason the experiences in one case should be of value in the other.

The same topics of conversation seem to prevail in the various districts of Great Britain, namely, unemployment and unsettled conditions of labor, high costs of material, and the excess-profit tax. New enterprises are being held up in the hope of more settled conditions in the near future. The steel business of Sheffield, particularly in the heavy branches, is reported short of work with many furnaces idle, this being more true of the basic than the acid furnaces. Crucible furnaces are running not much over half-time, while high-speed steel seems to be at a standstill. This, in turn, affects the demand for tungsten and other alloys.

The British Railway Administration is evidently placing more orders for equipment and material of all kinds than is being done on this side in proportion to the railway mileage and the need of railway rehabilitation. This should be one of the fields to give stability to our machine-tool and other trades, as no matter what final disposition may be made of the railways, any material improvement is a national asset.

Reports from Birmingham, England, are very encouraging, and the demand for labor seems to be fully equal to the supply. A portion of this labor is being employed on local reconstruction with reference to the industries of the district, particular attention being paid to the development of the hollow-ware industry, which was largely in German hands before the war. There seems to be very little tendency toward using war machinery for this purpose, new presses being built especially for this industry, which promises to develop to large proportions. Some of the strictly war products, such as airplane fittings and similar parts, can hardly hope to continue along the old lines, and must either go out of business or find new lines of manufacture. The general trade, however, seems to be able to employ all the capable mechanics that can be found.

Machine-tool builders in general are receiving numerous inquiries from various parts of the world, including France, Belgium, and the East. The demand does not seem to be materially affected by high prices, the main precaution being to avoid the piling up of bad debt. The Birmingham Chamber of Commerce is considering a world-wide trade propaganda, using the motion picture and other methods of acquiring consumers everywhere with the capacity and products of the Birmingham shops.

The Manchester district does not seem to be quiet so fortunate, although machine tools are in demand here. As an example of the demand for lathes, we may quote the case of a hollow spindle lathe with a 22-ft. bed and 38-in. swing. This had been in use about six months and the dealer held it for about $1200. Several customers wanted to purchase, and instead of having them bid against each other, the dealer told them to settle among themselves who was to have the machine. In another instance a 14-in. shaping machine of good design and with a fair equipment sold for $600. Automatic screw machines, hand turrets, and milling machines of standard make are being disposed of by strictly munitions plants with almost no difficulty.

London, Mar. 10, 1919.

* * *

The United States Employment Service Broadens Its Field

The United States Employment Service has further extended the scope of its work by the establishment of two new zone offices of the Professional and Special Section, in Philadelphia and Boston. The new zone offices are in addition to the two main offices at New York and Chicago, and will serve the zones in which they are located.

World's Industrial Forge

By E.C.Porter, News Editor

Fresh from overseas, with a new and broader point of view, officers of the Army and Navy are now seeking opportunities to use their brains and energy in American business. The main offices of the Professional Section are daily receiving the lieutenants, captains, majors and even colonels who led their men to victory, and without exception these men ask but for one thing—opportunity to win new successes in the business world. They are men of proved tenacity, of the quickest intelligence, hundreds of them experienced in executive, professional and technical work.

By means of a comprehensive system every officer or man is being afforded an opportunity to state his education and experience in full. His qualifications, determined by a personal interview, are carefully analyzed and matched against the positions available in his particular line of work. As a result, employers throughout the United States who state their needs to the officers of the Professional Section are daily receiving acceptable men.

Employers requiring the services of educated and experienced men are asked to state definitely the nature of the positions available, to the nearest of the following U. S. Employment Service, Professional and Special Section offices:

New York office, 16 East 42nd Street; Chicago, 62 East Adams Street; Philadelphia, 1518 Walnut Street; Boston, 16 Tremont Street.

* * *

Chairman of Tariff Commission Will Go to Paris

Dr. F. W. Taussig, Chairman of the United States Tariff Commission, has been directed by the President to proceed to Paris for the purpose of taking part in the readjustment of commercial treaties and similar problems.

The Tariff Commission was authorized by Congress to investigate the tariff relations between the United States and foreign countries, commercial treaties, preferential provisions, economic alliances, and the effect of export bounties and preferential transportation rates. For two years it has studied in detail commercial treaties, reciprocity and preferential arrangements, bargaining tariffs and colonial tariff systems.

* * *

Eight Weeks Employment Record

During the eight weeks ending Feb. 22, the United States Employment Service received 1,090,124 applications from men and women for jobs. Of this number 930,029 were referred to opportunities and 679,513 were reported placed in employment.

The American Welding Society A New Organization

First Meeting To Be Held in the Engineering Societies Building in New York City on March 28 — Plan of Society Organization Different From the Usual One

THE *American Machinist* has been requested to place before its readers the plans adopted for forming the AMERICAN WELDING SOCIETY, a national organization intended to be a disinterested and dependable source of information on welding, not only for the benefit of the manufacturers of welding equipment but also to aid those who use welding in their production or who purchase welded goods.

This society will merge the Welding Committee of the Emergency Fleet Corporation and the National Welding Council and will include others who may be interested. It will give greater stability to welding by standardizing welding processes and thus make its economies available in a wider field of industry.

With the signing of the armistice the days of the two welding committees mentioned above were numbered, as they were purely war activities, but their work had been so valuable that it was felt that steps should be taken to continue it and enlarge its scope. Consequently the new organization will deal with all of the various welding processes, forge welding, electric resistance welding including spot welding, electric arc welding, gas welding, thermit welding, etc.

The society will be governed by a board of 24 directors and the usual officers, and its principal work will be done through a committee to be known as the American Bureau of Welding which will be made up of the above-mentioned individuals and one representative from each of the following scientific societies and Government departments: American Bureau of Shipping, American Chemical Society, American Engineering Standards Committee, American Institute of Electrical Engineers, American Institute of Mining Engineers, American Physical Society, American Railway Association, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society of Refrigerating Engineers, American Society for Testing Materials, Bureau Veritas, Engineering Foundation, Lloyd's Register of Shipping, National Fire Protection Association, National Research Council, Society of Automotive Engineers, Inc., Society of Naval Architects and Marine Engineers, U. S. Department of Commerce, U. S. Navy Department, U. S. Shipping Board, U. S. War Department, and others at the discretion of the directors.

From the plan of organization it will be seen that the new society, through the Bureau of Welding, offers to the existing societies a means of conducting jointly their welding activities which, for efficiency, economy and magnitude of results, exceeds anything that would be practicable for them to accomplish individually. Therefore, the new society should be looked upon as the opportunity for the existing societies to have a common department of welding rather than as an additional society. This intent is fully carried out in the classification for membership by opening to members of affiliated societies membership in the new society at a nominal rate.

MEMBERSHIP

Class A—It is intended that the burden of supporting the new society shall fall principally upon those whose business interests would be advanced by the work of the society. These are clearly the companies that manufacture and sell apparatus and supplies for welding, or that employ welding as a process in their output, or that purchase goods welded whole or in part and desire to do so intelligently. Their representatives will be known as "Class A sustaining members accredited to corporations" with annual dues of $100. The number of Class A members from the same corporation is not limited. On the contrary, it is expected that the larger companies at least will support the society by as many Class A members as may accord with their standing in the industry.

Class B—The fact that a corporation is represented in the Class A sustaining membership opens the Class B membership with full rights, to others of its employees at annual dues of $20. This class is also intended to provide for any individual not employed by a corporation, consulting engineers, college professors, et al.

Class C—For the benefit of existing societies that become affiliated with this society through the proposed Bureau of Welding, the Class C membership provides that their members may become associate members in the society at annual dues of $10. These members having their own director participating directly in the work under the arrangement for affiliation, would not need to vote or to hold office.

Class D—Welding artisans may join the society under Class B if they de-

sire, but the Class D membership, with annual dues of $5, offers them the benefits of the society, other than voting and holding office, at a minimum cost.

Class E—This membership provides for trade associations, putting them in the same category as corporations.

Class F—This class makes provision for honorary members.

Activities of the Society

As a part of its routine, the society will ascertain what specific investigation or assistance is needed in any branch of the industry. If this assistance involves research, a definite program will be arranged and presented to the portion of the industry affected, indicating the benefits to be derived therefrom. The funds which will come from the annual dues are intended primarily to maintain the society, and will obviously not be sufficient for any extensive research. It is the intention, therefore, to finance each research separately. An investigation desired by the industry will be made, if sufficient financial support can be secured to conduct it efficiently.

The benefits of a proper standardization, both to the producer and to the consumer, are well recognized. But as some of the manufacturers interested in the new society have expressed fears that standardization might be carried too far, from the commercial point of view, it seems desirable to explain at some length the part which the society and the Welding Bureau are expected to play in this work.

Need for Uniform Methods

For some years past numerous overlapping and conflicting efforts in the field of industrial standardization have been carried out by more or less independent organizations, each according to its own method of procedure. There is the need, therefore, of reducing unnecessary effort and of providing uniform methods that will secure, in each case, the coöperation and support of all the organizations whose interests may be affected. To this end there has recently been formed the American Engineering Standards Committee through which it is hoped to gain this cooperation. The method of establishing a standard presented by this committee not only assures that all interested organizations or groups, whether producers or consumers, may participate in the work of creating it, but also requires practically unanimous consent to the standard before it can be issued.

It is intended that the work of the new society in standardization shall conform to the procedure established by the American Engineering Standards Committee, and shall be subject to its approval. In fact, a sub-committee of the Welding Bureau, when formed, will become the sectional committee on welding of the American Engineering Standards Committee.

The investigations of the Welding Committee have thus far shown that one of the most important elements in the success of an autogenous welding operation is the skill of the operator. To secure this, uniform methods of training are essential, and the society will take an active part in planning how welders should be trained, and how their proficiency may be determined.

Relation to Private Investigations

It is the desire of the society to stimulate private companies in their own researches, to aid them by giving them more basic material to work upon and by relieving them of part of the burden. But there is obviously a field best suited to the society although no dividing line can be drawn. For instance, when a broad and impartial quality is needed to make an investigation acceptable as a basis for legislation, regulations and codes of governing bodies, insurance companies and the like, the society, in the nature of the case, is in a better position to secure it than is any single interest.

Again, for the purposes of standardization, a private investigation, no matter how carefully planned, might not be accepted as complete and conclusive by those having a different point of view from the original investigator. Through the society all those interested would participate in planning as well as in conducting investigations.

Furthermore, a conclusive investigation is often too expensive to be within the range of any but the strongest companies; and even with them it might not be clear why they should carry such a burden alone when the benefits must accrue inevitably to the industry at large.

When the object of an investigation is in any part to increase the use of welding by increasing public confidence in it, it is clearly within the province of the society. What would be the efficacy of a single company as compared to that of the great engineering societies, the National Research Council, the Bureau of Standards, the Army, the Navy, the Shipping Board and other departments of the Government, the insurance interests, and others, all working in coöperation with the industry?

The new society will be the means for accomplishing this, whereby all parties at interest may participate directly in coöperative research and may make the conclusions, when agreed upon, their own, and wherein the authority needed will arise automatically.

The first meeting will be held on Friday, March 28, 1919, at the Engineering Societies Building, 33 West 39th Street, New York, at 10.30 a.m. If you cannot attend in person, the receipt of a letter before the time of the meeting indicating the class in which you desire membership will entitle you to become a charter member of the society.

Francis P. Garvan Appointed Alien Property Custodian

President Wilson has appointed Francis P. Garvan to succeed A. Mitchell Palmer as Alien Property Custodian.

Mr. Garvan has been in charge of the Sales Division of the Office of the Alien Property Custodian for some time, with headquarters in New York City. His previous career was conspicuously identified with the public utility industries. He has been the Director of Investigations of the Alien Property Custodian since June, 1918, serving without salary. It was upon Mr. Garvan's initiative and under his supervision that millions of dollars worth of German property were found in this country and thus brought under the jurisdiction and control of the Alien Property Custodian.

Mr. Garvan is a leading lawyer of New York, and a graduate of Yale, class of '97. He was an Assistant District Attorney under District Attorney Jerome. Mr. Garvan is a member of the Executive Committee of the Bar Association; a Trustee of the Catholic University and a member of the University, Manhattan and Democratic clubs.

Business Items

The Biggs-Waterson Co., Cleveland, Ohio, is offering for sale the entire equipment of the Dayton Metal Products Co., Dayton, Ohio.

The Ontario Electric Steel Co., Inc., with offices at Fulton, N. Y., is the successor to the Fulton Steel Corp., manufacturer of high-speed and alloy steels, Singer Bldg., New York.

The Machinery Salvage Co., 1859 Fulton St., Chicago, Ill., is a new concern that will specialize in salvaging large plants. C. H. Rhodes, the senior member has had long experience in the machinery business and is well known among the trade.

The Taylor Society will open a permanent office in the Engineering Societies Building, 29 W. 39th St., New York, on Apr. 1, 1919. The activities of the society will be conducted from this office by Dr. Harlow W. Person, the new managing director.

The Handcock Foundry Co., Berkley, W. Va., recently incorporated with a capitalization of $25,000, has purchased the foundry of Daniels & Smith. It is reported that the capacity will be doubled. The directors of the new company are Roy Daniels, president; Nelson Perin, vice president; Albert C. Garland, secretary and treasurer; Dr. I. H. Tobias, Harry L. Creager and Austin C. Peck.

The Cleveland-Duplex Machinery Co., 1224 W. 6th St., Cleveland, Ohio, has been incorporated with G. Jack Hawkey as president and treasurer, and Richard Goedecke as vice president and sales manager. The appointment of T. D. Britton, in sales capacity is also announced. The business, formerly under the name of the Duplex Machinery Co., will continue to serve this territory in machinery and machine tools.

Personals

J. F. MACKIN, formerly with the Independent Pneumatic Tool Co., has joined the Black & Decker Manufacturing Co. and will represent them in the State of Ohio.

O. P. PALMER is the new purchasing agent for the Pratt & Whitney Co., Hartford, Conn. Mr. Palmer goes to the Pratt & Whitney Co., after 15 years' service with the Remington Arms Co., Bridgeport, Conn.

W. W. CLARK, with the Miller Rubber Co., Akron, Ohio, in charge of the export business to South America, has returned to the Hart-Parr Co., Charles City, Iowa, where he was formerly foreign sales manager.

WALTER P. HATCH, who for the past nine years has had charge of the wire sales division in the home office of the Morgan Spring Co., Worcester, Mass., has been appointed district sales manager for the western district, and will make his headquarters at Chicago.

MAJOR VICTOR PAGE, of the U. S. Air Service and formerly of the New Departure Manufacturing Co., Bristol, Conn., has returned from France and after a brief rest will take up his position as managing editor of *Everyday Engineering* in New York City.

J. T. PLUMMER, who has been connected with the Haynes Stellite Co. as district manager for the past two and one-half years, at Cleveland, Ohio, and at Kokomo, Ind., with the executive offices, has resigned to open sales offices in Chicago for the "Perfect" pulley coverings. These coverings are made by the Kingsley Manufacturing Co. of Indianapolis, Ind., and consist of a specially prepared fabric which is attached to the pulley face to prevent belts from slipping.

L. H. HARTMAN, chief of the Surplus Property Division, severed his connection with the War Department Mar. 1, and returned to his own business interests in Chicago. He was called to Washington six months ago to take up the problem of handling surplus and inactive supplies out of which grew the Surplus Property Division after the signing of the armistice. Mr. Hartman retires at this time feeling that he has finished his work in creating and perfecting the surplus property organization, and because his private business interests demand his entire time and attention. He is president of the L. H. Hartman Co., a firm of business counselors in Chicago.

C. W. JOHNSON has been appointed assistant manager of works of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn. After graduating from Ohio State University, he entered the employ of the Steel Motor Co., Johnstown, Penn., and a year later became associated with the Bullock Electric Co., Cincinnati, Ohio. In 1904 he was made superintendent of the Allis Chalmers Bullock, Ltd., of Montreal, Can. In 1907 he entered the employ of the Westinghouse company, being appointed chief inspector of works and later was promoted to general superintendent, in which capacity he served until his recent appointment. Mr. Johnson is a member of the American Society of Mechanical Engineers, American Institute of Mining Engineers and the Engineers' Society of Western Pennsylvania.

* * *

Metal-Working Machinery Exports From United States

There is given below the value of the exports of lathes, sharpening and grinding machines, and other metal-working machinery from the United States during the calendar year 1918, and the countries of destination, the data having been prepared by the statistical division of the Bureau of Foreign and Domestic Commerce:

Countries.	Lathes.	Other machine tools.	Sharpening and grinding machines.	All other metal working.
Belgium			$490	
Denmark	$2,651	$2,948	1,369	$3,685
France	2,577,292	2,444,674	2,468,429	7,860,204
Greece		570	150	
Iceland and Faroe Island			80	
Italy	648,710	841,025	411,559	1,346,440
Norway	31,065	42,287	5,968	176,357
Portugal	1,398	4,396	595	7,472
Russia in Europe		1,014		
Spain	14,980	40,727	17,970	52,887
Switzerland	4,400	8,339	10,881	49,537
England	3,304,898	5,474,464	2,225,838	7,627,055
Scotland	52,165	46,056	40,446	524,688
Ireland		1,293		
Bermuda	16	517	5	11
British Honduras		49	244	1,000
Canada	1,315,047	1,220,675	275,720	2,002,381
Costa Rica		1,286		2,670
Guatemala	669	109	491	3,014
Honduras	59	279	222	220
Nicaragua		1,018	9	175
Panama	9,465	6,985	4,333	16,173
Salvador	262	1,104	92	25
Mexico	52,360	41,657	47,955	69,915
Newfoundland and Labrador		1,841		3,717
Barbados		314		
Jamaica	1,964	161	249	5,969
Trinidad and Tobago	12	3,553	180	3,443
Other British West Indies		297	178	486
Cuba	81,758	97,610	12,565	117,685
Danish West Indies		5		
Dutch West Indies	455	502	132	163
French West Indies	1,297	1,069	278	232
Haiti	861	1,844	287	2,993
Dominican Republic	9,547	7,271	50	6,009
Argentina	26,981	49,241	15,662	36,489
Bolivia	3,000	2,468	311	12,608
Brazil	81,986	57,986	5,468	85,126
Chile	81,736	85,683	37,744	439,955
Colombia	3,518	4,077	651	5,278
Ecuador	970	11,135	2,383	200
British Guiana	393	1,568	261	9,375
Dutch Guiana			283	
Paraguay	86	65	8,844	
Peru	36,340	22,184	12,476	20,060
Uruguay	3,520	2,618	730	13,653
Venezuela	795	4,472	357	14,925
China	81,540	20,210	6,313	37,092
French China			77	
Japanese China	3,680			4,481
Chosen		580		
British India	$239,604	$156,751	$42,607	$812,700
Straits Settlements	5,523	4,558	1,381	4,264
Other British East Indies		45	19	
Dutch East Indies	167,373	31,573	5,539	56,303
French East Indies	125	437	1,607	8,716
Hongkong	13,919	9,765	570	14,411
Japan	767,389	681,068	336,933	2,261,784
Russia in Asia	1,406		47	7,250
Siam	2,780	1,752	650	130
Australia	88,644	116,068	76,563	122,705
New Zealand	19,187	15,092	6,239	9,254
Other British Oceania		18		
French Oceania			103	
Philippine Islands	35,193	15,671	31,263	34,334
Belgian Kongo		12	116	3,430
British West Africa	1,148	36	622	16,788
British South Africa	63,216	33,447	36,114	45,270
British East Africa	7,868		240	41
French Africa				192
Madagascar	1,414			
Portuguese Africa	2,782	768	8	12,022
Egypt		75		5,112
Total	9,853,507	11,626,360	6,161,876	23,978,554

New Publications

The Inventors' Manual.—By George M. and A. A. Hopkins. One hundred and forty-four 5 x 7¼-in. pages; bound in red cloth boards. This manual is published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $1.25.

This book is designed to guide inventors in perfecting their inventions, taking out their patents and disposing of them. The various subheads of the text include: The Faculty of Inventing; Inventor and Invention; Patent Advertising; Making and Prosecuting Your Own Patent; Incompetent and Bungling Attorneys; A Limited Patent; A Word about Coupon Attorneys, or those of the "No Patent, No Pay" Type; Record of Inventions; Assignments; Reversion of a Patent; Design Patents; Money in Patents; Patent Tricks, Old and New; Joint Ownership; Foreign Patents; The Value of Patents; The Inventor and Promoter. About half of the book is filled with census data regarding occupations, populations of cities and states. A few examples of typical patents of every-day things are also in the back of the book.

Trade Catalogs

Airco Service. Air Reduction Sales Co., 120 Broadway, New York. Folder giving the advantages in the use of Airco products in repairing damaged locomotive cylinders.

"Built Up" Rail Frogs. Air Reduction Sales Co., 120 Broadway, New York. Single sheet circular giving the benefits derived from the use of Airco products in building up worn frogs.

The Craig & Coffman Turret Toolpost. The Craig & Coffman Tool Co., Kansas City, Mo. Catalog. Pp. 8; 5½ x 7⅜ in. Description of the construction, operation and advantages of this turret toolpost.

Jones Machine Moulded Pulleys. W. A. Jones Foundry and Machine Co., Chicago, Ill. Catalog No. A-7. Pp. 32; 4½ x 7 in. A general price list of the various types of pulleys manufactured by this company.

O. Z. Divided Machine Vises. O. Zernickow, 15 Park Row, New York. Folder. Pp. 4; 8½ x 11 in. These vises are fully described and are illustrated in use on a milling and a planing machine and a drill

Type "C" American Roller Bearings. American Roller Bearing Co., Pittsburgh, Penn. Bulletin No. 1004. Pp. 8; 6⅜ x 10 in. A circular describing the type "C" roller bearing. Specifications and price lists are given.

Suggestions for Installation of Shafting and Monorail Systems in an Austin No. 3 Standard Building. Austin Co., Cleveland, Ohio. Single sheet circular describing these two systems for carrying transmission equipment.

Pittsburgh Metal Cutting Saws. Pittsburgh Saw and Manufacturing Co., Pittsburgh, Penn. Catalog No. 10. Pp. 55; 5⅜ x 8⅜ in. An illustrated and descriptive catalog devoted to circular metal cutting saws. Details and prices are given.

Lamp Security. Flexible Steel Lacing Co., Chicago, Ill. A single sheet folder bearing information on the Flexco-Lok guards for electric lamps. Table of sizes and prices are given. Copies of this folder may be had free on request to the company.

The Oesterlein Story. The Oesterlein Machine Co., Cincinnati, Ohio. Booklet. Pp. 22; 5½ x 7⅜ in. This is a detailed description of the unusual points in Ohio milling machines. All types of its milling machines are illustrated and specifications are given.

Railroad Time Zones. The Metal and Thermit Corporation, 120 Broadway, New York, is sending out a large calendar and map showing the new railroad time zones which went into effect Jan. 1, 1919. The map is 17 x 28 in. which makes it clear and legible.

The Fifty Thousandth Locomotive. The Baldwin Locomotive Works, Philadelphia. Booklet. Pp. 25, 9 x 6 in., giving a description with illustrations and dimensions of the fifty thousandth locomotive just completed by the Baldwin Locomotive Works for the Southern Railway Company.

Liberty High-Speed Surface Grinding Attachment. Liberty Tool and Gage Works, Woonsocket, R. I. Pamphlet. Pp. 6, 6 x 9¼ in. The high speed surface grinding attachment is herein described under the headings of general description, construction, classes of work, and sizes of wheels and speeds.

"Lenox" Band Saws. American Saw and Manufacturing Co., Springfield, Mass. A circular price list of this company's line of saws, "Lenox Band Saws." They have milled teeth, are hardened and tempered by a new method by which they can control the depth of hardness. They can be furnished with 10, 14, 18 and 24 teeth to the inch

The Fortin 5-Spindle Drill Head. Spafford Tool Works, Hartford, Conn. Circular. Pp. 6; 6 x 9¼ in. Giving description and particular advantages of this turret drill head attachment together with illustrations and specifications. The last page of the circular is devoted to a description of the "Supreme" Quick Action Vise, also manufactured by this company.

Universal Wood Milling Machine. Oliver Machinery Co., Grand Rapids, Mich. Catalog. Pp. 24, 8½ x 11 in. A catalog describing the use of the wood milling machine on various patterns, and illustrating the wide range of work done on this machine. Halftone illustrations are given of wood patterns made of herring-bone gears, spiral spur and worm gears, coreboxes, pattern bends, pulley arms, etc.

Hyatt Roller Bearings. Hyatt Roller Bearing Co., N. Y., for Machine Tools. Bulletin. Pp. 19, 8½ x 11 in., giving complete designs for the application of Hyatt Roller Bearings to machine tools of all kinds and at the various bearing points on machine tools. It also contains a complete load and speed table giving the safe load of Hyatt bearings for all dimensions and all classes of machine tool service.

Test of a Flat Slab Floor of the Western Newspaper Union Building. Bulletin 106, Engineering Experiment Station, University of Illinois, Urbana, Ill. Bulletin 106 gives the results of test in 1917 of a four-way reinforced-concrete flat slab floor of the Western Newspaper Union Building in Chicago, Ill. The text is adequately illustrated by means of photographs and diagrams, in which such data as the following are given: "Arrangement of Reinforcement in Test Area," "Location of Gage Lines on Upper and Lower Side of Slab," "Load Deflection and Location of Deflection Points," "Load Strain for Gage Lines on Reinforcing Bars on Upper and Lower Sides of Slab." Copies of Bulletin 106 may be had gratis by addressing the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A company in France wishes to purchase or to secure an agency for the sale of bolts, nuts, screws, nails, rivets, etc., and hardware. Correspondence should be in French. References. No. 28595.

A company in England desires to purchase household hardware, small tools, toys, and novelties. Quotations should be given f.o.b. New York or factory. Terms, cash or 10 days sight, New York. References. No. 28647.

A man from Chile, now in this country, wishes to represent manufacturers on a commission basis, for the sale of the following: Machinery, hardware, automobile accessories, and mechanical equipment in general. References. No. 28651.

A man in Denmark desires to secure an agency for the sale of steel products, such as beams, angles, channels, tees, ship channels, plates, iron and steel round bars, and tool steel; metal castings, electrical accessories ,packings, armatures, iron and brass cocks and valves, and railway equipment. References. No. 28653.

An agency firm in France desire to secure an agency for the sale of machine tools, manufacturing implements, automobiles and small iron wares, in France, Switzerland, England, Italy, Belgium and Spain; also desires to represent American firms at fairs in France. Correspondence should be in French. References. No. 28593.

Ed. Dufresne, engineer of art and manufacturers, Thiers (Puy-de-Dome), France, desires the representation of American firms for the sale of wood, metals, tools, construction materials, machinery, etc.

E. Wegmuller-Ribner, Berne, Switzerland, Junkerngasse 40, desires to purchase or to secure the agency for the sale of machinery and accessories, and tools. Correspondence should be in French.

Emmanuel Pironneau, a French engineer, has opened a New York office at 1779 Broadway, New York City, and is representing a number of large French manufacturing concerns for whom he will purchase machine tools and supplies. Mr. Pironneau also has charge of looking up American products which can be manufactured on a large scale in France. He is interested in connecting with concerns in this country manufacturing agricultural machinery, small tools, general hardware, specialties, etc., which products will be distributed through his Paris office.

Obituary

GEORGE HUNTER, consulting superintendent of the Elgin National Watch Co., died at Elgin, Ill., Mar. 4 at the age of 84 years. He was connected with the Elgin company since its organization in 1864, and was general superintendent of the company from 1872 to 1903.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, Mar. 18, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, April 24-26.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club. Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, Apr. 28-May 3.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

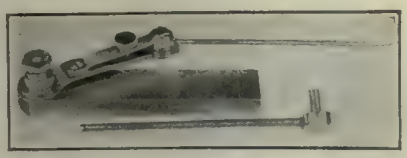
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Indicator, Universal

T. Daniel Bush, South Allentown, Penn.

"American Machinist," February 27, 1919

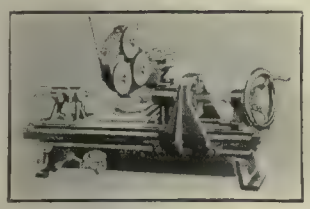


Adapted for use in any size of machine, where work must be set up to given lines or layouts and consists of a base holding an arm which in turn holds the ball-headed needle. The arm is held to the base by means of spring tension adjusted by the knurled head screw at the left, while the tension on the ball head of the needle is controlled by the knurled head screw at the right of the arm. The needle being held by spring pressure will move before force enough to break it is applied. In case it is desired to use the device with a surface gage a rod is provided having a screw at its end, the entire device being substituted for the regular base. This attachment is shown in the foreground.

Grinding Machine, Thread

American Thread Grinding Machine Co., 814 Gates Ave., Brooklyn, N. Y.

"American Machinist," March 6, 1919

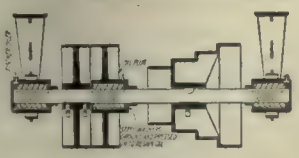


Three grinding wheels are carried on a head, which is the turret type. The wheels are positioned by means of the stop shown at the front of the turret while this is clamped by means of the screw shown at the top. The turret carrying the three grinding wheels is mounted on a cylindrical shaped base, this construction making it possible to tip the wheel to the helix angle of the thread. A dressing fixture is located at the rear, it being the idea to true the wheel not in use while grinding. The truing device is provided with graduations, so that the diamond can be adjusted to the desired angle. The base carrying the wheel turret is also provided with graduations, so that it can be quickly set to the desired helix angle. The work is revolved and fed by the handwheel at the right. This wheel carries a master screw and is fixed to the main carriage in regard to longitudinal position.

Countershafts, Roller-Bearing

Queen City Machine Tool Co., Cincinnati, Ohio

"American Machinist," March 6, 1919



All shaping machines hereafter placed on the market by this concern will be equipped with a roller-bearing countershaft as shown in the cut. Ball bearings on the countershafts are of the Hyatt roller type and Fischer oilers are used. The cross-section illustration shows the construction of the device quite clearly.

Pumps, Motor-Driven Lubricant

Fulflo Pump Co., Blanchester, Ohio.

"American Machinist," March 6, 1919



Built in ⅜, ¾, 1 and 1½ in. sizes arranged for either floor or wall mounting and are equipped with ½, ¾, ¾ and 1 hp. motors respectively. The pump shown in the illustration is the ¾-in. size equipped with a motor running 2700 r.p.m. The capacity at this speed is 21 gal. per min. with an 11-ft. head, 20 gal. per min. with a 12½ ft. head, and 11 gal. per min. with a 24-ft. head, cutting compound being used. They are of the centrifugal type and, having both intake and outlet located at the top, retain enough fluid for priming purposes without the aid of valves or other mechanical means. The impellers are of the semi-enclosed type and are supported by a bearing at either end, the thrust being taken care of by a hardened-steel collar. Standard pumps have cast-iron bodies, covers and impellers, but may be furnished in brass or bronze if desired. The base is arranged for a three-point mounting, which enables it to be leveled without the necessity of machining the surface to which it is to be attached.

Calipers, Indicating

Indicating Caliper Co., 506 East 19th St., New York City

"American Machinist," March 6, 1919

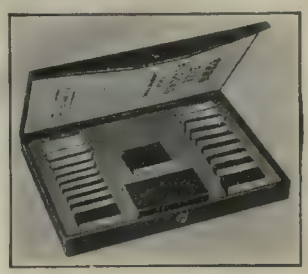


Made in two sizes, to open 2 and 3 in., the illustration being of the latter size. Has a large handle that fits into the palm of the hand, while the movable jaw is moved by pressing the trigger with the finger. When the points separate, a geared segment operating on the small gear wheel carrying the pointer causes this pointer to move over the graduated scale, indicating the distance between the points. A spring coiled in the barrel of the pinion actuates the pinion and the hand which is attached to it and draws the points of the caliper together. The 2-in. caliper is graduated to read to hundredths of an in., while the 3-in. caliper is graduated in sixty-fourths.

Size Blocks, "Loway"

A. F. Way Co., Inc., Hartford, Conn.

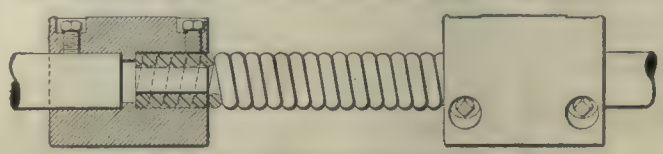
"American Machinist," March 6, 1919



In placing these size blocks on the market the idea has been to provide a set of blocks that are within the reach of every mechanic. Made of selected material, and with the exception of sizes below 0.0937 in. are heat treated, hardened and seasoned. All blocks measure between their rated size and 0.0001 in. oversize, thus making the combined error of five blocks only 0.0005. Each block is marked with a letter, and each set is furnished with a chart in which the various combinations obtainable are given with their letter equivalents, this table showing at a glance the necessary blocks to make up any required measurement. The blocks are put up in three sets. Set A, which is the one shown, combining sets B and C, having a total over-all measurement of 6.293 in.; set B consists of 13 blocks, measuring in steps of 1/64 up to 4 19/32 in.; set C measuring in steps of 0.025 in. up to 4.825 in.

Couplings, Cushion and Flexible, "Karge"

Three Rivers Machine Tool and Die Corp., Phoenix, N. Y.



"American Machinist," March 6, 1919

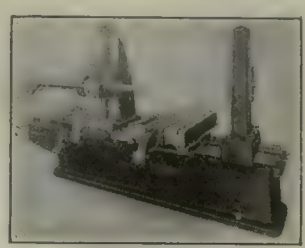
Constructed of special alloy-steel coils terminating in couplings by which they are fastened to the ends of the solid-steel shafting. Cushion couplings are intended to be employed as a regular coupling in connecting up line shafts or to be inserted immediately ahead of heavy-duty machines to serve as a buffer or cushion and lessen the starting stresses on motors. These couplings also take care of misalignment of the shaft up to 1 in. The flexible couplings now have a longer coil in use, permitting a continuous line of shafting to be carried over or under obstructions or around a corner, from one floor to another or even down one side of a partition wall and back on the other side without the use of gears or belts. Three methods are used for connecting the couplings

Boring Mill, Horizontal

Blomquist-Eck Machine Co., 1146 East 152d St., Cleveland, Ohio

"American Machinist," Jan. 2, 1919

(*This card is to replace those published on pages* 92a *and* 234a.)



Diameter of spindle, 3½ in.; travel of spindle, 30 in.; taper in spindle, Morse No. 5; number of speed changes, twelve, 16 to 196 r.p.m.; number of feed changes for spindle or table, 9; number of feed changes for spindle or table with back gears, 18; feeds, 0.003 to 0.518 in. per spindle revolution; working surface of table, 24 x 54 in.; automatic longitudinal feed of table, 36 in.; automatic traverse feed or parallel movement of table with bed, 37 in.; maximum distance from spindle nose to outboard bearing, 5 ft. 5 in.; maximum distance from top of plain working table to center of spindle, 27 in.; maximum distance from top of bed to top of table, 10 in.; weight, crated, 11,600 lb.; 5 hp. recommended; motor recommended, constant speed, 900 to 1200 r.p.m.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34.60	$34.60
Northern Basic	31.80	31.80
Southern Ohio No. 2	32.80	32.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	36.15
Southern No. 2 (silicon 2.25 to 2.75)	39.95	39.95
BIRMINGHAM		
No. 2 Foundry	31.00	31.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	36.15*
Virginia No. 2	35.10†	38.10†
Basic	33.90*	33.90*
Grey Forge	33.90*	33.90*
Bessemer	.....	.....
CHICAGO		
No. 2 Foundry Local	31.00	31.00
No. 2 Foundry Southern	37.25	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	31.00
Basic	30.00	30.00
Bessemer	33.60	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For ⅛-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$2.90	$3.50
Warehouse, New York	4.17	4.70
Warehouse, Cleveland	3.82	3.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloa	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.22	6.45	5.75	6.385	6.22	6.45
*No. 26 black	4.60	6.12	6.12	6.35	5.65	6.285	6.12	6.35
*Nos. 22 and 24 black	4.55	6.07	6.07	6.30	5.60	6.235	6.07	6.30
Nos. 18 and 20 black	4.50	6.02	6.02	6.25	5.50	6.185	6.02	6.25
No. 16 blue annealed	4.10	5.37	5.37	5.65	4.95	5.585	5.37	5.65
No. 14 blue annealed	4.00	5.27	5.27	5.55	4.85	5.485	5.27	5.55
No. 10 blue annealed	3.90	5.17	5.17	5.45	4.75	5.385	5.17	5.45
*No. 28 galvanized	6.05	7.57	7.57	7.70	7.15	7.635	7.57	7.70
*No. 26 galvanized	5.75	7.27	7.27	7.40	6.85	7.335	7.27	7.40
No. 24 galvanized	5.60	7.12	7.12	7.25	6.70	7.185	7.12	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 10%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 1/8, 5/32, 3/16 No. 8, 7/32 and No. 10	25.50 to 35.00	3/16 by 12 in. long	14.00
1/4		1/4 by 19 in. long	12.00
No. 12		5/16 by 19 in. long	10.00
5/16, No. 14 and 3/8		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/16	33.00
Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.		1/8	30.00
		3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
1/8, 1/4, and 3/8	47%	20½%	1/4 to 1½	36%	20%
1/2	51%	36½%			
3/4 to 3	54%	40½%			
LAP WELD					
2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	43%	25½%	1/4 to 1½	36%	21%
1/2	48%	35½%			
3/4 to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
3/8 to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	23%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.00	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.25	5.10	7.75
Spelter	6.75	6.85	7.75
ST. LOUIS			
Lead	5.00	4.80	7.10
Spelter	6.40	6.50	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

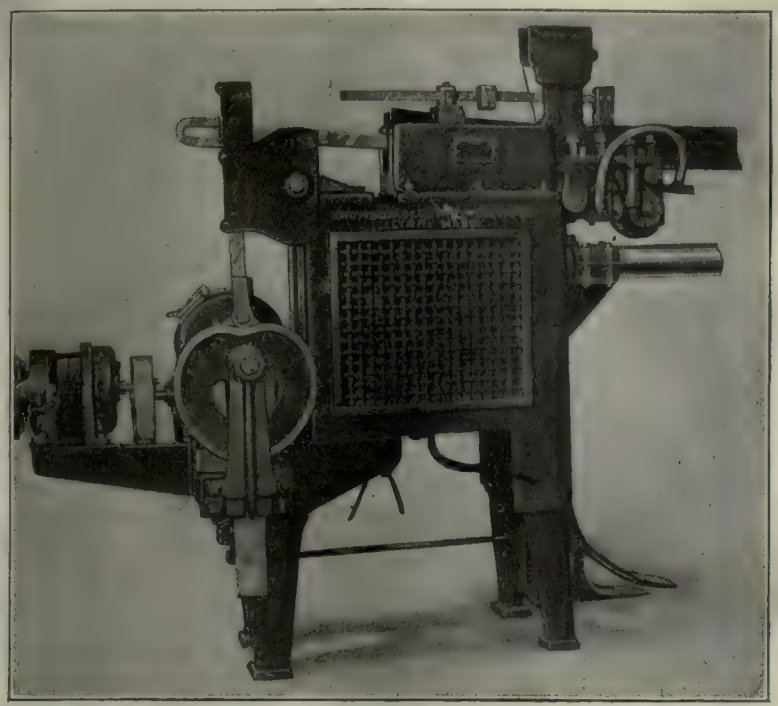
	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	24.50	32.50	32.00	36.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	28.50	28.50	33.50
Brass sheets	18.75	23.75–28	30.75	25.00	32.00	29.00	33.50
Brass pipe	28.00	34.00–37	36.50	33.00	38.00	37.00	38.50
Solder (half and half) (case lots)	46.50	38.00–41	62.00	41.50	48.50	39.00	40.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	28.50	35.00

March 27, 1919 American Machinist Vol. 50, No. 13



Electric Seam Welding

By P. T. VAN BIBBER

Sales Engineer Thomson Electric Welding Co., Lynn, Mass.

Outside of the manufacturing concerns employing electric seam welding machines, few mechanics realize their importance or method of operation. The machines and applications here shown will clearly indicate the field that is covered.

SEAM welding is the process of joining two overlapping edges of sheet metal for their entire length without the application of any solder or spelter along the joint. In the Thomson process of lap-seam welding, the heat is produced by passing a large volume of electric current through the edges to be welded by means of a copper roller on one side of the joint and a copper track or horn underneath. In any electrical path, wherever high resistance is interposed, heating will result, and the higher the resistance to the current, the greater will be the heating effect. In the electric lap seam welding machines, the copper roller and horn are good conductors and the joint between the edges of the metal to be welded is the point of highest resistance. On this account it is evident that the greatest heating effect will be at that point. As the roller passes over the joint, heating the stock to a plastic state beneath it, pressure is applied by springs on the roller which forces the two edges together as fast as they are heated. Since 20 B. & S. gage or lighter metal heats very rapidly, the pressure and heating can be effected at the same instant of contact by the roller, and it is possible to weld as fast as 6 in. per second.

The only preparation necessary for seam welding is that the stock must be absolutely clean, that is, free from any traces of rust, scale, grease, or dirt, if a tight, well-appearing joint is desired. If it is not necessary for the joint to be tight, it will not be necessary to have the stock so clean, although heavy scale or rust will obstruct the passage of current, so that little or no heating effect can be secured under these conditions.

In welding sheet brass of 22 to 30 B. & S. gage, to secure a perfect joint the metal should be carefully pickled and washed to remove all traces of grease and tarnish which tend to prevent the passage of current across the joint of the edges. The metal should be welded soon after pickling, as, no matter how carefully it may be washed, oxidation is always sure to start very shortly after the brass has been removed from the pickling acid.

Steel, to be successfully seam welded, should not have a carbon content of over 0.15 per cent., for a higher carbon steel than this has a tendency to crystallize at the point of weld, due to the rapid cooling of the welded portion from the surrounding cold metal. After welding, the joint will be found to be about one-third thicker than the single thickness of the metal. It is possible, by applying more pressure, to reduce this finished thick-

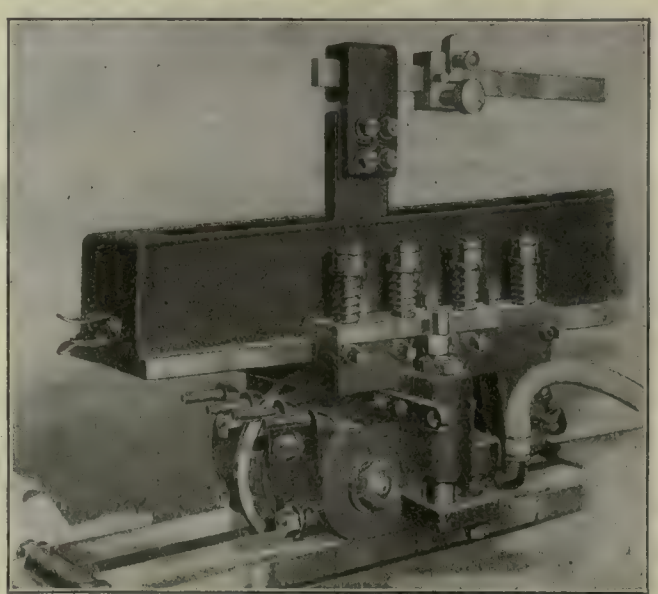


FIG. 2. DETAILS OF WELDING ROLLER HEAD

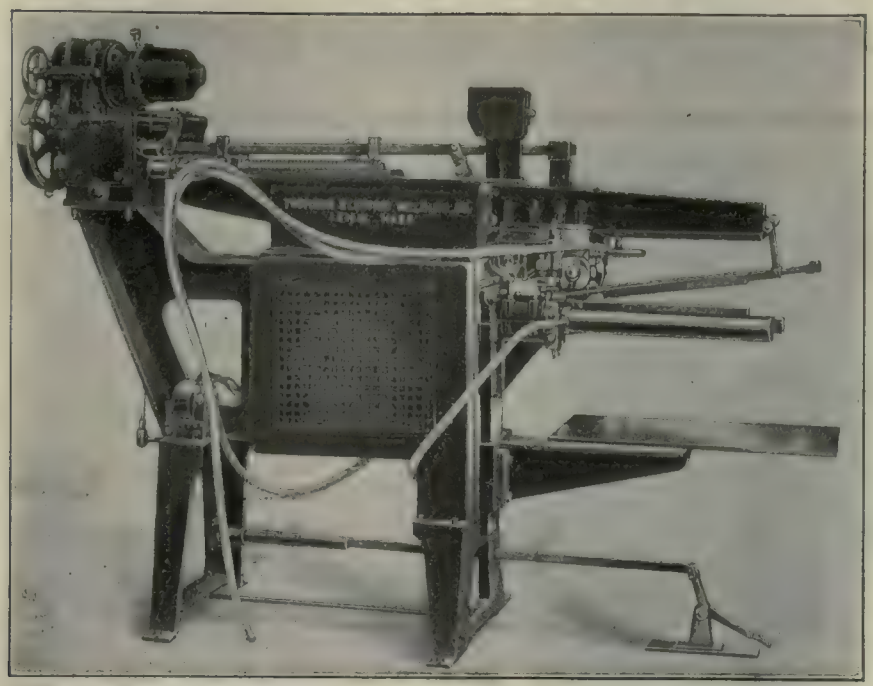


FIG. 3. THOMSON NO. 318 LAP SEAM WELDING MACHINE

ness still more, but it wears more on the copper roller to do so.

In welding brass, a soft, annealed metal should be used, for although hard-rolled brass can be welded, it does not force the two edges together very much and the finished joint under these conditions is almost twice the original metal thickness. However, with a soft, annealed brass the finished joint will be not over a third greater than the single metal thickness, and by applying sufficient pressure can be reduced down to be not over 10 per cent. thicker.

The principal advantage of electric seam welding is that no spelter and no flux are required, the metal itself forming its own cohesive properties, which allows great speed in production. The greatest efficiency of a seam welding machine lies not only in its welding qualities but in the use of a suitable jig to properly hold the work. The jig used should be made so as to enable the operator to place or remove the work in the shortest possible time, since the welding itself is very fast compared with any other known method of making a continuous joint.

In order that their seam welding machines may operate in every installation with the highest efficiency possible, the Thomson Electric Welding Co. build them standard only up to a certain point and then design a special holding jig to best fit the work to be done in each individual case. The amount of lap allowed in making lap seam welds is usually about twice the single sheet thickness of the metal.

The operation of a lap seam welding machine is very simple, once the machine is set for any given piece of work for which a special jig has been built. After placing the piece in the jig and securely locking it there, the operator depresses a foot-treadle which throws in a clutch and starts the copper roller across the work. By the proper setting of adjustable control-stops on the control-rod at the top of the machine, the current is automatically turned on as the roller contacts with the overlapping edges of the piece to be welded and is automatically turned off when the roller reaches the end of its stroke; another stop reverses the travel of the roller and brings it back to the starting position. The control-stops may be adjusted to turn the current on or off at any point along the stroke of the roller for doing work with a seam shorter than the maximum capacity of the machine. The roller stroke may be also shortened so that the complete cycle of operation will be accomplished in the shortest space of time on seams shorter than maximum seam capacity of any machine. In order to keep the copper roller from overheating in action, water is introduced through its bronze bearings on each side. This same water circulation, also passes through the under copper horn or mandrel and then through the cast-copper secondary of the transformer, so that the machine can be operated continually, 24 hours per day if desired, without overheating.

Lap Seam Welding Machines

The lap seam welding machine, known as Model 306, shown in Fig. 1 will weld a seam 6 in. long in soft iron or steel stock up to 20 gage in thickness, or brass and zinc up to 24 gage thick. This machine will make from 60 to 600 welds per hour, depending on the nature of the work and the quickness with which the pieces can be placed in and removed from the jig. The copper horn is water-cooled and has an inserted copper track on which the work rests. The upper contact consists of a

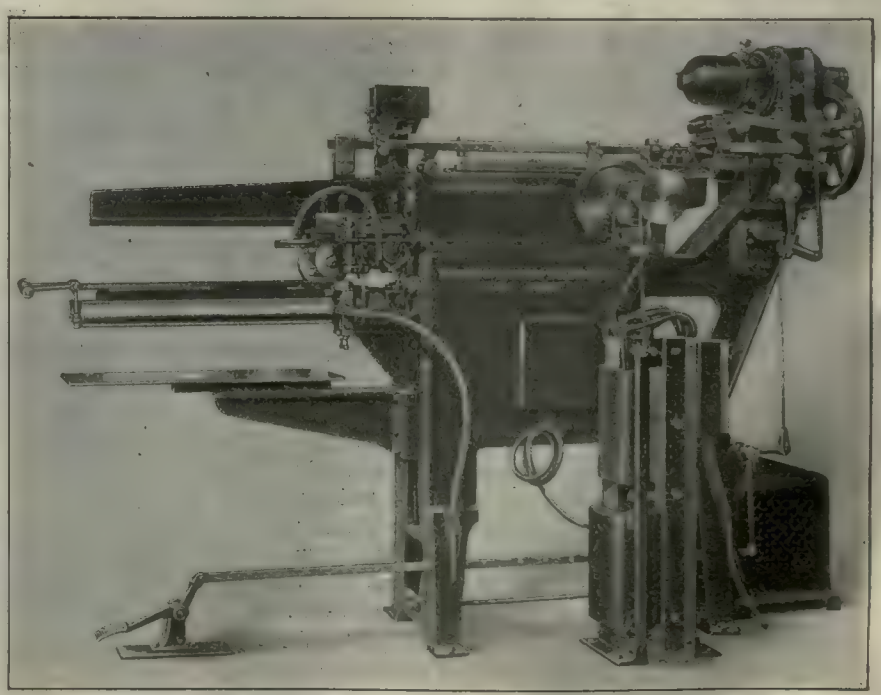


FIG. 4. LARGE SIZE, NO. 324, LAP SEAM WELDING MACHINE

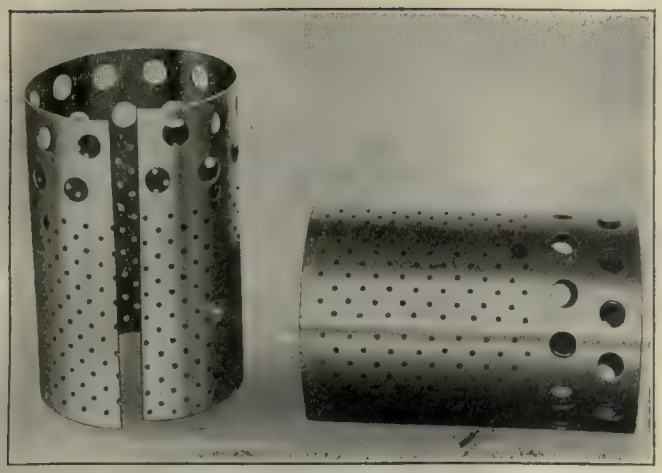


FIG. 5. OIL STOVE BURNER TUBES BEFORE AND AFTER WELDING

copper roller 6¼ in. in diameter, mounted on a knockout shaft supported in water-cooled bearings. Pressure is exerted on the copper roller by means of a series of springs on each side which are adjustable to give the proper tension for various thicknesses of stock. Current control is automatic through a magnetic wall switch carrying the main current. The latter is controlled from a mechanical switch which is thrown in or out by the action of the roller-carrying mechanism as it starts and completes the stroke for which it is set. Standard windings are for 220-, 440-, and 550-volt, 60-cycle, alternating current. Current variation for different thicknesses and kinds of stock, is effected through a regulator which gives 50 points of voltage regulation. A variable-speed ½-hp. motor gives a wide variation in the speed with which the roller may be fed over the work. The standard ratings for the machine are 15 kw. or 25 kv.-a., with 60 per cent. power factor. This machine covers 32 x 96 in. floor space, is 68 in. high and weighs 2750 lb.

A close-up view of the type of roller-carrying head used on all the lap seam welding machines, is shown in Fig. 2. In this view the roller is shown operating between the clamping bars of a special holding jig on the horn. As the roller itself occasionally requires smoothing off around its contacting surface, its bearing has been designed to knock out quickly so that removal and replacement of the roller is very simple and easy to accomplish. The cleaner the stock being welded is kept, the longer a roller will operate without requiring smoothing off, as dirt and scale on the stock cause a slight sparking as the roller passes along, which tends to pit up its contact surface.

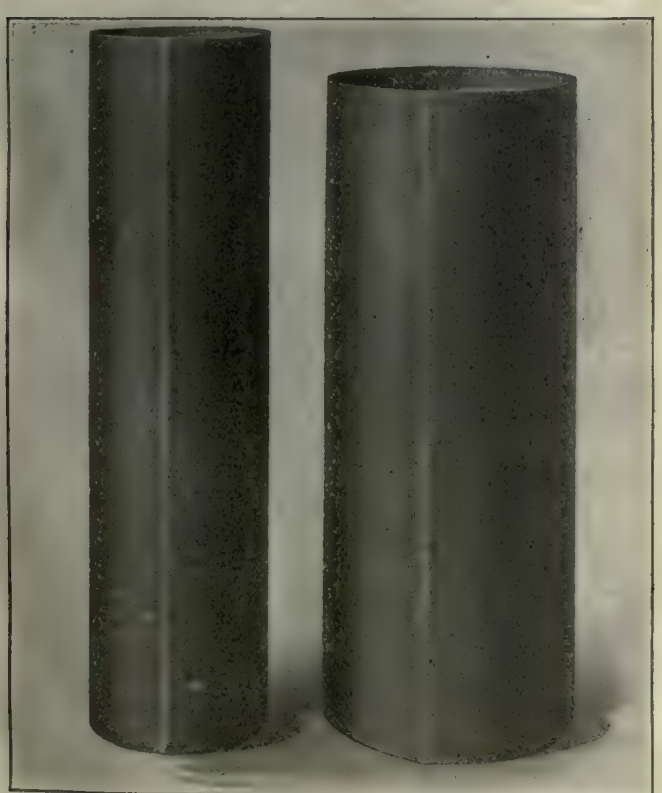


FIG. 6. SEAM WELDED AUTOMOBILE MUFFLER TUBES

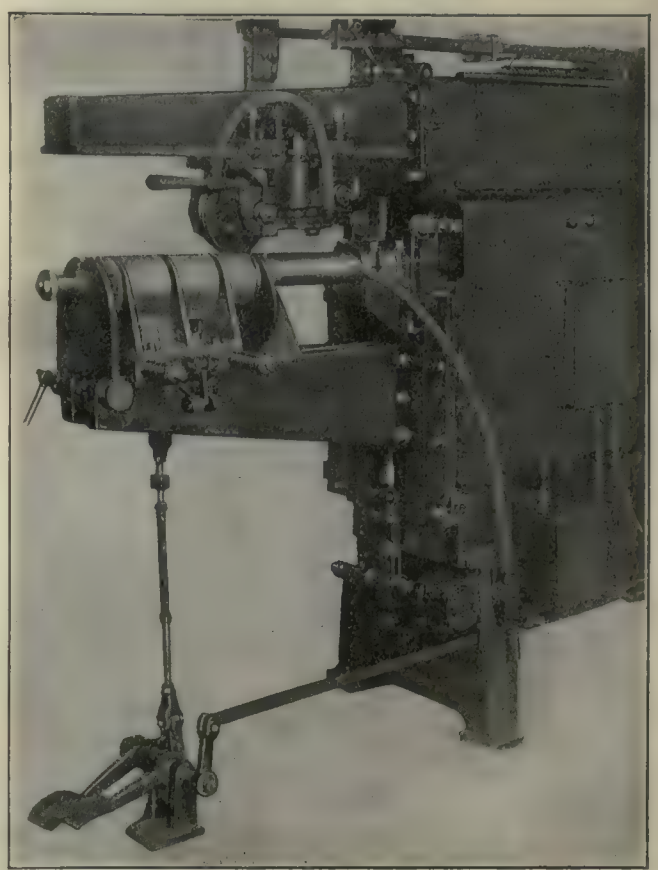


FIG. 7. HOLDING JIG FOR AUTOMOBILE MUFFLER TUBES

The machine shown in Fig. 3, known as Model 318, is a larger and heavier machine than the one previously described and will weld a lap seam 18 in. long on the same gages of metal quoted. Another very similar but smaller machine (Model 312) is also made for welding seams up to 12 in.

In Fig. 4 is seen a considerably larger machine, Model 324, capable of welding a lap seam up to 24 in. in length. The production is from 30 to 120 welds per hour. The machine covers a floor space of 36 x 90 in., is 72 in. high, and weighs 3500 lb. All other specifications are the same as given for Fig. 1, which is shown in the headpiece.

Examples of Holding Jigs

The machines shown may be fitted with numerous forms of holding jigs from the simple bar clamps shown on the horns in Figs. 3 and 4, to various more complicated forms, some of which may be mounted on the knee

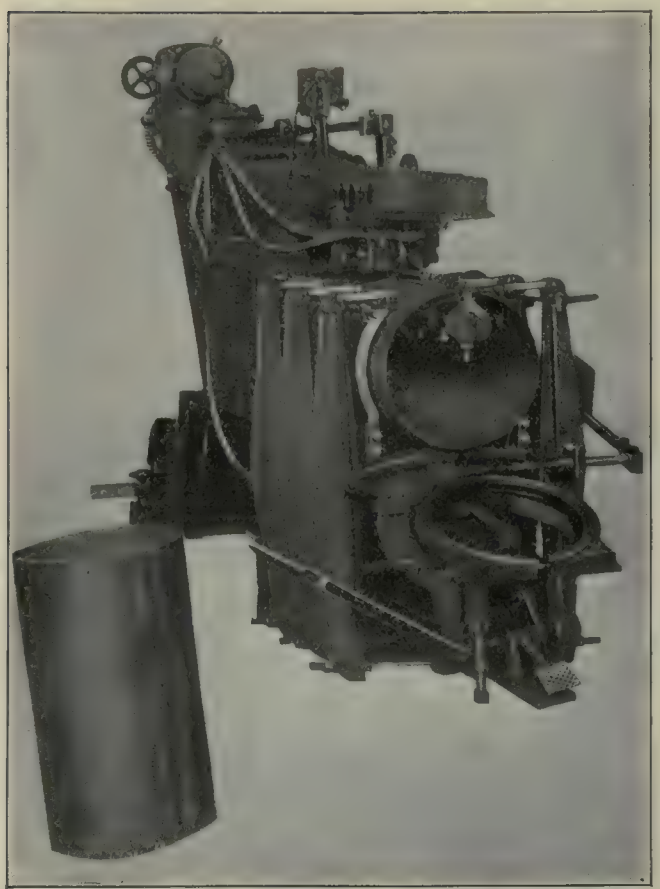


FIG. 8. HOLDING JIG FOR LARGE SHEET METAL CANS

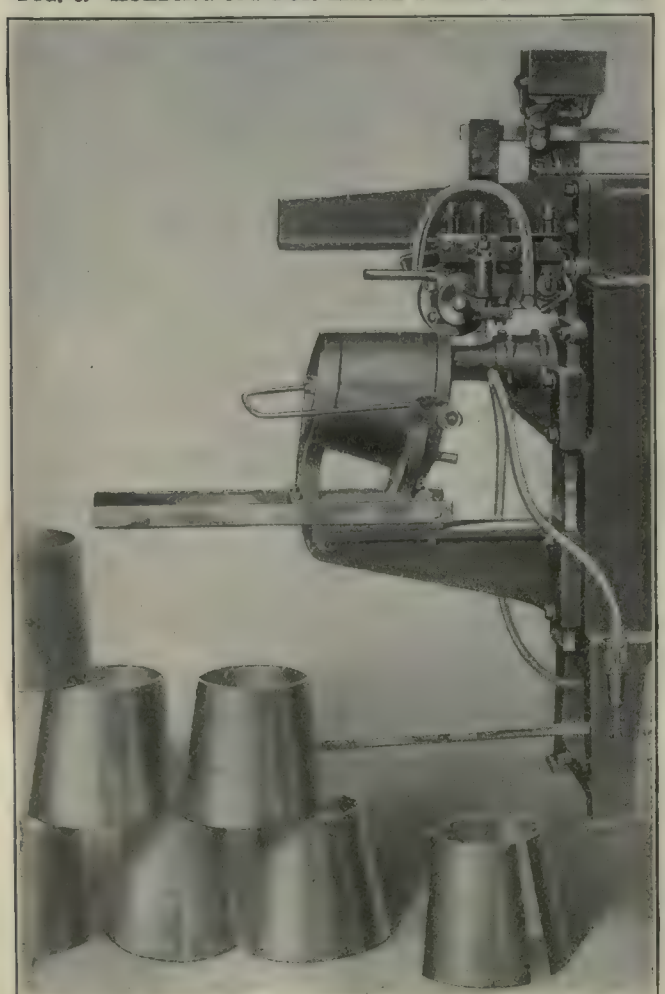


FIG. 9. JIG FOR HOLDING BUCKET BODIES

below the horn or bolted direct to the face of the machine column.

The small oil-stove burner tubes shown in Fig. 5 lend themselves nicely to the seam welding process. Cylindrical pieces such as the shell tubes for automobile mufflers shown in Fig. 6, need a rather elaborate holding jig. A machine fitted up for this work is shown in Fig. 7. To insert a muffler shell into this jig the hinged end is swung outward and downward; the two halves of the holder are spread apart by pressing down on the left-hand treadle; the shell is then thrust into the holder; the treadle is released, which allows the holder sides to be pressed in by the springs and hug the muffler shell around the horn of the machine, with the edges overlapping enough for

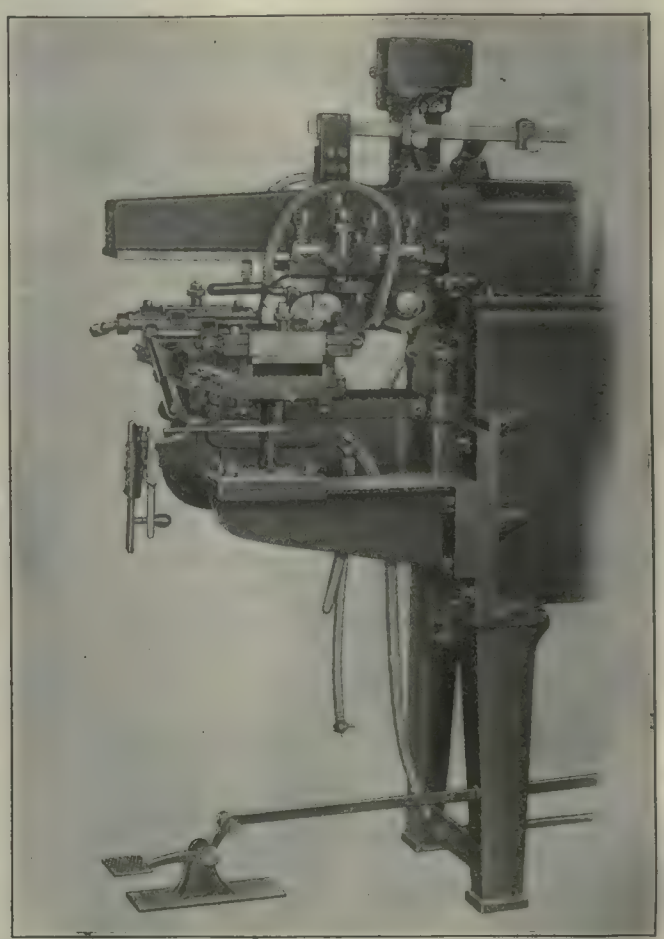


FIG. 10. JIG FOR WELDING ENDS OF METAL STRIPS TOGETHER

the weld; the end gate is then closed and the welding roller started over the seam. The principal function of the gate is to hold the muffler shell square in the jig and prevent it being pushed out by the welding roller.

A jig for holding large cans is shown in Fig. 8. The side clamps of this jig are operated by means of the lever shown at the left. An end gate, shown open, is used in the same way as in the muffler shell jig. Work of this kind is of course much slower than with a smaller jig, yet it is faster than by any other process of closing the seams.

Bucket bodies are held as shown in Fig. 9. The holding jig is made to slide in a channel bolted to the machine knee. The jig is slid back clear of the horn and, with the gate in the flaring end open, the bucket blank is inserted. The gate is then closed by means of



FIG. 11. MACHINE FOR FLANGE SEAM WELDING

the handle, the jig and work is pushed over the horn to a stop, and the weld is made as usual.

Another application of seam welding, is to use it for welding the ends of strip stock together, end to end, so as to facilitate continuous passage of the strip through the dies of a punch press. A machine fitted up for this work is shown in Fig. 10. The ends of the two strips to be welded are inserted in the jig from opposite sides and the edges brought together. The pieces are then clamped by means of the two levers shown in front of the jig, which operate eccentrics over the clamping plates. The welding roller is then run over the ends as in other work of this kind.

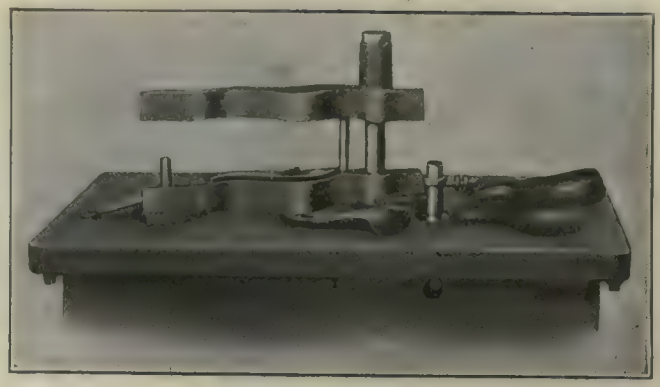


FIG. 12. JIG FOR HOLDING TEAPOT SPOUTS FOR WELDING

Flange seam welding differs from lap seam welding in that instead of the metal being lapped a slight fin or flange is formed along the edges of the metal parts, the flanges being welded together and practically eliminated in the process. This class of welding is especially adapted to the manufacture of light gage coffee and teapot spouts or similar work.

A machine built especially for flange seam welding, known as Model 26, is shown in Fig. 11. The work be-

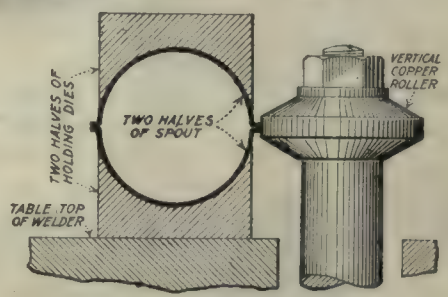


FIG. 13. DIAGRAM OF FLANGE SEAM WELDING OPERATION

ing done is the welding of the two halves of teapot spouts. In the operation the two halves of the spout are clamped securely in a special copper jig, Fig. 12, which has been carefully hand-cut to fit the halves of the spout perfectly on the entire contacting area. The jig is pushed around on the flat copper table, which constitutes the top of the welding machine, so that the seam

TABLE 1. COMPARATIVE THICKNESS AND APPROXIMATE CURRENT CONSUMPTION FOR 6-IN. SEAM

THICKNESS OF SINGLE SHEET				K.W.H. CONSUMED PER 1000 WELDS	COST PER 1000 WELDS @ 1c PER K.W.H.*	THICKNESS OF SINGLE SHEET				K.W.H. CONSUMED PER 1000 WELDS	COST PER 1000 WELDS @ 1c PER K.W.H.*
Decimals of inch	Decimals of Millimeter	B. & S. Std. Gauge	Birmingham Gauge			Decimals of inch	Decimals of Millimeter	B. & S. Std. Gauge	Birmingham Gauge		
.00394	10			.075	.0007	.02			25	.78	.0078
.00787	.2			.175	.0017	.0201		24		.78	.0078
.01002		30		.25	.0025	.022			24	.95	.0097
.01126		29		.3	.003	.02257		23		.975	.0097
.01181	.3			.35	.0035	.02362	.6			1.05	.0105
.012			30	.35	.0035	.025			23	1.175	.0117
.01264		28		.375	.0037	.02535		22		1.257	.0126
.013			29	.4	.004	.02756	7			1.35	.0135
.014			28	.45	.0045	.028			22	1.4	.014
.01419		27		.46	.0046	.02846		21		1.425	.0142
.01575	.4			.525	.0052	.03149	8			1.65	.0165
.01594		26		.55	.0055	.03196		20		1.7	.017
.016			27	.56	.0056	.032			21	1.7	.017
.0179		25		.675	.0067	.035			20	1.925	.0192
.018			26	.68	.0068	.03543	9			1.95	.0195
.01968	.5			.75	.0075	.03589		19		2.	.02

* Multiply these values by the rate you are paying per K. W. Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

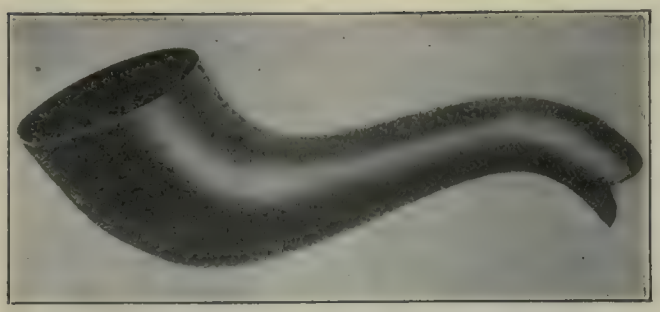


FIG. 14. A FINISH WELDED TEAPOT SPOUT

of the edge to be welded is allowed to ride along the small power-driven copper roller which is mounted on a vertical shaft, as illustrated in Fig. 13. The halves which are welded by this process must be blanked out by special steel dies to give the correct amount of fin or flange on each edge. This fin is heated to the plastic stage by contact with the roller and the slight pressure applied not only forces the metal of the two fins to cohere but also forces the projection into a level with the outer surface of the spout, thus giving a finished job direct from the welder which is smooth enough without any grinding to be ready for the enamelling or agate-coating process.

The secret of success of this work lies wholly in the proper preparation of not only the copper holding-dies, but also the steel flanging and forming dies. A finished spout, just as it comes from the welding machine, is shown in Fig. 14. The welded seam is barely visible.

In order to assist those who have welding jobs to do, to calculate the current cost on various jobs, Table I is given. This table shows the approximate current consumption, and multiplying the rate given by the local rate charged, the cost of 1000 welds can be easily ascertained.

Table II is very convenient for ascertaining the size of copper wire needed to connect the different machines mentioned to the main source of current supply.

TABLE II. SIZE OF COPPER WIRE TO USE TO CONNECT UP THE WELDING MACHINE
(Where the machine is not over 150 ft. from source of supply)

Type Machine	K.V.A. Demand	220-Volt Circuit		440-Volt Circuit		550-Volt Circuit	
		Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses
No. 26	8	No. 12 B. & S.	35 Amp.	No. 14 B. & S.	20 Amp.	No. 14 B. & S.	15 Amp.
No. 306							
No. 312	25	No. 4 B. & S.	100 Amp.	No. 10 B. & S.	50 Amp.	No. 10 B. & S.	50 Amp.
No. 318							
No. 324							

Group Insurance

BY A. J. SCHNEIDER

Perhaps a few figures and facts giving information on the Cincinnati Planer Co.'s first year's experience with group insurance may be of interest to those who are making an effort to reduce labor turnover. The shop is located in a suburb of Cincinnati, "out in the country where the sun shines," with good transportation facilities and first-class working conditions.

The group life insurance became effective in October, 1917, and the following information refers to the one-year period from Oct. 1, 1917, to the end of September, 1918. The amount of insurance is based upon length of service, beginning with $500 for three months' service and ending at $1,500 for nine years or more of service.

It was thought at first that one weakness of the plan might be that after receiving the policy and putting it away the employee would lose interest and forget about it. This would often be the case if the policy were simply presented to the employee and nothing else done about it. But there are several important factors that make it impossible for employees to lose interest or forget. When the applicant is hired the employment department explains the plan, shows him a framed sample policy which hangs in a conspicuous place, presents him with an Employee Instruction and Rule Book and directs him to take it home to study. The policy itself is good looking and simple, and the monthly shop bulletin, which is mailed to the homes, affords a good opportunity as a constant reminder. The notice which is mailed when the amount of insurance increases is a pleasant memento, while death is the most forceful argument of all.

The only figures that can be given are on labor turnover, absence, lateness and cost of insurance. Other factors such as increased loyalty, good-will, coöperation, organization, etc., cannot and should not be weighed with figures. The company had four deaths during the one-year period on a payroll the average number of which was 660.

The labor turnover for the calendar year 1916 was 245 per cent., and for 1917 it was 171 per cent.; for the October-September period mentioned it was only 147 per cent.

Absence for 1916 was 5.9 per cent. and lateness 3.1 per cent.; for 1917 the figures were 5.8 and 3.2 respectively, while for the October-September period they were 6.2 and 3.9 per cent.

It is not claimed that group insurance is the only factor influencing these figures and values, nor do we know how to figure exactly what part of the improvement is due to insurance. It is simply a matter of study and good, liberal, square-deal judgment. The cost per employee was $5.13 for one year. This amount of course will vary according to the average age and insurance amount.

Possibly some day many plants will establish a sinking fund and carry their own life insurance. This could be done by a company that at all times has the complete confidence of its employees and that could find some way to take care of the remote possibility of an epidemic or catastrophe. Basing this plan on the law of averages this would be comparatively easy.



I. Introduction and Types of Cams

This series of articles is presented with a view to placing before the reader the whole subject of cam design on a systematic scientific basis. The first few articles include as much of the author's work on "Elementary Cams" (John Wiley & Sons, Inc.) as is considered necessary to an understanding and application of the fundamental principles on which the whole work is based. Later articles will contain much additional material that is also entirely new on the subject of cam design and construction.

WITH the constant increase of automatic machinery in practically the whole range of manufacturing industry the matter of form and size of the cam calls strongly for a comprehensive method of technical analysis. Such analysis becomes more and more important as automatic devices or machines are designed to operate at higher speeds.

Of the vast number of cams in use in industrial manufacturing plants particularly it is quite certain that a large majority have been formed entirely "by eye" as a result of experience and successive trials and without recourse to technical analysis or systematic computation. The entire development of cam work has been practically individualistic without a common thread of principle running through it all. This is in sharp contrast to the technical development of the subject of toothed gearing, for example. Cams, considered on a scientific basis, have been more neglected in engineering books than any other of the important branches of mechanism. Even the nomenclature of the subject is in a chaotic state, the same types of cams being known by various names in different localities—some of them not far apart.

This series of articles has been prepared with a view to gathering the various types of cams that are in common use in some comprehensive and orderly manner, and then pointing out how to design one of each class for proper form and size. The first few installments will include practically all of the base curves that are in common use in industrial manufacturing work, and will enable the cam designer to lay down his plans with a foreknowledge of what may be expected in each case. In the later installments additional base curves for cams will be introduced, some of them heretofore unknown and unused so far as the author has been able to observe. In addition, all of the cam types will be compactly grouped and analyzed for their adaptability for a given operation, particularly with reference to the minimum size of the cam and the relative velocities and accelerations of the follower member. This will be accomplished almost entirely with the use of simple arithmetical computations and with graphical methods of construction.

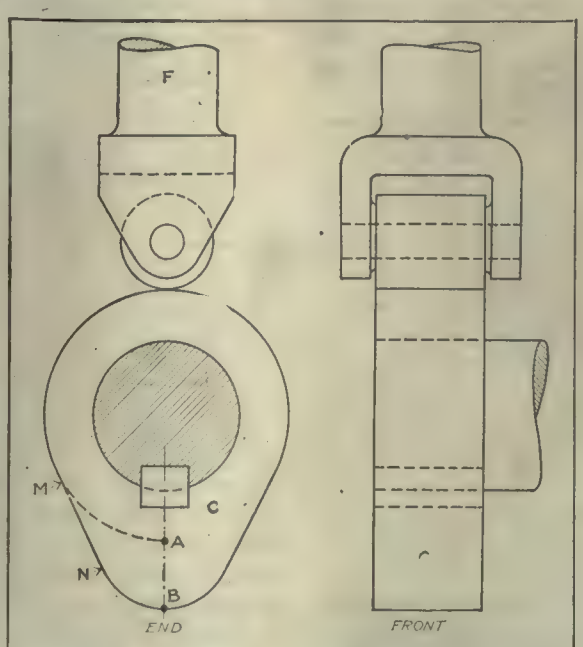


FIG. 1. RADIAL CAM AND FOLLOWER

Cams are rotating or oscillating pieces of mechanism having specially formed surfaces against which a follower slides or rolls and thus receives a reciprocating or intermittent motion such as

cannot be generally obtained by gear wheels or link motions.

Various forms of cams are illustrated at *C* in Figs. 1 to 10. The follower in each case is shown at *F*, all having roller contact except the ones shown in Figs. 7, 8 and 9a. The former has a V edge and the two latter have plane surfaces in contact with the cam.

Follower edges or rollers may have motion in a straight line as from *D* to *G*, Fig. 7, or in a curved path depending on suitably constructed guides or on swinging arms. The total range of travel of the follower may be accomplished by one continuous motion or by several separate motions with intervals of rest. Each motion may be either constant or variable in velocity, and the time used by the motion may be greater or less, all according to the work the machine has to do and to the will of the designer.

Cams may be most simply and at the same time most completely classified according to the motion of the follower with respect to the axis of the cam, as:

(*a*) Radial or disk cams, in which the radial distance

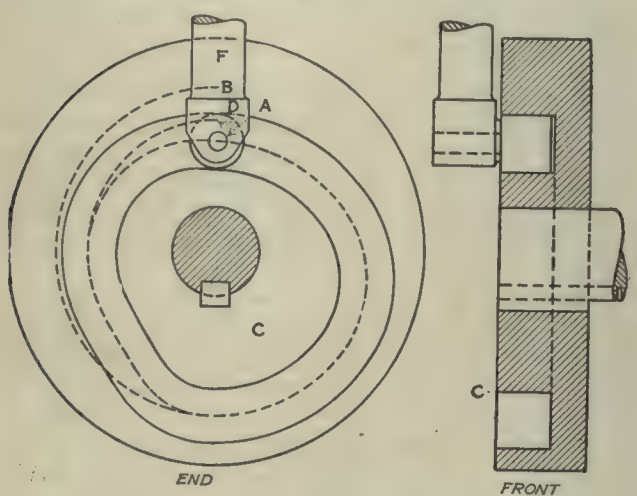


FIG. 2 FACE CAM AND FOLLOWER

from the cam axis to the acting surface varies constantly during part or all of the cam cycle, according to the data. The follower edge or roller moves usually in a radial, or an approximately radial, direction with respect to the cam. Various forms of radial cams are illustrated in Figs. 1, 2, 7, 8 and 9.

(*b*) Side or cylindrical cams, in which the follower edge or roller moves parallel to the axis of the cam or approximately in this direction. Several types of side cams are shown in Figs. 3, 4 and 10.

Nearly all the cams referred to in the above figures illustrating the two general classes of radial and side cams respectively have special or local trade names, which will be pointed out in later paragraphs.

(*c*) Conical and (*d*) spherical cams, in which the follower edge or roller moves in an inclined direction having both radial and longitudinal components with respect to the axis of the cam, as illustrated in Figs. 5 and 6.

Cams, according to popular usage, have generally come to be known by a wide range of names, the same cam often being designated by a number of different names according to geographical location and personal preference and surroundings of the cam builder or user This is an unfortunate condition, and in the general classification in the preceding paragraph an endeavor is made to establish a fundamental basis for clarifying and simplify the nomenclature of cams as much as as possible. In a work of this kind, however, it is essential that at least the more common of the ordi-

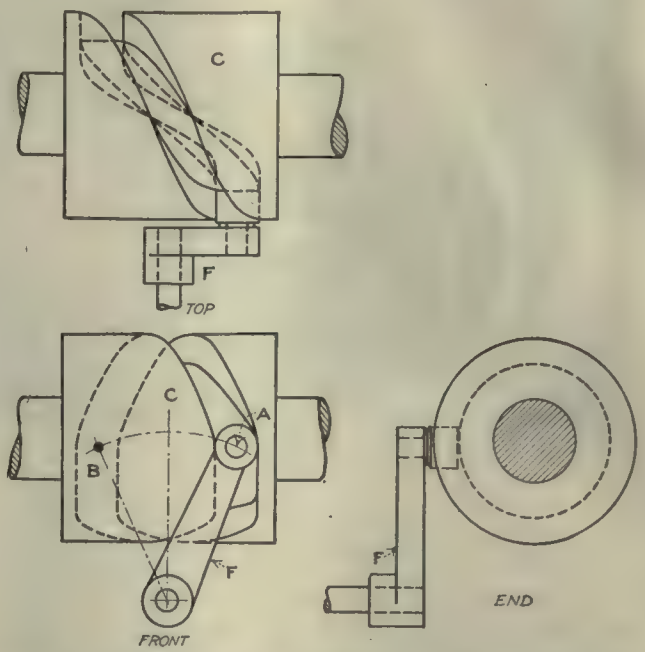


FIG. 3. CYLINDRICAL CAM AND SWINGING FOLLOWER

nary working terms be recognized and defined and that the cams under their popular names be properly placed in the fundamental classification given in the preceding paragraph.

The following specially named cams fall under the classification of radial cams:

(*e*) Periphery cams, in which the acting surface is

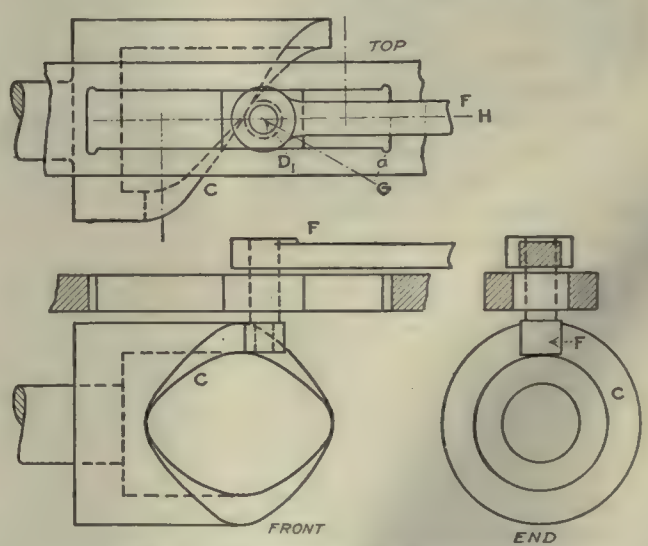


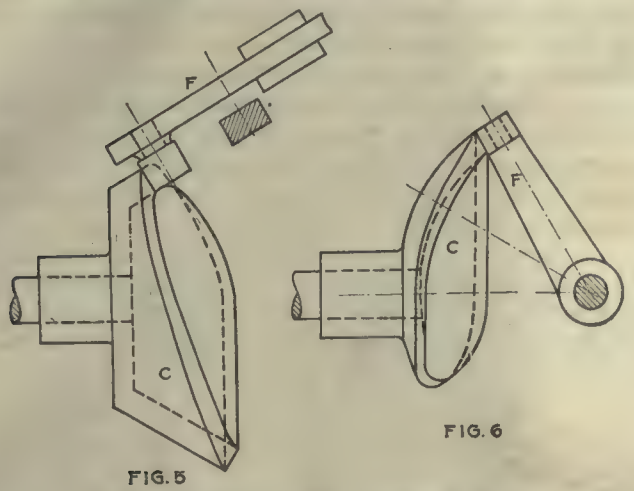
FIG. 4. END CAM AND FOLLOWER

the periphery of the cam, as illustrated in Figs. 1, 7 and 9. While these are examples of true periphery cams it must be recorded that the cylindrical grooved cam, shown in Fig. 3, is also known to some extent as a periphery cam, due no doubt to the fact that in designing this cam the original layout for the contour of the groove is first made on a flat piece of paper, which

is then wrapped on to the surface or "periphery" of the cylinder.

(*f*) Plate cams, in which the working surface includes the full 360 deg. and forms either the periphery of the cam or the sides of a groove cut into the face of the cam plate, as illustrated in Figs. 1 and 2 respectively. Figs. 7 and 9 also show plate cams.

(*g*) Tangential cam, in which a portion *MN* of the cam lobe, Fig. 1, is bounded by a straight line.



FIGS. 5 AND 6. TWO TYPES OF CAMS

Fig. 5—Conical cam with reciprocating follower. Fig. 6—Spherical cam with swinging follower

(*h*) Heart cams, in which the general form is that which the name implies (see Fig. 7). This type of cam is often so laid out as to give uniform velocity to the driver. In this case each half of the lobe is bounded by an Archimedean spiral with the ends eased off.

(*i*) Frog cam, in which the lobes are more or less irregular, as illustrated, for example, at *C* in Fig. 9.

(*j*) Mushroom cam, in which the periphery of a radial

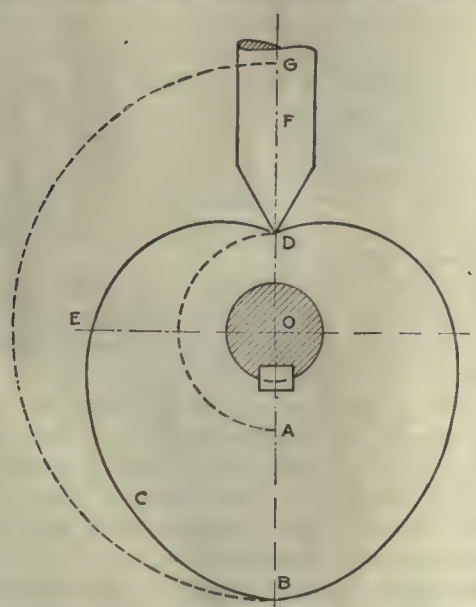


FIG. 7. HEART CAM AND FOLLOWER, SLIDING CONTACT

or disk cam works against a flat surface, usually a circular disk at right angles to the cam disk, instead of against a roller (see Fig. 9a).

(*k*) Face cam, also called a groove, but more properly a plate-groove, cam to distinguish it from the cylindrical-groove cam, in which a groove is cut into the flat face of the cam disk. In this form of cam, shown in Fig. 2, the roller has two opposite lines of contact, one against each side of the groove, when the roller has a snug fit. The plate or disk in which the groove is cut is generally circular; but it may be cast to conform with the contour of the groove or it may be built with radial arms supporting the irregular grooved rim. In the latter case it lacks resemblance to the face cam, but nevertheless it must, because of the nature of its action, be classed with it. The face cam, as ordinarily considered and as illustrated in Fig. 2, is better adapted for higher speeds because of its more nearly balanced form of construction. Against this, however, must be considered one of two disadvantages, either the high rubbing velocity of the roller against one side of the groove when the roller is a snug fit, or lost motion and noise as the working line of contact changes from one side of the groove to the other when the roller has a loose fit. The term groove cam might be applied with advantage

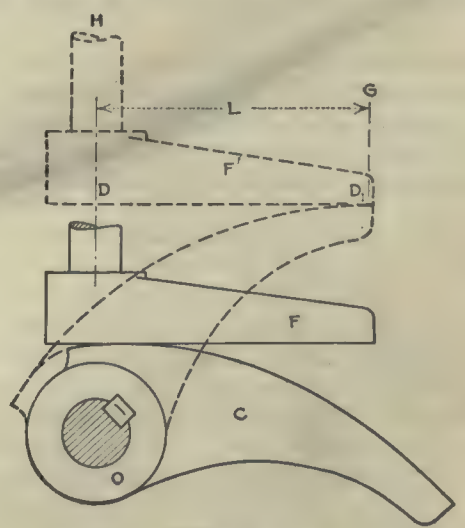


FIG. 8. TOE AND WIPER CAM

in clearness of meaning to such face cams as are cut or cast on noncircular plates.

(*l*) Wiper cam, which has an oscillating motion and is constructed usually with a long curved arm in order that it may "wipe" or rub along the plane surface of a long projecting "toe," or follower. The wiper cam is used generally to give motion to a follower which moves straight up and down, as shown from *F* to *F'* in Fig. 8. This, however, is not essential, and the follower may also have a swinging motion. The disadvantage of sliding friction, which is inseparable from the wiper cam, is balanced to some extent by the fact that the very sliding permits, within certain range, of the assignment of specified intermediate velocities between the starting and stopping points which cannot be obtained with similar forms of cams which have pure rolling action.

(m) Rolling cam, which greatly resembles the wiper cam in general appearance, but which is totally different in principle, for the curves of the cam and follower surfaces are specially formed so as to give pure rolling action between them. The rolling cam is specially well adapted to cases where both driver and follower have an oscillating motion and where the velocities between the starting and stopping points are not important and are not specified.

(*n*) Yoke cam, a form of radial cam in which all diametral lines drawn across the face and through the center of rotation of the cam are equal in length. This form of cam permits two opposite follower rollers, whose centers remain a fixed distance apart, to roll simultaneously on opposite sides of the cam and thus give positive motion to the follower. For illustration see Fig. 9.

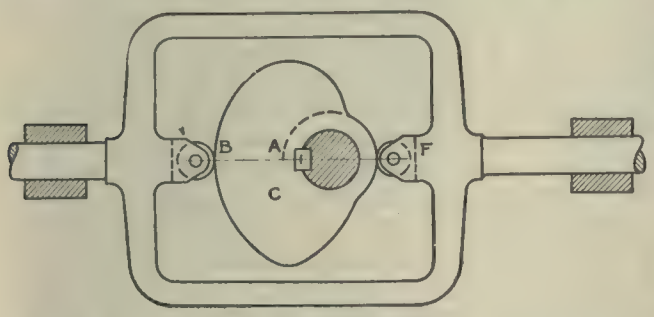


FIG. 9. YOKE CAM

Yoke cams may be and frequently are made of two disks fixed side by side, the peripheries being complementary to each other and the two rollers of the yoke rolling on their respective cam surfaces. The advantage of yoke cams is that they give positive motion with pure rolling of the follower roller, there being contact on only one side of the roller center in contradistinction to the double contact of the roller which exists in face and groove cams.

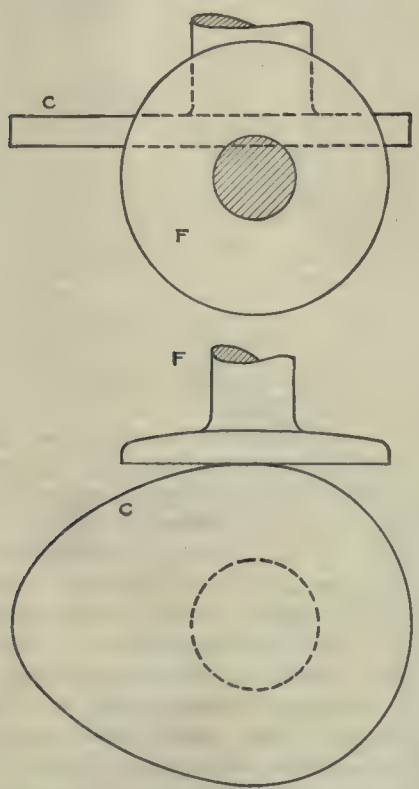


FIG. 9A. RADIAL CAM WITH MUSHROOM FOLLOWER

The following specially named cams fall under the general classification of side cams. These include cams that have been made from blank cylindrical bodies by using a rotary cutter with its axis at right angles to the axis of the cylinder and by moving the axis of the rotary cutter parallel to the axis of the cylinder while the cylinder rotates. A groove of desired depth is thus left in the cylinder, Fig. 3, or the end of a cylindrical shell is thus milled to a desired form, Fig. 4. A side cam may also be formed by screwing a number of formed clamps on to a blank cylinder, the sides of the clamps thus acting as the working surface as illustrated in Fig. 11. All types of side cams may properly be considered as derived from blank cylindrical forms, and therefore the name "cylindrical cam" could be regarded as synonymous with side cam; but general custom has limited the use of the term cylindrical cam to the barrel, or drum, type mentioned below:

(*o*) Cylindrical cam, also called barrel cam, drum cam or cylindrical-groove cam, in which the groove cut around the cylinder affords bearing surface to the two opposite sides of the follower roller, thus giving positive motion, as illustrated in Fig. 3.

(*p*) End cam, in which the working surface has been cut at the end of a cylindrical shell, or has been formed on the side surface of a circular disk, thus requiring outside effort such as a spring or weight to hold the follower roller against the cam surface during the return of the follower. An end cam is shown in Fig. 4.

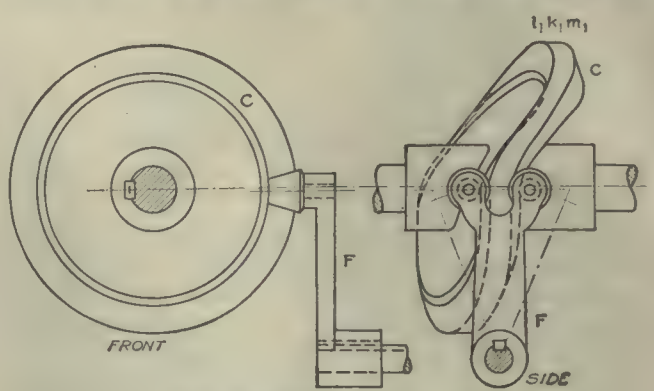


FIG. 10. DOUBLE-END CAM

(*q*) Double-end cam, in which a projecting twisted thread has been left on a cylindrical body, against both sides of which separate rollers on a follower arm may operate and thus secure positive motion. Instead of cutting down a cylinder to leave a projecting twisted thread it may be cast integral with a warped plate, as illustrated in Fig. 10, but this in no way changes its characteristic action.

There are a number of names in common use for cams, which cover both radial and side cams. Most prominent in this connection are those mentioned in the following paragraphs.

Box cam, designating a cam in which the follower roller is incased between two walls, as in the face cam, Fig. 2, or the cylindrical cam, Fig. 3. Literally box cams would also include yoke cams, in which the yoke would be the box. Box cams, because of their form of construction, give a positive drive.

Internal cam, in which there is only one working surface, and this is outside of the pitch surface. The internal cam corresponds to the internal gearwheel in toothed gearing. It may also be considered as a face cam with the inside surface of the groove removed, thus requiring that the follower roller should always be in pressure contact on the outside surface of the groove by means of a spring or weight, etc. Under some conditions of structural arrangements of the cam machine

the internal cam may be used to advantage where it will give a motion to a follower on the opposite stroke to that of the periphery cam, and it will also sometimes permit of a larger roller than the periphery cam.

Offset cam, in which the line of action of the follower rod, when extended, does not pass through the center of the cam, as would be the case, for example, if the center line *DG* of the follower rod in Fig. 7 were moved to the right or the left so that its extension would not pass through the center of rotation of the cam.

Positive-drive cam is one in which the cam itself drives the follower on the return as well as the forward motion. Many cams drive only on the forward motion of the follower, and depend upon gravity or the action of a spring to drive the follower in its return motion; such cams are illustrated in Figs. 1, 4, 5, 6, 7 and 8. Cams having positive drive, and therefore independent of gravity or springs, are illustrated in Figs. 2, 3, 9 and 10. It will be noted that positive-drive cams include the face, yoke, cylindrical and double-end types of cams; also that the box cam, although it includes some of these, should also be considered as a group name of the positive-drive type.

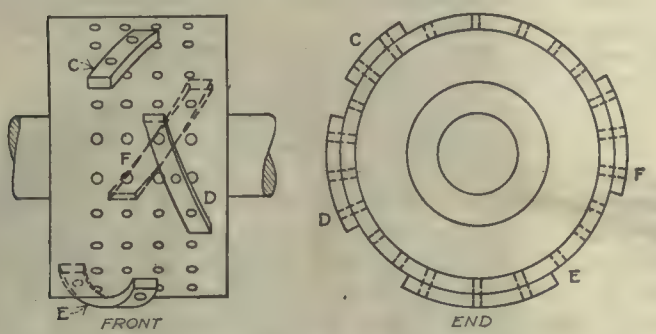


FIG. 11. BARREL CAM

Single-acting and double-acting cams comprise all forms of cams, the single-acting ones giving motion only in one direction and depending on a spring or gravity to return the follower. Double-acting cams have the follower under direct control all the time and are the same as positive-drive cams described in the preceding paragraph.

Cams which always give continuous motion to the follower from one end of the stroke to the other are called single-step cams. When the follower's motion in either of its two general directions is made up of two entirely separate movements it is called a double-step cam with reference to that stroke. If three or more separate movements are given to the follower while it moves in one general direction it is generally referred to as a multiple-step cam, or as a triple-step, quadruple-step cam, etc. Since a cam may be, for example, a double-step cam on the out or working stroke and a single-step cam on the return stroke such a cam may be referred to as a two-one-step cam, always giving the number referring to the working stroke first.

Adjustable cam, also called clamp cam, strap cam, dog cam, and carrier cam, in which specially formed pieces are directly bolted or clamped to any of the regular geometrical surfaces, usually to either the plane or cylindrical surfaces. In Fig. 12 the clamps are shown at *C* and *D* fastened to a disk. The cam, considered as a whole, belongs to the radial class. In Fig. 13 the clamps are shown at *C* and *D*, also fastened to a disk; but in this case the clamps, or dogs as they are usually called when used in this way, are so formed as to give a sidewise motion to the follower, and therefore this cam belongs to the side-cam class. In Fig. 11 clamps are shown at *C*, *F*, *E* and *D* fastened to a cylinder, and

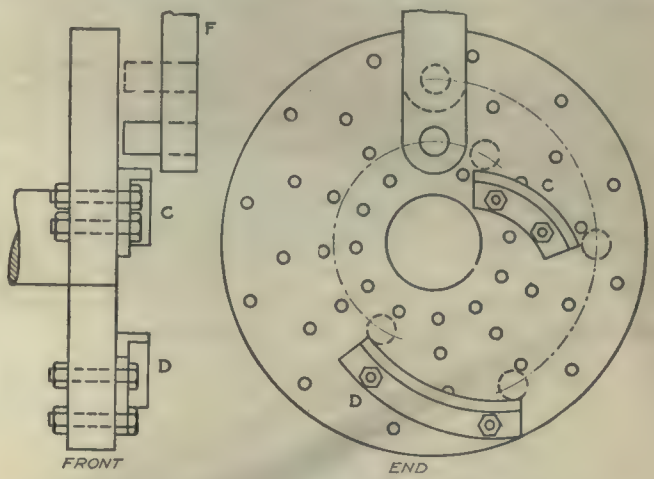


FIG. 12. ADJUSTABLE PLATE CAM

they are shaped to give the same action as a regularly formed end cam in the side-cam class. The type of cam illustrated in Fig. 11 is also known as an adjustable cylindrical or barrel or drum cam and is very widely used for regulating the feeding of the stock, and in operating the turret in automatic machines for the manufacture of screws, bolts, ferrules and small pieces generally that are made up in quantities.

Double-mounted or multiple-mounted cams are sometimes resorted to where several movements can be concentrated into small space. This consists merely in placing two or more of any of the cam surfaces described in the preceding paragraphs on one solid casting or cam body. For example, a face cam, a cylindrical and an end cam may all be cut on one piece.

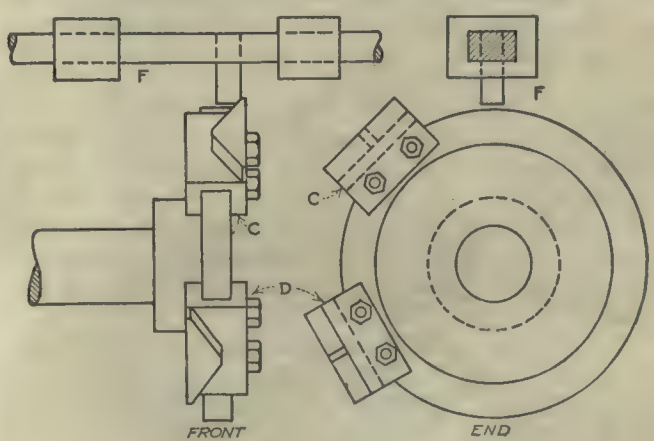


FIG. 13. DOG CAM

Oscillating cams, in which the cam itself turns through a fraction of a turn instead of through the entire 360 deg. While any type of cam may be designed to oscillate instead of rotate it is usually the toe-and-wiper and rolling forms of the radial type of cam that are known as oscillating cams.

Cams falling in the conical class have no special name other than the one here used. The spherical cams are

sometimes termed globe cams. Cams in conical and spherical classes are particularly useful in changing direction of motion in close quarters and in directions other than parallel and at right angles. In both Figs. 5 and 6 single-acting cams are shown, but it is apparent that, with thicker walls on both the cone and the sphere, grooves could be cut in them, thus giving positive-drive cams in both cases.

Summing up the general and special names for cams we have in tabular form:

- Cams
  - Box
  - Internal
  - Offset
  - Positive-drive
  - Single-acting
  - Double-acting
  - Step
  - Adjustable or strap
  - Dog or carrier
  - Multiple-mounted
  - Oscillating
  - *a* Radial or disk
    - *e* Periphery
    - *f* Plate
    - *g* Tangential
    - *h* Heart
    - *i* Frog
    - *j* Mushroom
    - *k* Face or plate-grooved
    - *l* Toe and wiper
    - *m* Rolling
    - *n* Yoke or duplex
  - *b* Side or cylindrical
    - *o* Cylindrical, grooved, barrel or drum
    - *p* End
    - *q* Double-end
  - *c* Conical
  - *d* Spherical or globe

Shop Democracy and Dividends

By John R. Godfrey

"Making the world safe for democracy" has become a bit threadbare in spots, having been used very promiscuously by many who haven't the slightest idea of what democracy means, unless it is voting for some particular man or party. But it applies to the machine shop just as well as to the nation, and the foremen who get wise to its application to their own job are on the road to climbing the ladder of machine-shop fame.

The foreman in the little old shop of yesterday was an autocrat with a capital A. The Kaiser had nothing on him in many ways. He could fire the best man in the shop if he didn't like the color of his necktie, if they differed in politics or religion, or bet on different horses. If the foreman's wife got up late and breakfast wasn't up to scratch, or the cakes were cold, or the milkman was late, woe betide the man or boy who ran foul of him. The cost to the firm never entered his head. He was boss, "by gosh," and he had to keep "discipline." He could damage a man's reputation and drive him out of town.

Of course in the long run the old man got his number and he walked the plank. But in the meantime he was monarch of all he surveyed and a bit more, and he could raise more hell with the output of a shop than even a double-dyed systematizer turned loose.

It was this petty despotism which led to the taking of the power of hiring and firing away from the foreman and putting it in the hands of an employment agent or manager. There are other reasons, of course, depending on the organization of the shop. But even with this work in other hands the foreman is in a position where a little insight into the meaning of democracy is a good thing to have.

In some shops the foreman is a work planner; in others a work chaser or animated bulletin board to tell the men when they are behind or playing safe; in some shops they are still instructors, as in the old days of apprenticeship. But no matter which of these he may be, a little tact in handling men, a little diplomacy if you please, goes a long way.

There is a Japanese proverb to the effect that it is often better to keep the man whose faults you know than to risk getting a new man of whose faults you know nothing. And it's a good thing to remember when you feel like firing a man for doing some fool stunt like reversing the machine to back the reamer out that he isn't apt to do the same thing a second time and that perhaps he had never been told of the damage it does to the reamer. Of course he ought to know, but the opportunities of learning except by observation are decidedly limited these days in most shops.

Then too we must make allowances for home conditions—for sickness or other difficulties. Of course it's nothing you or the shop is responsible for, but it happens just the same and you can perhaps imagine yourself in his place. When a man has a kiddie at home with diphtheria or his mother-in-law has the mumps he can't help letting his thoughts wander a bit, and it sometimes affects his work.

Different men have to be handled differently to get the best results. Here is where your tact and knowledge of human nature comes in. Some men require driving, but more can be led, coaxed or even "jollied." Certain types of workmen respond to inquiries about the children and the family in general. Don't balk and say it isn't your job, to play nurse or welfare worker to a bunch of kids. Your job is to get production, to turn out product that will pass inspection. If you can do this by asking after Johnny's toothache or Annie's measles, that's part of the job. In one case I know of, the foreman in a paper-box factory kept girls on the job by putting a cat in the room with them.

Keeping men on the job is another way of increasing production, or rather from preventing it from falling off. This is one of the things we have learned since the old days when the foreman fired right and left. Every time a man leaves your shop he takes with him some knowledge that he has learned while there, some knowledge that is more valuable to your shop than to any other. Of course he may have other qualities which offset this and make it pay to lose the experience he has gained, be it much or little. But it is always well to consider that a man should be worth more to you the longer he stays.

I know a work manager, of a large plant too, who preaches this gospel to all his foremen. In fact he preaches it so hard that a new foreman would have heart failure, if he had any new foremen, which he doesn't. No man gets to be a foreman under three to five years in that shop unless under unusual circumstances. They have to learn the ways of the shop, the spirit of the management and the quality of the product first of all.

This manager goes so far that he calls in a foreman and questions him when certain men in his department fail to get on the list of recommendations for a raise. Just imagine it! His theory is that if a man isn't worth more to the company at the end of six months or a year, there's something wrong. It may be with the foreman or with the man, but it's wrong anyhow. If it's the man the foreman should have found it out before. If it's the foreman's fault for not teaching him then the foreman wants to get busy himself.

How the 155-Mm. Howitzer Is Made—VII

By J. V. HUNTER
Western Editor *American Machinist*



The parts of the breech mechanism must be machined within very close tolerances. Upon their proper functioning when the gun is in action may depend the outcome of an engagement. In this final article of the series the methods used in their production are described and many of the jigs and fixtures used are illustrated.

THE regulating plate is placed on the upper face of the lower hinge lug on the howitzer body and takes the downward wear of the block carrier, due to the constant opening and closing of the breech mechanism. The sequence of operations is as follows:

Operation 1.—Bore, ream, turn hub, and face. Machine—17 in. by 6 ft. Le Blond lathe.
Operation 2.—Face opposite side, chamfer inside corner and thread. Machine—19 in. by 8 ft. Le Blond lathe.
Operation 3.—Mill outside edges; finish-mill corners. Machine—No. 4 Becker vertical milling machine.
Operation 4.—Caseharden.
Operation 5.—Grind hole. Machine—Modern internal grinding machine.
Operation 6.—Grind hub. Machine—Modern universal grinding machine.
Operation 7.—Grind hub face with face of wheel. Machine—Modern universal grinding machine.
Operation 8.—Surface-grind flat face. Machine—Modern universal grinding machine.

OPERATIONS ON THE REGULATING PLATE NUT

Operation 1.—Drill, chamfer, tap and face. Machine—17 in. by 6 ft. Le Blond lathe. Tools—Gages, special taps, thread gages.
Operation 2.—Turn diameter and finish opposite face. Machine—18 in. by 8 ft. Mueller lathe. Tools—Snap gages.
Operation 3.—Mill wrench slots. Machine—No. 10 Pratt & Whitney hand-milling machine. Tools—Holding fixture, gage.
Operation 4.—Bench work.
Operation 5.—Caseharden.

The block-carrier hinge-bearing plate is similar in appearance to the regulating plate, and fills a corresponding service on the lower side of the hinge lug of the block carrier. The operations follow:

Operation 1.—Drill, bore, ream, turn and face lug side. Machine—17 in. by 6 ft. Le Blond lathe. Tools—Rose reamers, plug gages.
Operation 2A.—Mill flat side. Machine—No. 2 Cleveland plain-milling machine. Tools—Milling fixture.
Operation 2B.—Countersink. Machine—Henry & Wright drilling machine. Tools—Special countersinks.
Operation 3.—Drill holes and counterbore. Machine—Henry & Wright drilling machine. Tools—Counterbores, gages.
Operation 4.—Mill edges. Machine—No. 12 Pratt & Whitney profiling machine. Tools—Milling fixture.
Operation 5.—Caseharden.
Operation 6.—Grind flat face. Machine—No. 2 Brown & Sharpe surface grinding machine. Tools—Holding fixture.
Operation 7.—Grind hole. Machine—10 x 10 Modern internal grinding machine. Tools—Gages.
Operation 8.—Grind lug side. Machine—No. 3 Modern universal grinding machine. Tools—Gages.

BLOCK-CARRIER HINGE-BEARING-PLATE SCREWS

Operation 1.—Turn thread and cut off. Machine—No. 1 Brown & Sharpe screw machine. Tools—Box tools, Magic chuck, gun taps, cut-off tools.
Operation 2.—Slot head. Machine—No. 10 Pratt & Whitney hand-milling machine. Tools—Slitting saws.

BLOCK-CARRIER LEVER CATCH

Operation 1.—Mill two flat sides. Machine—No. 3 Cincinnati plain-milling machine.

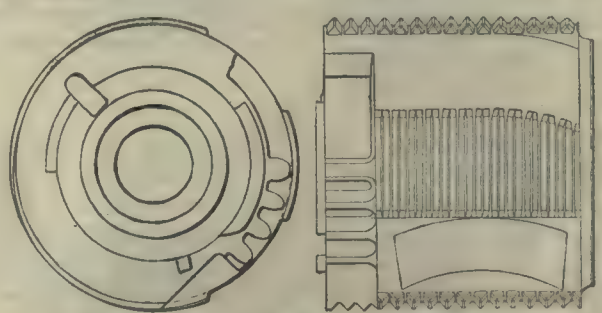


FIG. 121. DETAILS OF THE BREECH BLOCK

Operation 2.—Profile dovetail edges. Machine—No. 12 Pratt & milling machine. Tools—Gages.
Operation 3.—Mill angle edge. Machine—No. 3 Cincinnati plain-Wiitney profiling machine. Tools—Gages.
Operation 4.—Mill angle cut on end. Machine—No. 3 Cincinnati plain-milling machine.
Operation 5.—Bench work.
Operation 5A.—Assemble.
Operation 6.—Caseharden.

BLOCK-CARRIER-LEVER CATCH SCREW

Operation 1.—Turn, thread and cut off. Machine—No. 1 Brown & Sharpe screw machine. Tools—Gages, box tools, Magic chuck, taps, cut-off tool.
Operation 2.—Mill square head. Machine—No. 10, Pratt & Whitney hand-milling machine.

BLOCK-CARRIER ASSEMBLING STUD

Operation 1.—Turn and cut off. Machine—No. 1 Brown & Sharpe screw machine.
Operation 2.—Mill flats. Machine—No. 10 Pratt & Whitney hand-milling machine.

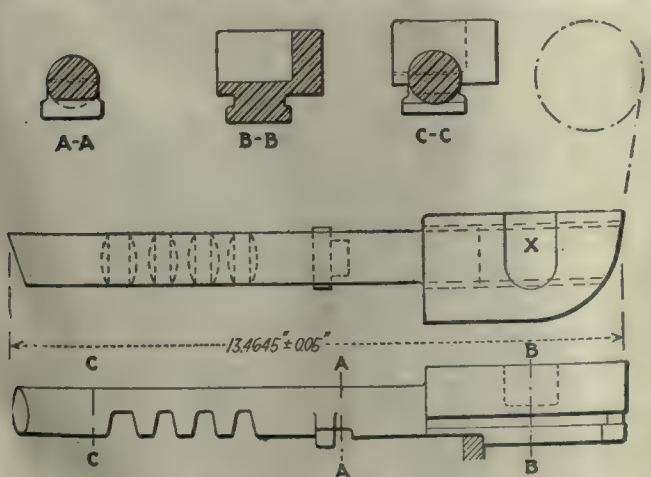


FIG. 119. DETAILS OF THE RACK

The large end of the rack, Fig. 119, has a socket *X* which connects with the operating lever, and the final motion of this lever in closing the breech imparts the

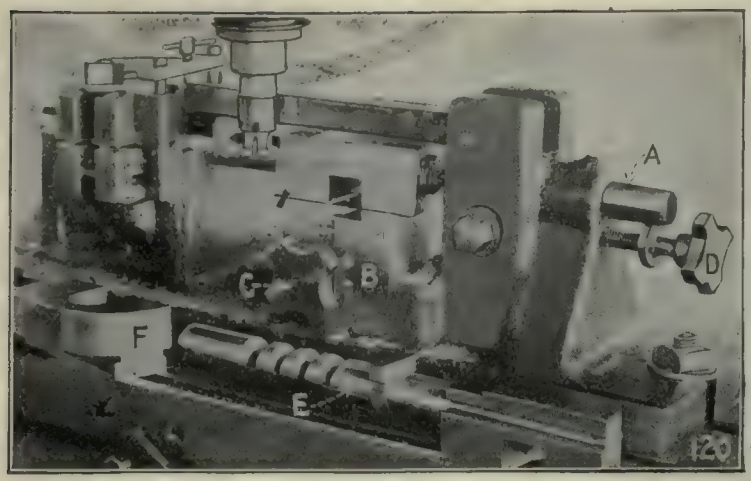


FIG. 120. MILLING FIXTURE FOR RACK

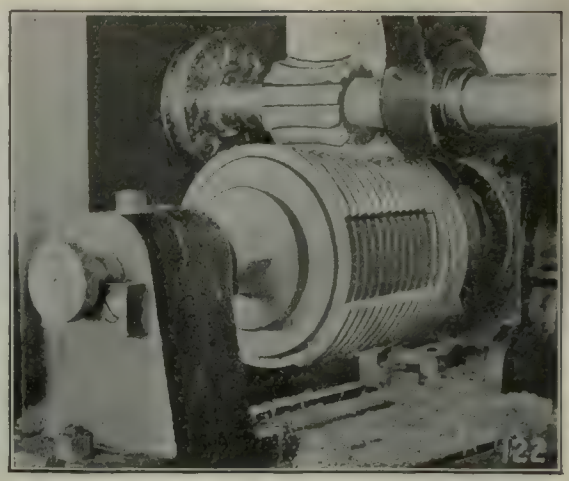


FIG. 122. INTERRUPTING A THREAD

necessary movement to the rack to rotate the breech block. The operations of the rack are as follows:

Operation 1.—Center. Machine—18 in. by 8 ft. Prentice lathe.
Operation 2.—Rough-turn shaft. Machines—18 in. by 8 ft. Prentice lathe and 21 in. by 8 ft. Le Blond lathe. Tools—Special.
Operation 3.—Rough-grind to a size and finish-grind face of stop for location point for all future operations. Machine—No. 3 Modern universal grinding machine. Tools—Gages.
Operation 4.—Rough-mill top and sides. Machine—No. 3 Cincinnati plain-milling machine.
Operation 5.—Rough-mill bottom, slide and stop. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages.
Operation 6.—Rough-mill opposite stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 7.—Rough-mill opposite stop. Machine—No. 5C Becker vertical milling machine. Tools—Profile fixture.
Operation 8.—Mill rack teeth. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages, cutters.
Operation 9.—Straighten.
Operation 10.—Finish-grind. Machine—No. 3 Modern universal grinding machine.
Operation 11.—Finish-mill top and sides. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages.
Operation 12.—Finish-mill bottom, slide and stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 12A.—Finish-mill T on slide. Machine—No. B Becker vertical milling machine. Tools—Slot centers, gages.
Operation 13.—Finish-mill opposite stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 14.—Finish-mill slot and profile end. Machine—No. 5C Becker vertical milling machine. Tools—Gages.
Operation 15.—Finish-mill both stop faces. Machine—No. 3 Cincinnati plain-milling machine.
Operation 16.—Bench work.
Operation 17.—Caseharden.
Operation 18.—Straighten.

One of the milling fixtures for holding the rack is shown in Fig. 120. This is for operations 11, 12 and 12A, and combines a centering device *A* with an adjustable plate *B* to take up the downward pressure during the milling cut. The adjustment of this surface plate is by the knob *C*, and the center has a similar screw adjustment *D*. Two views of the rack are shown; one at *E* shows the teeth milled in its stem, and the piece *F* shows the grooves of the T-section.

The rack lock prevents the rack from moving when the breech is open. Closing the block carrier pushes the lock back by pressure against the breech end of the gun, releases the rack, allowing it to rotate the breech block. The sequence of operations on the rack lock are as follows:

Operation 1.—Straddle-mill two flat surfaces and edge. Machine—No. 12 Brown & Sharpe plain-milling machine.
Operation 2.—Mill inside radius. Machine—No. 12, Brown & Sharpe plain-milling machine.
Operation 3.—Mill convex edge. Machine—No. 12 Brown & Sharpe plain-milling machine.
Operation 4.—Cut off square. Machine—No. 2B Milwaukee plain-milling machine.
Operation 5.—Drill and ream. Machine—Henry & Wright drilling machine.
Operation 6.—Straddle-mill ends. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7.—Mill-stop edge. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7A.—Bench work.
Operation 8.—Caseharden.
Operation 8A.—Polish.

The Breech Block

In drilling the breech block, Fig. 121, for the assembling stud the hole must be located by the position of the thread and all following operations are then performed on fixtures which locate the piece in reference to the position of this hole. The jig used for locating the relative position of the thread and assembling stud hole incloses the entire threaded section of the breech block and locates the thread position when it bottoms in the jig. Interrupting the thread is shown in Fig. 122.

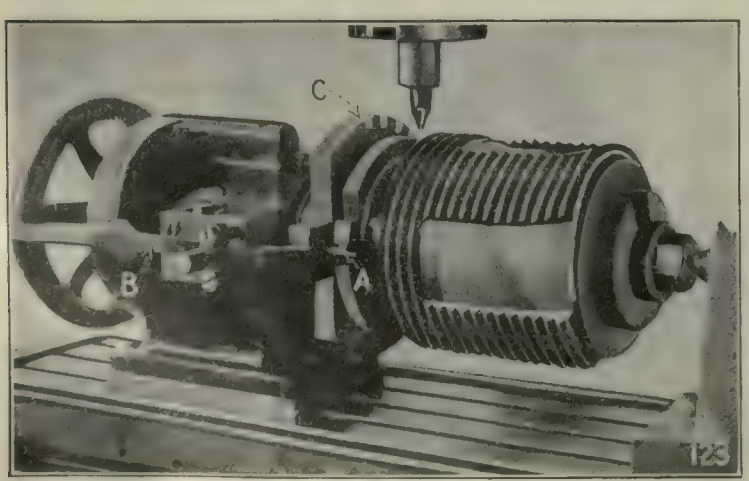


FIG. 123. CUTTING THE GEAR TEETH

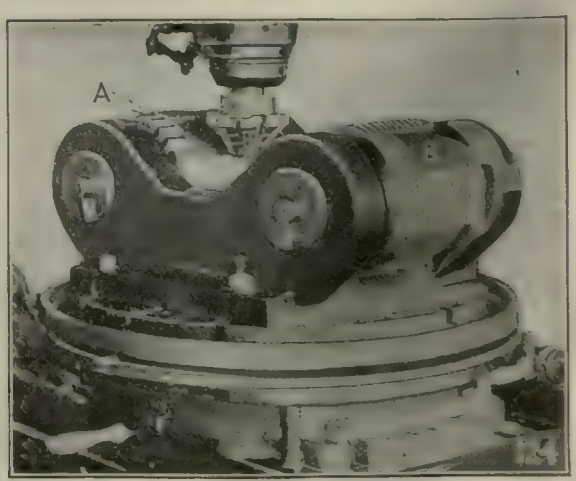


FIG. 124. MILLING SWING CLEARANCE

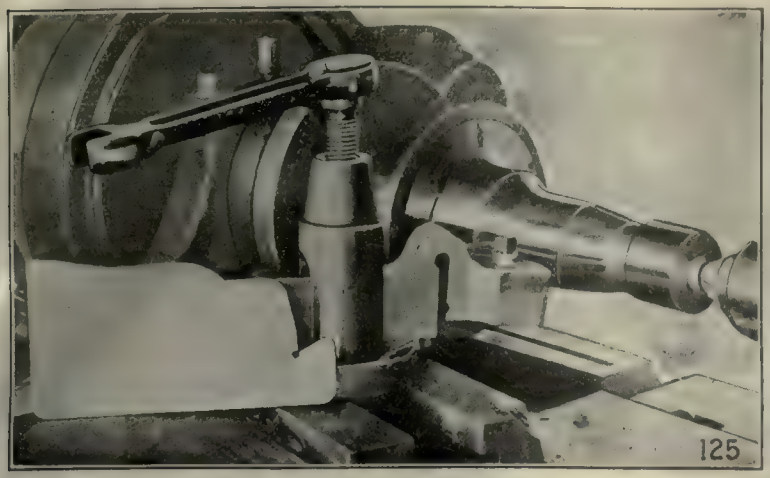


FIG. 125. TURNING THE OBTURATOR SPINDLE

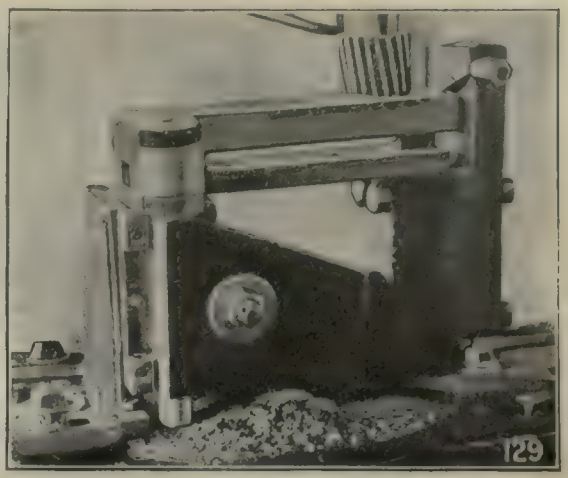


FIG. 129. FINISH-MILL

The cut here shown is the roughing cut and is followed by a finish cut to the correct depth of sector.

Cutting the gear teeth in the breech block is shown in Fig. 123. In the position shown the fixture has been revolved beyond its operating point to indicate the method of control by the stop at *A*. The lever latch *B* engages the notches *C* in the index plate, which is clamped to the breech block.

Machining the swing clearance on the breech block is illustrated in Fig. 124. Two breech blocks are held in

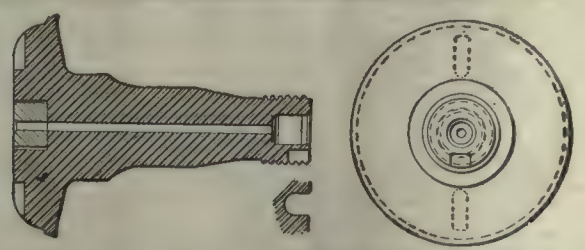


FIG. 126. OUTLINE OF OBTURATOR SPINDLE

this fixture at the same time, although the cutter works on each singly. The fixture is mounted on a revolving table so centered that when it is revolved the proper curvature for swing clearance is produced in the sectors of the block. After making the cut on block *A* the work is moved to the left sufficiently to make the cut on the block *B*. After these cuts have been made on two blocks they are removed and replaced, one for the other, and the following cut made on each. Later the clearance cuts are similarly made on the lower sides of the blocks.

The complete operations for machining the breech block are as follows:

Operation 1.—Drill, rough-face and rough-turn. Transfer heat number to outside diameter. Machine—No. 3A Warner & Swasey turret lathe.

Operation 2.—Rough turn other end; rough and finish bore

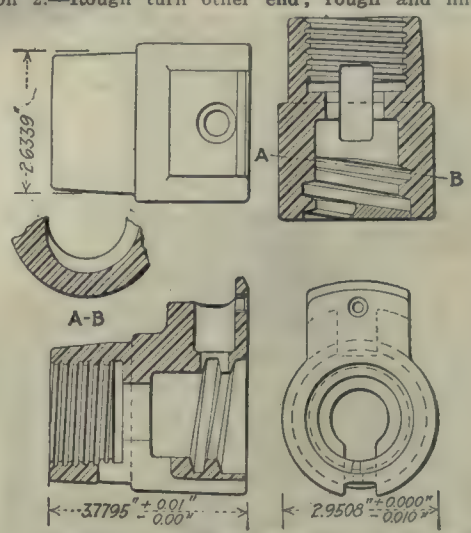


FIG. 127. DETAILS OF FIRING-MECHANISM HOUSING

and counterbore gear end. Machine—No. 3A Warner & Swasey turret lathe.

Operation 3.—Finish turn and face ends. Transfer heat number with 1.8-in. stencils to muzzle and concentric with and as close as possible to bore. Machine—21 in. by 8 ft. Le Blond lathe.

Operation 4.—Thread. Machine—24 in. by 10 ft. Prentice lathe.

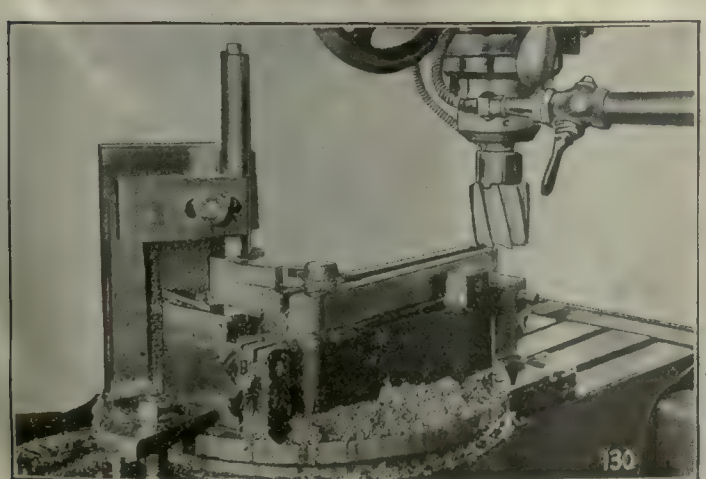


FIG. 130. MILLING THE BOTTOM FACE

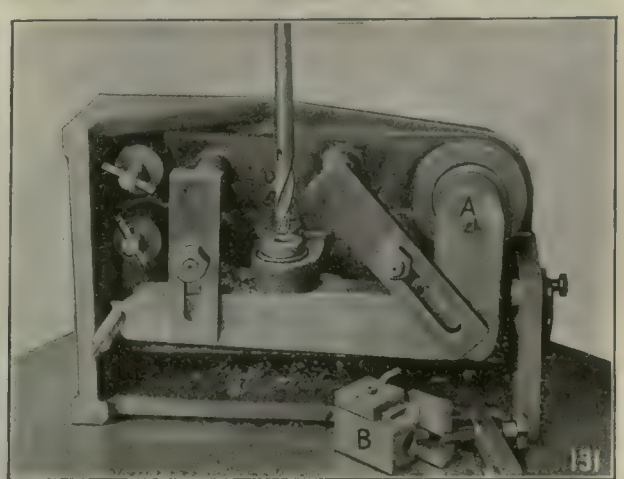


FIG. 131. DRILLING OPERATIONS

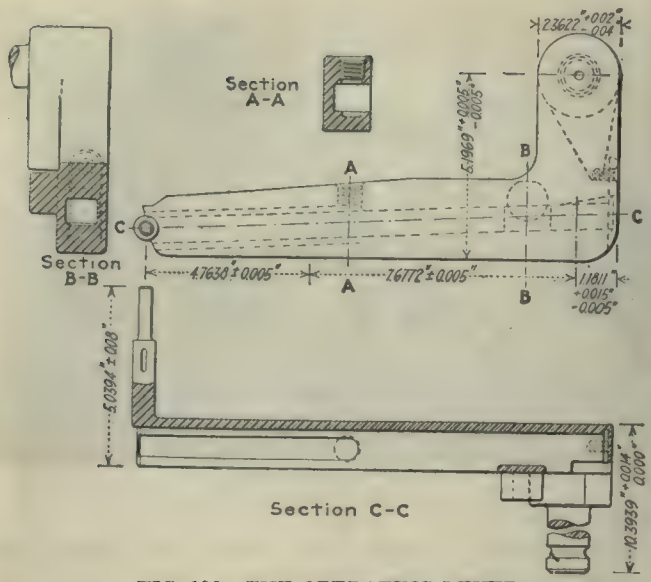


FIG. 128. THE OPERATING LEVER

Operation 5.—Drill hole for assembling stud. Transfer heat number to breech end opposite assembling stud hole concentric with and as close as possible to collar to read as from center bore. Machine—12-in. two-spindle Henry & Wright drilling machine.

Operation 6.—Mill sectors. Machine—No. 3 Kempsmith plain-milling machine.

Operation 7.—Mill square corners in two sectors. Machine—No. 5C Becker vertical milling machine.

Operation 8.—Shape clearance on sectors; transfer heat number to upper face of right-hand thread segement, stamping to read as from center of cross-section of breech block. Machine—No. 5C Becker vertical milling machine.

Operation 9.—Mill clearance gear teeth. Machine—No. 5C Becker vertical milling machine.

Operation 10.—Rough and finish gear teeth. Machine—No. 5C Becker vertical milling machine.

Operation 11.—Mill cam slot. Machine—Model B Becker vertical milling machine.

Operation 12.—Counterbore 3-in. diameter. Machine—No. 3A Warner & Swasey turret lathe.

Operation 13.—Bench work.

The Obturator Spindle

The obturator spindle is made from a forging and the operations are nearly all lathe work. One of the form-turning operations is illustrated in Fig. 125, showing a spring-tool and profile gage used in the work. The outlines of this piece are shown in Fig. 126 and the operations are as follows:

Operation 1.—Cut off boss and center. Machine—19 in. by 8 ft. Le Blond lathe; transfer heat number to face head end.

Operation 2.—Turn 3.75 in. and 2.65 in. spots to a size. Machine—19 in. by 8 ft. Le Blond lathe. Tools—Gages.

Operation 3.—Drill small center hole. Machine—12-in. Henry & Wright drilling machine. Tools—Plug gages.

Operation 4.—Recenter ends. Machine—Saxer-Creider speed lathe. Tools—Pilot countersinks.

Operation 4A.—Rough-turn all over. Machine—16 in. by 6 ft. Prentice lathe. Tools—Gages, forged tools.

Operation 5.—Finish-turn all over. Machine—18 in. by 8 ft. Prentice lathe. Transfer heat number to taper bearing back of thread section. Tools—Radius gages, snap gages, forming tool.

Operation 6.—Mill slots in head. Machine—No. 3B Becker vertical milling machine. Tools—Gages.

Operation 7.—Grind. Machine—No. 3 Modern universal grinding machine. Tools—Snap gages.

Operation 8.—Chase thread. Machine—18 in. by 6 ft. Prentice lathe. Tools—Gages.

Operation 9.—Inside thread in small end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Gages, counterbores.

Operation 10.—Inside thread large end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Plug gage, special tap.

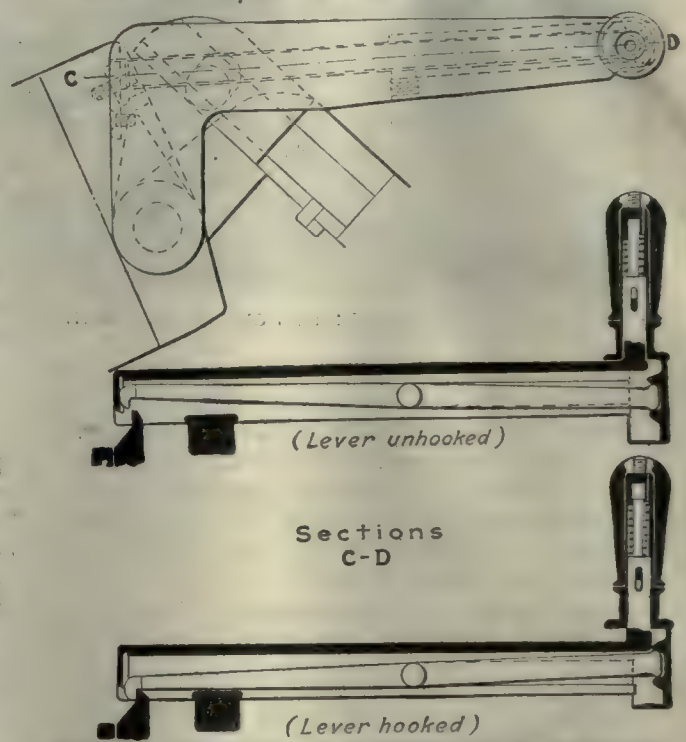


FIG. 133. THE OPERATING-LEVER LATCH, SHOWING METHOD OF ITS OPERATION

Operation 11.—Mill locking slot and remove fins. Machine—No. 3B Becker vertical milling machine.

Operation 12.—Assemble plug and vent bushing and gasket, face-off vent bushing, countersink ream hole in bushing and gasket. Machine—18 in. by 8 ft. Prentice lathe. Stamp heat number ¼ in. away from and concentric with diameter of vent plug to read as from center of plug. Tools—Wrenches.

The Firing-Mechanism Housing

The firing-mechanism housing which engages and holds the obturator spindle in place is shown in Fig. 127. The sequence of operations follows:

Operation 1.—Heat-treat forging.

Operation 2.—Turn, face, bore, ream, counterbore and thread taper end. Machine—No. 4 Warner & Swasey turret lathe with tapping and chasing attachments.

Operation 3.—Turn, face and counterbore opposite end. Machine—16 in. by 6 ft. Reed lathe.

Operation 4.—Mill Acme thread. Machine—Pratt & Whitney thread-milling machine.

Operation 5.—Turn 2.065 in. and 2.5394 in. radius and face back projecting section. Machine—Reed lathe.

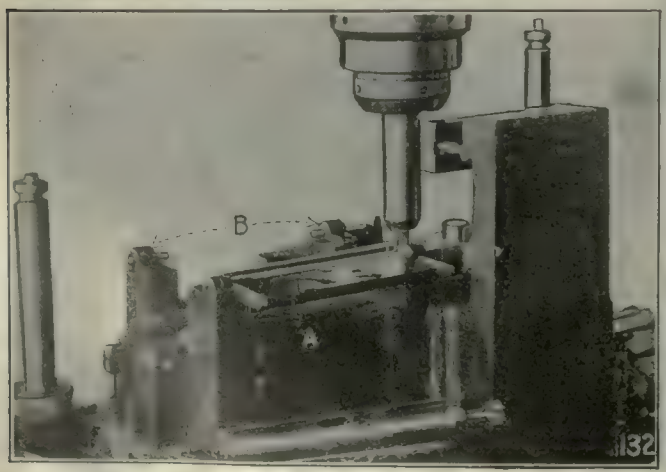


FIG. 132. SLOTTING THE LEVER

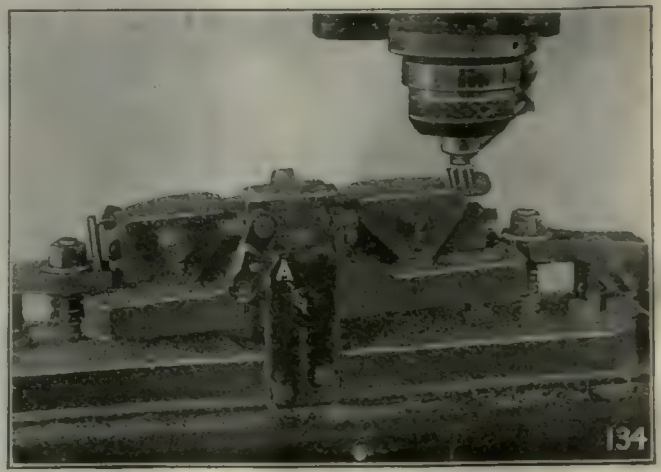


FIG. 134. A TILTING FIXTURE

Operation 6.—Form mill sides of plug. Machine—No. 2 Rockford plain-milling machine.
Operation 7.—Profile mill. Machine—No. 2 Cincinnati vertical milling machine.
Operation 8.—Drill, counterbore and tap all holes. Machine—12-in. Henry & Wright drilling machine. Tools—Counterbores.
Operation 9.—Mill key slot. Machine—12-in. Henry & Wright drilling machine. Tools—Gages.
Operation 10.—Slot. Machine—6-in. Pratt & Whitney slotting machine. Tools—Holding fixture; plug gages.
Operation 11.—Slot clearance on Acme thread. Machine—6-in. Pratt & Whitney slotting machine. Tools—Holding fixture; special tools.
Operation 12.—Hand work.

OPERATIONS ON THE FIRING-MECHANISM HOUSING KEY

Operation 0.—Heat-treat bars.
Operation 1.—Form-mill top side. Machine—No. 24 Osterlein plain-milling machine.
Operation 2.—Straddle-mill end. Machine—No. 24 Osterlein plain-milling machine.
Operation 3.—Form-mill bottom side. Machine—No. 24 Osterlein plain-milling machine.
Operation 4.—Saw to length. Machine—No. 24 Osterlein plain-milling machine.
Operation 5.—Drill, counterbore and countersink hole. Machine—12-in. Henry & Wright drill.
Operation 6.—Mill slot for spring. Machine—No. 2 Becker vertical milling machine.
Operation 7.—Grind sides. Machine—No. 2 Brown & Sharpe surface-grinding machine.
Operation 8.—Turn 1.279 in. and 1.474 in. radii. Machine—15-in. Crawford lathe.
Operation 9.—Bench work.

The operating lever, Fig. 128, is machined from a drop-forging. There are two spindle arms on the opposite ends, one of which is a hinge pin and the other is the center spindle for the operating-lever handle. The sequence of operations is as follows:

Operation 0.—Heat-treat forging.
Operation 1.—Rough-turn and center both ends of large shaft. Machine—Le Blond gap lathe.

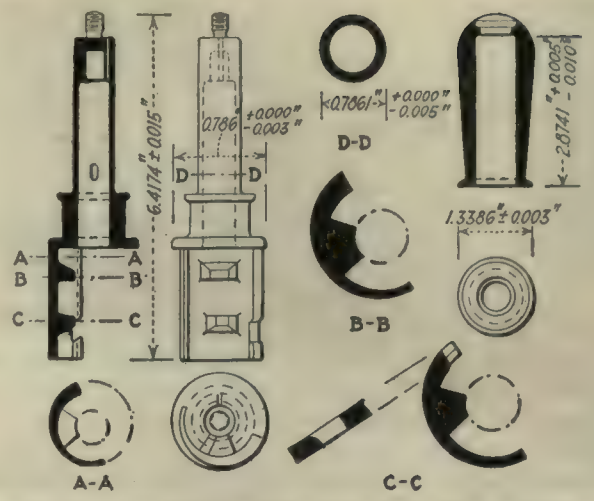
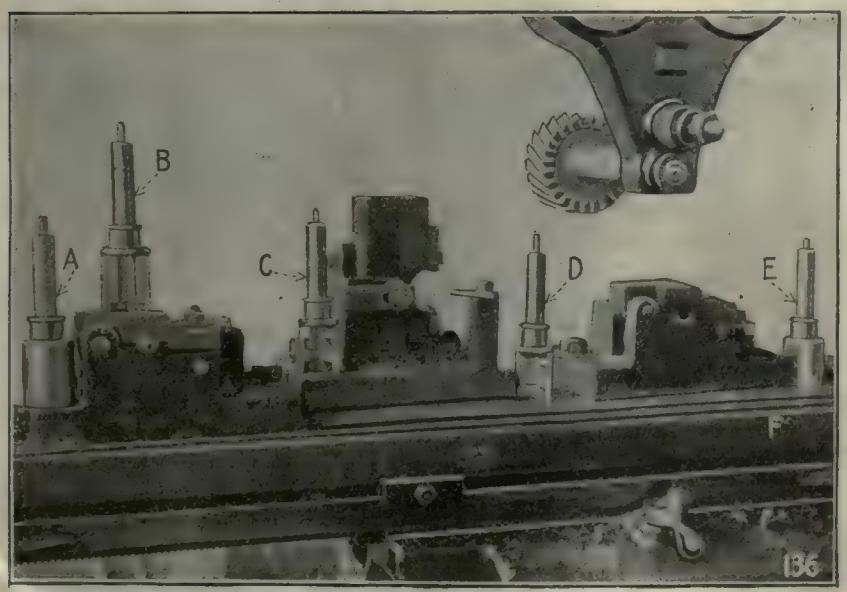
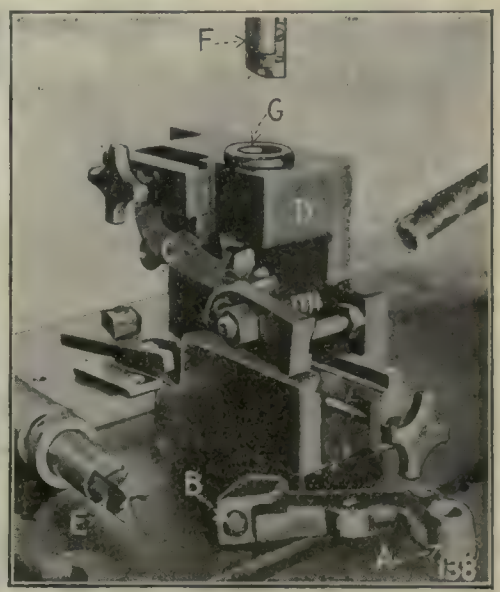
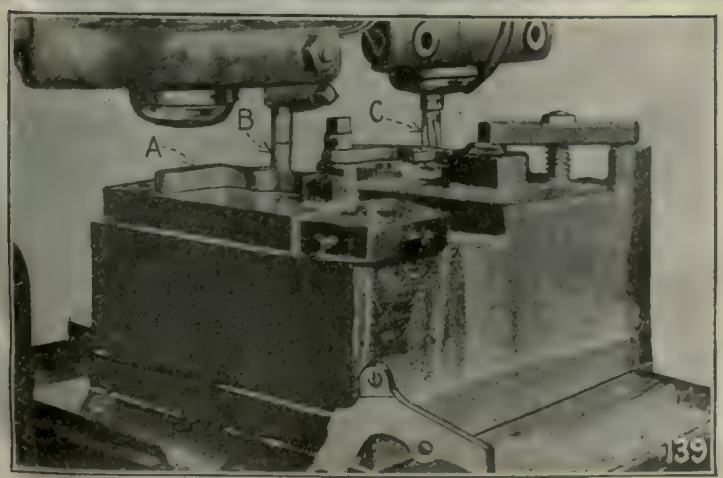


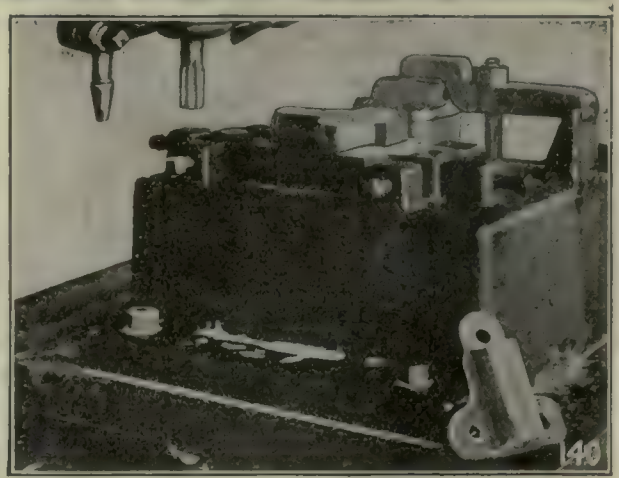
FIG. 135. DETAILS OF OPERATING-LEVER HANDLE

Operation 2.—Rough-mill top face and outside edges. Machine—No. 3 Hendey plain-milling machine. Tools—Gages.
Operation 3.—Rough-mill inside edges. Machine—No. 3 Hendey plain-milling machine. Tools—Gages.
Operation 4.—Rough-mill bottom face. Machine—No. 3 Kempsmith plain-milling machine. Tools—Stub arbors, drills.
Operation 5.—Finish-turn large shaft. Machine—20 in. by 8 ft. Le Blond lathe.
Operation 6.—Rough and finish turn handle shaft. Machine—20 in. by 8 ft. Le Bland lathe.
Operation 7.—Rough-off stock and finish-mill top face and all edges. Machine—No. 5C Becker vertical milling machine.
Operation 8.—Finish-mill all surfaces on bottom face, including









FIGS. 136, 138, 139 AND 140. MACHINE OPERATIONS ON OTHER PARTS

Fig. 136—Milling fixture for operating-lever handle. Fig. 138—Hollow-milling the striking point on the hammer. Fig. 139—Profiling the hammer. Fig. 140—Profiling outside edge of lock-bolt housing

hollow-milling for hub. Machine—No. 2 Cincinnati plain-milling machine; model B Becker vertical milling machine. Tools—Gage, special collet.

Operation 8A.—Form-mill handle-shaft end. Machine—No. 2 Cincinnati plain-milling machine. Tools—End mill, centers.

Operation 9.—Drill and tap all holes. Machine—12-in. Henry & Wright drilling machine.

Operation 10.—Mill T-slot. Machine—No. B Becker vertical milling machine.

Operation 11.—Mill dovetail slot for cover. Machine—No. B Becker vertical milling machine. Tools—Gage.

Operation 12—Broach slotted hole. Machine—No. 3 La Pointe broaching machine.

Operation 13.—Drill and broach small hole in handle shaft. Machine—12-in. Henry & Wright drill. Tools—Gage, drill, fixture, broaches.

Operation 14.—Bench work.

Fixtures for Machining the Operating Lever

There is a large amount of stock on the back edge of the lower forging which is roughed off in a shaping machine. The fixture used for milling the top face and edges is shown in Fig. 129.

The next operation is conducted on two separate machine tools. Fig. 130 shows the method of holding the piece during the milling cut. Hollow-milling the hub is an ordinary drilling-machine operation and needs no description.

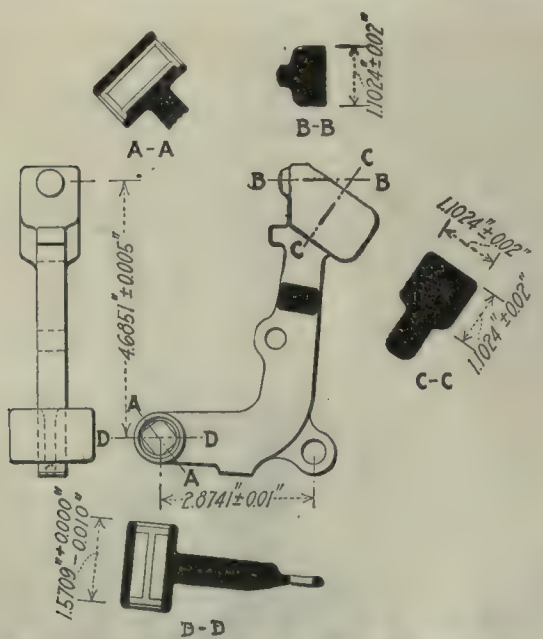


FIG. 137. DETAILS OF PERCUSSION HAMMER

The jig used for the drilling operation, Fig. 131, locates the work by slipping the hinge-pin end into a hardened bushing, as indicated at *A*. An auxiliary jig *B* is placed on the shaft end while drilling the holes in this portion.

The fixture shown in Fig. 132 is used in milling the T-slot on the bottom. This slot contains the arm for tripping the latch during the opening and closing of the breech. The part *A*, which is hinged, is turned over to the left and used as a profile gage for a portion of this cut; it is also held between the lugs *B* for gaging a cut on the opposite side of the slot.

Other Breech-Mechanism Parts

One of the operations on the operating-lever latch, Fig. 133, is shown in Fig. 134. The fixture shown is pivoted about a center pin *A*, and is used for milling the taper on each end of the latch. In use the fixture is tilted up in one direction, and after completing this cut the angle of tilt is reversed for milling the taper on the opposite end. The sequence of operations on the operating-lever latch piece follows:

Operation 1.—Mill and hollow-mill two sides. Machine—No. 4B Becker vertical milling machine. Tools—Hollow shank mills, blades; end mills.

Operation 2.—Mill latch side. Machine—No. 3B Becker vertical milling machine. Tools—End mills.

Operation 3.—Finish-mill side opposite latch. Machine—No. 3B Becker vertical milling machine. Tools—End mills.

Operation 4.—Finish-mill side opposite latch. Machine—No. 2 Cincinnati plain-milling machine. Tools—Gages, milling fixtures.

Operation 4A.—Bench work.

Operation 5.—Casecharden.

Operation 5A.—Polish.

Operation 6.—Grind. Machine—No. 2 Brown & Sharpe grinding machine.

The Operating Lever Handle

The operating-lever handle, Fig. 135, passes through a series of milling operations to shape out the hollow part of its base. Previous to these milling operations its exterior has been finished. Several of the fixtures used are mounted on the milling-machine table, Fig. 136. The piece is shown at *A*, and the first cut *B* removes half of the large end, exposing the bore. Succeeding cuts shown at *C*, *D*, *E* and *F*, complete the series.

The sequence of operations on the operating-lever handle are as follows:

Operation 1.—Drill, ream and face 0.67 in., 0.63 in., 0.354 in. holes. Machine—Foster turret lathe. Straight-shank counterbore, ring gage, two-step hand reamers, pilot reamers, plug gages, pilot bushing.

Operation 2.—Center small end. Machine—Foster turret lathe.

Operation 3.—Rough-turn small end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Snap gages go and no-go, collets, stub-nut arbors.

Operation 4.—Rough large end and finish-turn all over; thread and face to length. Machine—16 in. by 6 ft. Prentice lathe.

Operation 5.—Mill half section of large end. Machine—No. 1½ Milwaukee plain-milling machine.

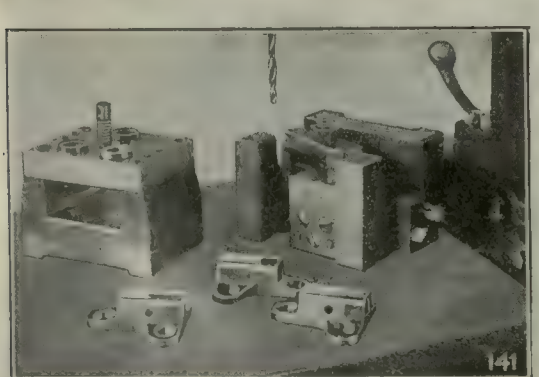
Operation 6.—Mill to form large end. Machine—No. 1½ Milwaukee plain-milling machine.

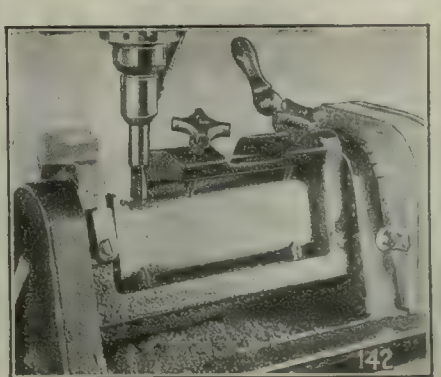
Operation 7.—Mill latch slot on large end. Machine—No. 1½ Milwaukee plain-milling machine.

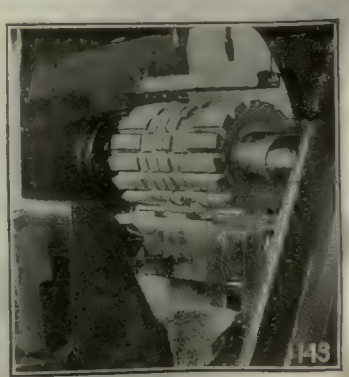
Operation 7A.—Mill clearance cut. Machine—No. 2 Becker vertical milling machine. Interlocking centers, stub arbors.

Operation 8.—Shape out clearance of sectors. Machine—10-in. Pratt & Whitney profiling machine. Tools—Gages.

Operation 9.—Drill all holes. Machine—Henry & Wright drilling machine.







FIGS. 141 TO 143. FINAL DRILLING AND MILLING OPERATIONS

Fig. 141—Drilling jigs for lock-bolt housing. Fig. 142—Rotating fixture for milling breech key. Fig. 143—Milling tongues on counterweight

Operation 10.—Finish-broach slot. Arbor press.
Operation 11.—Turn large end eccentric. Machine—16 in. by 6 ft. Prentice lathe.
Operation 12.—Bench work.
Operation 13.—Caseharden.
Operation 14.—Polish.

The Percussion-Hammer Part

The percussion hammer, Fig. 137, is machined from a drop-forging and has considerable excess stock which must be removed. One of the forgings shows in the foreground of Fig. 138 at *A*.

The operation here illustrated is hollow-milling the striking point *B* of the hammer. As will be seen by the piece *C* in the jig *D* this cut is made after the side-milling operations are completed. The roughing work is done with the three-lipped hollow mill *E* and the finishing cut is made with the cutter *F* shown in the spindle of the machine. Both cutters are guided by the bushing *G*.

The face and back are profiled as shown in Fig. 139. The hardened plate *A* acts as a guide for the former pin *B*, while the milling cutter *C* is finishing the edges. This cut is followed by another using a concave cutter to round the edges. The sequence of operations is as follows:

Operation 1.—Straddle-mill ends of hub and sides of head. Machine—No. 2B Milwaukee plain-milling machine.
Operation 2.—Drill all holes and conterbore holes in hub. Machine—Henry & Wright drilling machine.
Operation 3.—Broach hole for shaft. Machine—No. 3 La Pointe broaching machine.
Operation 4.—Face and turn hub and reface sides of head. Machine—18 in. by 8 ft. Mueller lathe.
Operation 5.—Face both sides of web from hub to head. Machine—18 in. by 8 ft. Mueller lathe.
Operation 6.—Hollow-mill striking point. Machine—Henry & Wright drilling machine.
Operation 7.—Mill face and back of web to profile. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 8.—Countersink holes and round edges. Machine—Henry & Wright drilling machine.
Operation 9.—Hand work.
Operation 10.—Caseharden.
Operation 11.—Polish.

PERCUSSION-HAMMER OPERATING SHAFT

Operation 0.—Heat-treat forging.
Operation 1.—Center. Machine—Saxer-Creeder-Speed lathe.
Operation 2.—Turn all diameters to a size, face and thread. Machine—17 in. by 6 ft. Le Blond lathe.
Operation 3.—Form-mill radius on boss and mill sides of crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 4.—Mill stock on radius of crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 5.—Mill flat on boss on crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 5A.—Grind to sizes. Machine—No. 3 Modern universal grinding machine
Operation 6.—Mill flats on hammer shaft bearing and collar surface. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 7.—Mill safety-plunger cut. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 8.—Remove centers and face to length.

PERCUSSION-HAMMER OPERATING-SHAFT HOUSING

Operation 0.—Heat-treat forging.
Operation 1.—Center. Machine—Pratt & Whitney centering machine.
Operation 2.—Turn spots on each end for collet chuck and steadyrest. Rough-face to length. Machine—16 in. by 6 ft. Crawford lathe.
Operation 3.—Drill, ream and counterbore hammer-shaft bearing. Machine—15 in. by 6 ft. Crawford lathe.
Operation 4.—Re-turn spots on end to a dimension. Machine—16 in. by 6 ft. Crawford lathe.
Operation 5.—Rough-form, mill dovetail faces. Machine—No. 3B Milwaukee milling machine.
Operation 6.—Finish mill dovetail section. Machine—No. 3B Milwaukee milling machine.
Operation 7.—Hand-finish dovetail section to fit templet.
Operation 8.—Form-mill top side to form outside thickness and bottom edge to greatest width. Machine—No. 2B Milwaukee milling machine.
Operation 9.—Mill bottom side to form end radius. Machine—No. 2B Milwaukee milling machine.
Operation 10.—Mill slot for hammer and mill ends to length. Machine—No. 2B Milwaukee milling machine.
Operation 11.—Mill pad and profile of lug for safety plunger. Machine—No. 14 Pratt & Whitney profiling machine.
Operation 12.—Mill clearance on top. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 13.—Drill, counterbore and countersink all holes. Machine—Henry & Wright drilling machine.
Operation 14.—Shape slot for plunger. Machine—No. 3 Becker vertical milling machine.
Operation 14A.—Mill angle on end. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 15.—Hand-finish.
Operation 16.—Assemble shaft hammer, plunger and spring complete ready to assemble on gun.

The finished outline of the percussion-hammer lock-bolt housing is obtained by a profile-milling operation, Fig. 140. Some of the drilling jigs used are shown in Fig. 141.

PERCUSSION-HAMMER LOCK-BOLT HOUSING

Operation 1.—Mill flat surface. Machine—No. 24 Osterlein plain-milling machine.
Operation 2.—Drill holes for fastening screws and hole for broach. Machine—two-spindle Henry & Wright drilling machine.
Operation 3.—Form-mill all outside surfaces lengthwise of piece. Machine No. 24 Osterlein plain-milling machine.
Operation 4.—Form-mill all outside surface crosswise. Machine—No. 24 Osterlein plain-milling machine.
Operation 5.—Mill angle cut on top side. Machine—No. 24 Osterlein plain-milling machine.
Operation 6.—Profile outside edges. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 7.—Broach square holes. Machine—No. 3 La Pointe broaching machine.
Operation 8.—Countersink holes for holding screws, drill and tap holes for stop screw. Machine—Henry & Wright drilling machine.
Operation 9.—Hand-finish all over.
Operation 10.—Assemble with bolt and spring complete ready to assemble on gun.

HOWITZER BRIDLE

Operation 0.—Heat-treat forging.
Operation 1.—Shape bottom. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 2.—Shape two sides to a dimension. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 3.—Mill key slot—Auto-spline machine.
Operation 4.—Broach. Machine—No. 3 La Pointe broaching machine.
Operation 4A.—Shape square end. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 5.—Face and turn boss on top. Machine—18 in. by 8 ft. Reed lathe.
Operation 6.—Drill, ream and counterbore. Machine—Fosdick radical drilling machine.
Operation 7A.—Grind all flat surfaces. Machine—Blanchard vertical grinding machine.
Operation 7B.—Bench work.
Operation 7C.—Inspection A. B. S. and Government.
Operation 8.—Fit to gun. Lay out angle surface and measure side surfaces.
Operation 9.—Shape angle surface.

The Breech Key

For the breech leg a rotating milling fixture, Fig. 142, is used for finishing the end next to the shoulder lug with an end mill.

The sequence of operations is as follows:

Operation 0.—Heat-treat forging.
Operation 1.—Grind two sides. Machine—Blanchard vertical surface-grinding machine.
Operation 2.—Form-mill two edges and top of lug. Rough and finish cuts. Machine—No. 2B Milwaukee plain-milling machine.
Operation 3.—Mill both ends to length. Machine—No. 2B Milwaukee plain-milling machine.
Operation 4.—Finish-mill lug. Machine—No. 3H Becker profiling machine.
Operation 5.—Form-mill bevel on end. Machine—No. 2B Milwaukee plain-milling machine.
Operation 6.—Mill radius on lug end. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7.—Drill and tap hole. Mill locking-screw hole. Machine—Henry & Wright drilling machine.

The Counterweight

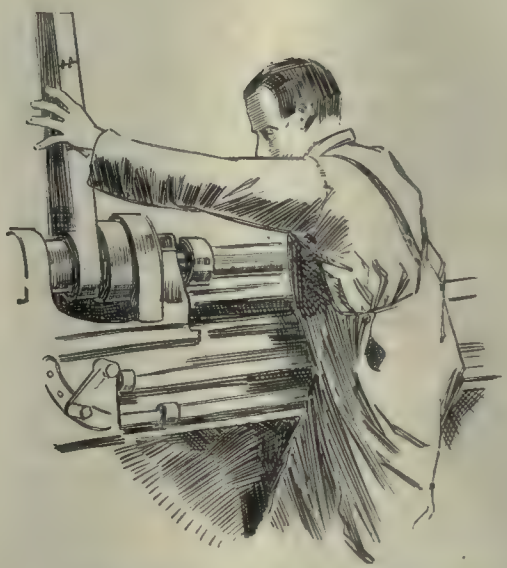
A counterweight serves to balance the howitzer. It is a cast-steel block milled on all surfaces for a finish. One of the milling operations which produces the tongues on its face for holding it in correct position on the gun body is illustrated in Fig. 143. The sequence of operations is as follows:

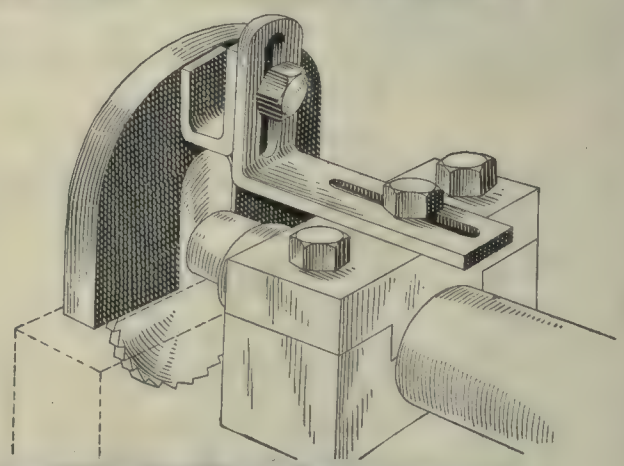
Operation 1.—Face top side. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 2.—Face sides and form radii. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 3.—Face ends. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 4.—Form-mill bottom side. Machine—No. 3B Milwaukee plain-milling machine.
Operation 5.—Form-mill large radius. Machine—No. 3B Milwaukee plain-milling machine.
Operation 5A.—Form-mill radius on edges. Machine—No. 4 Becker milling machine.
Operation 6.—Drill, counterbore and ream soles for holding bolts and sight plates. Machine—Fosdick radial drilling machine.
Operation 7.—Drill, counterbore and tap all holes for lifting eye. Machine—Fosdick radial drilling machine.
Operation 8.—Drill and tap holes for lifting eye-locking screws. Machine—Fosdick radial drilling machine.

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas

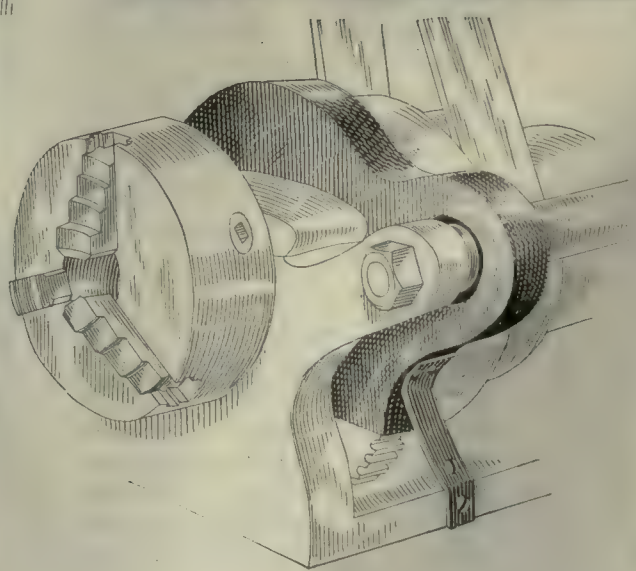












Extracts From Chordal's Letters

When the backwoods machine shops were primitive affairs the old-time machinists were put to their wits' end to devise ways and means to get out the work, and in the days when the sawmill engine was also a primitive affair and had to stand all sorts of abuse the engineer had to be a genius to keep it running. Cylinders wore terribly from the old hemp piston packing, and if the packing was set up tight enough to stop the leakage of steam the engine would run hard and would not deliver power enough to run the mill. Taking off a cylinder and carting it a hundred miles through the woods to a machine shop to have it rebored was an expensive undertaking.

Mr. EDITOR:

* * * When I was a kid I worked for Porter Holcomb. Port, and a millwright by the name of Thompson owned the shop, which was a small affair working probably 10 men altogether. Port was not a machinist, but claimed to have been a molder. From my experience with him I will say that he was the best all-around machinist it has ever been my good fortune to come across. He ran the machine shop, which had two or three lathes and a drill press, and there was no sort of a job he would not tackle, and not only that but he would tackle it successfully.

* * * The time was just following the Civil War and Holcomb, Thompson & Co.'s shop was out in the wilds 125 miles from a railroad, and the country round about had been pretty well devastated by the armies, and the shop had a golden harvest in making general repairs and rehabilitations of the hundreds of small sawmills and grist mills scattered about the region within a hundred miles of the shop.

* * * Some hayseed would come in from the woods and start negotiations for the repair of his sawmill, about which there would be very little left when the war was over. He would bring some of the traps from the engine and from the mill and Porter would make him an estimate on what it would cost, and it was enough, to replace missing parts or to mend broken parts.

* * * The sawmill man, however, would be of the opinion that the cylinder of the engine was all right and that the thing could be got to run by supplying some missing bolts and a valve stem, and some of the screws that held the cylinder heads on, and some of the screws that held the steam-chest cover on, and some of the wrists of the rocker, and part of the eccentric rod, and the bolts of the eccentric strap, and the setscrews of the crosshead, and one of the strap ends of the connecting-rod, and a lot of other things about the engine. But the sawmill man's mind would be centered on that cylinder because it seemed to him to be complete. It had the two cylinder heads on minus a few bolts, and his presumption was that the piston was all right because it was closed up in the cylinder.

* * * And then it occurred to the sawmill man that even four years ago, when the mill went out of commission, there had been trouble with the piston. It would either work too hard and make a lot of noise rubbing in the cylinder or it would leak a lot of steam so that the engine would not give power enough.

* * * The pistons of these engines were, as a general thing, packed with hemp like Fig. 1. The hemp packing *A* would be soaked in oil and then driven in around the body of the piston with a drift and a sledge, the follower being absent, after which the follower would be put on and screwed up to compress the packing, and after awhile, when the thing began to leak too much, then the cylinder would be opened and the follower would be tightened up some more.

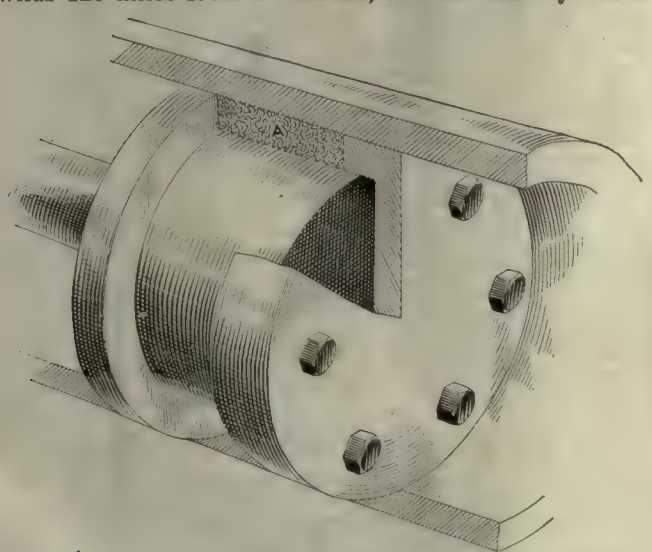


FIG. 1. A HEMP-PACKED PISTON

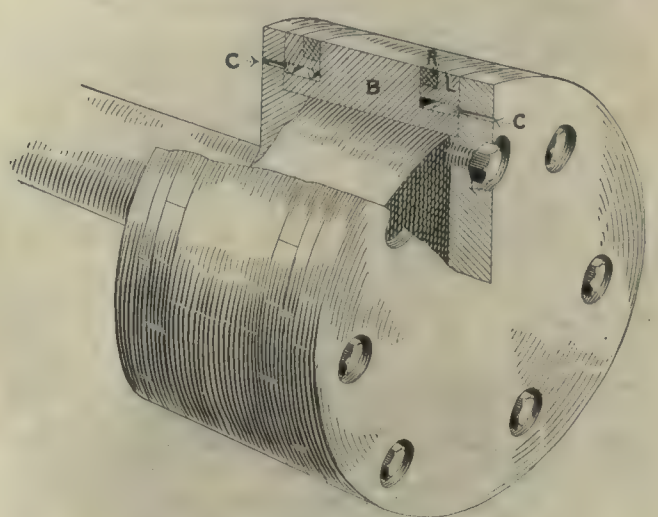


FIG. 2. DUNBAR PISTON PACKING

* * * There was lots of friction in this kind of packing and it wore the cylinder terribly, but the sawmill man, seeking to get his mill into running order again, would hesitate a long time about paying Port Holcomb a hundred dollars to rebore the cylinder, and furthermore he believed the cylinder was all right anyhow and he didn't want to go to the trouble of unbolting it from the bedplate and hauling it a hundred miles to the shop. Wasn't there some kind of packing that would be all right in this cylinder?

* * * Now here is where Porter Holcomb shone, for he was ready to take the sawmill man's order for Dunbar packing, especially on Port's recommendation that it would accommodate itself to a worn cylinder. And Port would get out this Dunbar packing, even if he was only a molder. I have turned out lots of Dunbar packings myself and always look at it as a pretty fine job of lathe work, but it had no terrors for Port.

* * * I suppose every man who has worked in a railroad shop knows all about Dunbar piston packing,

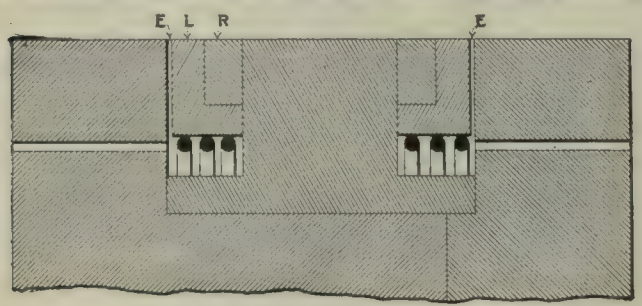


FIG. 3. CLOSE VIEW OF DUNBAR PACKING

but I will take occasion to explain to the uninitiated that it is a metallic packing composed of a lot of segments pressed out to the cylinder by steam pressure underneath the segments, the piston being provided with a set of the rings at each end, one ring to take steam pressure while the piston goes in one direction and the other ring to take steam pressure while the piston goes in the other direction.

Here, in Fig. 2, you have a general picture of the thing with its two rings, each ring composed of a pair of rings sawed up into segments breaking joint. *B* indicates the junk ring with the packing rings at each side of it. Each packing ring is composed of an *L*-ring and an *R*-ring. Rings of spring wire are disposed within the packing rings to keep them out to the cylinder, the main packing effect being produced by steam let inside the rings through the small holes *C*.

* * * Fig. 3 shows the packing full size, and Fig. 4 shows a pair of the *L* and *R* segments. One of the joints straddles pin *D* to keep the segments in proper order, and the backs of the *L* segments are provided with grooves *E* to let the steam behind the packing so as to press the faces of the *L* and *R* rings up against the junk ring.

* * * This description of Dunbar packing is an old story for engine men, but I am particularizing the description for the purpose of showing how Port Holcomb would master the job. He would give the sawmill man a piece of wire and explain to him how he was to cut off that wire and file its ends so that it would rub exactly the bore of his cylinder just inwardly beyond the counterbore. And the sawmill man would ride away to his mill and would come back with the old piston and its rod and with the wire, which he said showed the diameter of his cylinder to a gnat's heel. And then Port would proceed to make the new packing.

* * * Anyone who has had experience with Dunbar packing knows that you not only have to have things the right size but that there is considerable skill involved in assembling the parts in the cylinder. You put in the spider, but not the junk ring or the follower, and then you carefully build up the first packing ring and put the wire springs inside of it. Then you slide the junk ring into place, after which you proceed to build up the segments of the other packing ring and put the wire springs inside. Then you bolt the follower to place and the job is done.

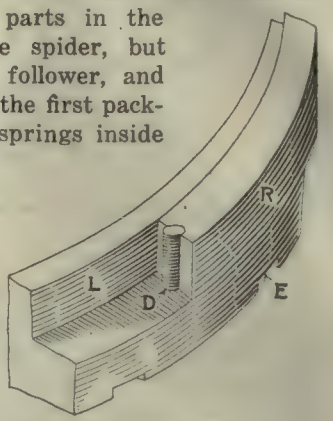


FIG. 4. L AND R SEGMENTS

* * * Now it would be utterly beyond the original capacity of the sawmill man to build up one of these pistons, but Porter Holcomb would save him the trouble. He would have a tinner make a tin hoop which would go around the piston, and Port would carefully surround it with bags and send the sawmill man home with instructions to poke the piston rod into the cylinder, letting the tin hoop into the counterbore, whereupon the piston was to be slid out of the hoop and completely into the cylinder.

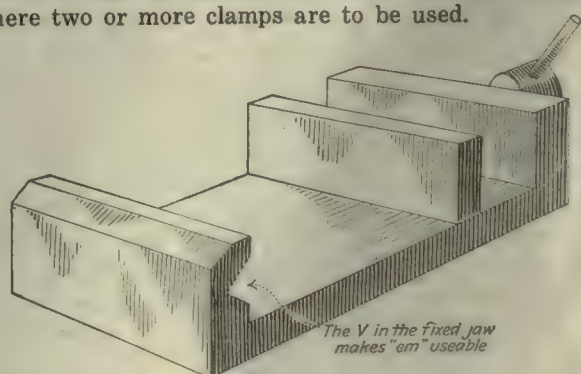
* * * Port furnished a number of Dunbar piston packings in this manner, and so far as I know they did their business all right. I remember the case of one chap who fell down on the job and got the tin hoop off of the piston before he got the piston into the cylinder, the result being that the whole of the packing fell into pieces and made a mess like a mouse's nest. The chap came back to the shop with the pieces, and he had to come about fifty miles, and thoroughly mastered the manner in which this packing was to be put together.

Very respectfully, CHORDAL.

Kink in Toolmaker's Clamps

BY FRED W. STALKER

A trouble-saving little kink in connection with toolmaker's clamps is shown in the sketch. The V in the fixed jam enables one to line up round work readily, the advantage being especially noticeable on long pieces where two or more clamps are to be used.



HANDY CLAMP FOR TOOLMAKERS

Disability Under the Compensation Acts—III

By CHESLA C. SHERLOCK

The meaning of permanent total disability is a fertile cause of legal controversy. The question as to whether a workman shall receive total-disability compensation for the loss of a second member is difficult to answer, particularly when the losses occurred while he was working for different employers. The spirit of the Compensation Acts must be considered as well as the bare statement of the statutes, and also the fact that the burden on the employer is only temporary, eventually being shifted to the consumer.

DISABILITY is in one sense always permanent, being divided into temporary, partial and total. We have already considered the first two classes and will now consider disability in the sense that it is permanent and total.

To say that a disability is permanent and total is to infer that the workman has lost 100 per cent. of his efficiency as a worker. It must be kept in mind that this complete loss of efficiency is in relation to his employment at the time of injury and not in relation to himself as an individual.

In considering other classes of disability we have found that earning power may or may not be the controlling factor in determining the workman's right to compensation. This is likewise true in the case of permanent total disability. It simply means that the workman has been deprived of his ability to earn a living in that particular employment in which he was engaged at the time of the injury. As an individual he may not in fact be actually deprived of his usefulness to earn money in other callings.

Too often confusion arises in cases of permanent total disability, employers being of the opinion that no workman is entitled to compensation on this basis unless he is unable to earn any portion of his livelihood in the future.

Permanent Total Disability

Permanent total disability is a condition which necessarily must be proved by the facts in the case, although it may in many instances arise by presumption of the law itself.

Thus the loss of both eyes is presumed in most of the states to amount to permanent total disability, as well as the loss of both hands, both feet, both arms, both legs, etc. It should be kept in mind that this loss must ordinarily be sustained as the result of the same accident and not as the result of separate accidents.

In this connection some of the hardest fought principles under the compensation acts are brought about. Suppose a machinist while working for one employer loses one eye. That employer pays him compensation accordingly, and at a later date, while working for another employer, the workman sustains another accident which deprives him of the sight of the other eye. The question arises as to whether this workman is entitled to receive compensation for permanent total disability from the second employer, or merely for the loss of one eye, which is generally rated as permanent partial disability.

This question of the loss of the second eye has probably caused more contention in the courts than any other disability question. The courts are slightly divided, some holding that the workman is entitled to permanent total disability benefits, while the majority of the courts hold that he is entitled only to compensation for the loss of one eye.

In California the commission considered one of the cases and came to the conclusion that the employer causing the loss of the second eye was liable not for both eyes, but merely for one. The commission felt that if it were to make a ruling to the effect that the loss of the second eye would entitle a workman to compensation as for the loss of both eyes it would work an injustice on one-eyed workmen within the state, the idea being that employers would refuse to employ such workmen in the future if the loss of the second eye was to impose permanent total disability liability upon them.

Massachusetts Supreme Court Decision

In Massachusetts the Supreme Court adopted the contrary view, holding that if a one-eyed workman was able to do the work of an able-bodied man that he "had the capacity which enabled him to do the work for which he was hired," and since the loss of the eye terminated that degree of capacity then the employer, having been responsible in the spirit of the law, should bear the loss.

This latter opinion seems to be founded on justice when the condition of the workman is considered in view of the evident spirit of the compensation system. True it is that an unequal burden is imposed on the employer causing the loss of the second eye, but it is the evident intention of the compensation acts to award permanent total-disability benefits to a man who loses both eyes in industrial labor. The mere fact that he is unfortunate enough to lose his eyes in separate accidents should not operate to deprive him of the benefits intended to be conferred upon him.

The burden on the employer is of course only temporary, as it is the theory of the compensation acts that the costs of industrial losses under the system shall be borne as a part of the cost of production and ultimately fall on the ultimate consumer, as they do.

In some instances this liability is directly imposed on the employer causing the second loss of a member by the statute itself, and as the situation becomes more and more noticeable it is safe to say that the liability will be imposed in most of the states.

In Iowa a ruling was handed down to the effect that a workman having only one eye and losing it was entitled to more compensation than a workman with two good eyes, but that he was not entitled to as much as he would have received had the eyes both been lost in a single accident.

Michigan sustains the California view, holding that if a workman sustains an injury which, considered in view of a previous injury, amount to permanent total dis-

ability but is partial itself the employer is liable only for the payment of partial-disability compensation.

West Virginia, however, agrees with the Massachusetts view, the commission of the former state granting life compensation to a workman losing the second member.

In New York the court followed the Massachusetts decision. The case was where a workman lost his second hand. The court said that there was a presumption that he had been forced to work at a reduced earning capacity because of the loss of the first hand and that to say that he was entitled only to the compensation which a man with two hands would receive for the loss of his first hand would be to place him at a double disadvantage and that he would only get about half as much compensation for an injury which was doubly important to him.

The legislature, however, after this decision, amended the New York law so that the compensation payable for a second injury is limited only to immediate effects and not to combined effects. The inference is that New York would allow a workman suffering the loss of a second member only compensation as suffering a permanent partial disability and not as suffering a total disability.

Effect of Intervening Causes

The permanent total disability can arise only from the consequences of the original injury and not from the consequences of any intervening act either on the part of the workman or of the physician who treats his injuries. In Kansas it was shown that a workman's total disability was the result of the malpractice of the physician furnished the workman by the employer and not the result of the accident. The court held that the workman was not entitled to recover compensation for permanent total disability from the employer as the disability was not the result of the accident, but the result of an intervening cause.

It is extremely doubtful, however, as to whether this decision would obtain, so far as it related to the physician, in all jurisdictions. The employer is bound by the clause in the acts to furnish competent medical aid, and it is generally held that if he fails to do this that he must be liable to the workman for the damage done. It is clear in either case, however, that the workman's right to maintain an action for damages against the employer for furnishing incompetent medical aid at common law is not impaired in the least by the acts.

The subject of preëxisting condition has already been treated in these columns, but it is worth while to recall some of the provisions stated therein in this connection. If an accident overtakes a workman and causes him to sustain a permanent total disability which he would not have sustained had he been in good physical condition he will be entitled to compensation for permanent total disability without regard to his preëxisting condition. The test of a workman's capacity is this: Was he able to do the work of an able-bodied man? If so then his preëxisting condition cannot be taken into consideration, although it may be so pronounced that only a minor injury would cause complete loss of earning power to him and entitle him to compensation for permanent total disability.

This is the rule practically everywhere, and while the courts have been disposed to draw sharp distinctions in the case of loss of second members and impose liability on employers in many of the states only for permanent partial disability they have not drawn any such distinctions in the case of preëxisting condition.

The New Jersey court, however, overruled the preëxisting condition rule in the case of a workman aged 73 years who had suffered a broken leg. It was shown that because of his age the bones refused to knit and he was actually permanently totally disabled. The court, however, granted him compensation only for the loss of the leg and not for permanent total disability.

If the permanent total disability is due to any fault of the workman himself arising after the accident took place he cannot receive compensation for such wrongful act of his own. This rule is particularly noticeable in cases where the workman refuses to accept the medical aid offered him by the employer, but persists in following his own remedies or in consulting incompetent or "quack" doctors. If such persistency on his part aggravates the original injury to such an extent that it causes permanent total disability the loss will be that of the injured man and not that of the employer.

If an operation will remedy the disability and change it from permanent total to partial total it is the duty of the injured man to submit to such operation if offered by the employer, provided it will not endanger his life. His refusal will entitle him only to compensation for the probable length of time spent in the hospital and then for the partial disability which would result from the operation if successful thereafter. If the operation will restore him completely to his former earning power in his employment he will be entitled, upon refusal to submit, only to such compensation as will cover the probable length of time he would spend in the hospital and in recovering from the operation.

Benefits for Total Disability

The benefits payable for permanent total disability vary in the different states. Some make a flat award based on a percentage of the workman's average wage extending over a period of weeks, generally 400. Others base the payment on the pension system, and others on a flat rate for life.

The average benefit, however, for permanent total disability is for eight years' compensation determined according to the workman's prior wages in his employment. Often this has no reference to the workman's expectancy of life, sometimes being considerably less and sometimes considerably more.

In Wisconsin under the law a workman received compensation for more than six years, although his expectancy at the time of the award was less than four and one-half years. In cases where the workman sustains permanent total disability in his youth his expectancy of life is of course often greater than the period over which compensation is to be paid, unless he lives in a state where the award is for life.

In this connection it is well to note that the expectancy of a workman permanently totally disabled is not ordinarily that of an able-bodied man and the majority of them do not survive their awards. In the case of a loss of both hands, eyes or feet, or where the disability is presumed by law, the workman often survives his compensation benefits.

Where the workman dies before his term of compensation payments are up some interesting questions arise. If death is due to the injury the dependents of the workman, if any, are entitled to death benefits less any compensation already paid. If the death is due to natural causes and is not the result of the original injury the compensation payments will cease on the death of the workman, unless the fixed award for the permanent total disability is held by the court to be a vested right in the estate of the workman. Then the remainder due would be payable to the workman's estate.

The Purpose of Compensation

Where a workman dies leaving no dependents the payments will cease on his death and ordinarily they will not be held to be vested rights in his estate. The purpose of compensation is not indemnity or benefits as under ordinary insurance. It is to share the loss of earning power or efficiency with the workman or his dependents. No beneficiaries are recognized under the compensation acts, unless they be actual or presumed dependents of the deceased.

The question of what is permanent total disability outside of those cases presumed by the law itself which we have already considered is a question of fact to be determined by the facts surrounding each particular case. It is not necessarily a fact to be determined by the jury.

In California a workman came in contact with an electric current and sustained permanent complete disablement of the right arm, shoulder, hand, a spinal deformity, together with complete loss of motion of spine, shoulder, hand, neck, limited motion of the right leg and distortion and lameness in both feet. It was held that he had suffered 100 per cent. permanent disability. And in another California case where a workman had suffered paralysis of the body from the waist down, including both legs, which was permanent, it was held that he had sustained 100 per cent. permanent total disability.

In Connecticut it was shown that a workman had no useful vision for his work but that he could count figures at a distance of two feet. The court refused him compensation for permanent total disability, but allowed it for partial disability.

In Massachusetts a workman suffered the loss of an arm, due to amputation, and on evidence that he was unable to carry on his work and that another operation was necessary to treat extreme sensitiveness of the arm it was held that he was totally incapacitated from work and entitled to compensation upon that basis.

In another case a workman sustained the entire loss of vision in one eye and 95 per cent. loss in the other. The court held that he was entitled to compensation for permanent total disability on a showing that he was unable to carry on his work. This in spite of the fact that the law generally specifically provides for loss of vision in "both eyes" if permanent total-disability benefits are to be paid.

On the whole, disability defines the actual amount of compensation for which an employer is liable after it is found that the accident causing the injury comes within the coverage of the acts. It is the first instance where the practical operation of the law comes into operation after the theoretical liability has been determined.

In our discussion of this subject we have found that there are three great classes of disability:

1. Temporary—where the workman is for the time being unable to carry on his work. It generally dates from the time he is injured until his earning capacity is restored to him. It may be either total or partial, but it is very seldom total, especially when the workman can by reasonable diligence earn a living.

2. Partial—where the workman has not permanently lost his earning power, but has suffered a partial impairment of his efficiency. These disabilities are generally permanent in character, and a workman is entitled to compensation for them according to the schedules without reference to his earning power.

3. Permanent or total—where the workman's earning power in his trade or calling has been completely destroyed. This may arise by presumption of law, as in the case of the loss of two members by the same accident or it may arise from the facts in the case.

A Universal Guard for Milling Machine Cutters

Special Correspondence

The guarding of milling cutters in operation is a difficult problem, owing to the conditions under which such cutters work. In designing a guard for this purpose provision must be made not only for setting and removing the work but for introducing oil or cutting compound in sufficient quantity and for the necessary clearance space for chips. It must be adaptable to all sizes of cutters and all classes of work within the range of the machine, must not interfere with any fixtures that may be used, and must make it practically impossible for the operator's fingers to come in contact with the cutter. In addition to fulfilling all these requirements it is usually desirable, if not essential, that the work at the point of cutting be visible throughout the milling operation.

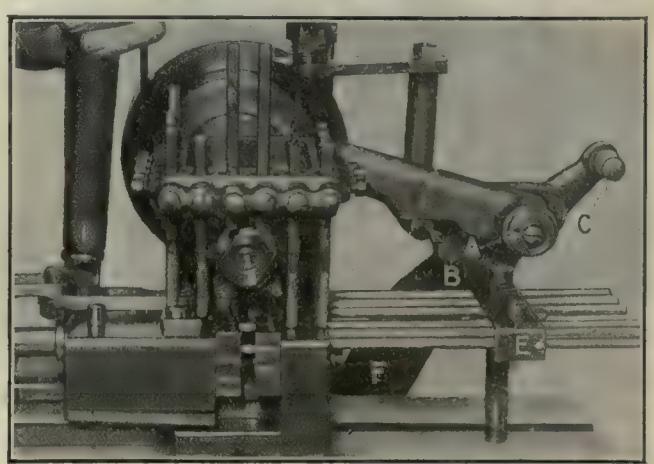


FIG. 1. CUTTER GUARD CLOSED

An interesting guard of the universal type, embodying novel features, is shown in the illustrations. It accomplishes the object set forth above, and it is so constructed as to be adapted to service on any class of milling machine where a safeguard is desired. By

a slight modification in the supporting bracket it may be suited to any size or type of milling machine and the guard may be proportioned for any size or form of cutter. It may be adjusted to accommodate any shape of work within its range and yet close the point of cutting against possibility of fingers or clothing being caught.

Method of Attaching

Figs. 1 and 2 show the guard attached to a hand-milling machine in both the closed and open positions. The supporting arm swings about the stud *A*, the guard being supported at the right height by the pin *B*. To remove it for the purpose of changing cutters it is necessary only to lift or swing the guard about the stud *A* until the arm rests against the pin *C*, where it is held by gravity until the operator is ready to again lower it to the closed position.

From the illustrations it will be seen that the guard consists of a slotted frame carrying a series of small rods which project downward to inclose the cutter and

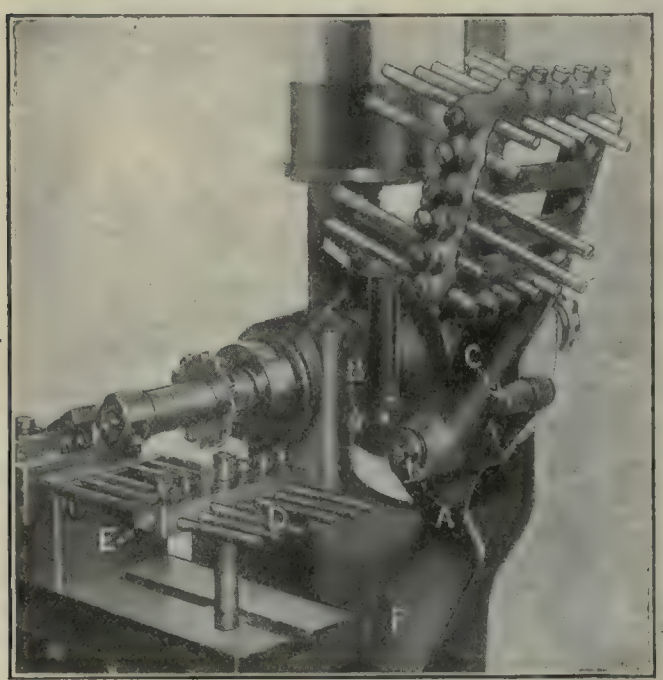


FIG. 2. CUTTER GUARD OPEN

work, the frame being cast integrally with the supporting arm. The rods are ¼ in. in diameter and spaced on ⅝-in. centers, so that the opening between them is but ⅜ in. They may be adjusted vertically to conform to the shape of the work and the fixture in use.

In the size illustrated there are six of these rods on each of the three sides of the guard. The bottom is guarded by a set of rods *D* carried horizontally in a holder *E*, which is fastened in the T-slot of the machine table. Thus the two portions of the guard form a complete fence around the cutter. The horizontal rods under the cutter are set to contact with the back of the vise, leaving no opportunity for the workman to get his fingers in contact with the cutter from this side when loading the fixture.

Notwithstanding the complete inclosure of cutter and work when in operation there is no interference with the setting or removal of the work; the cutting is always under observation and the work is as fully open to lubrication as if it were being done in the customary unguarded manner.

The bracket *F*, which attaches the guard to the milling machine, is so adjusted that the center of the pivot for the swinging arm comes slightly above the cutter arbor, and a slot at the point of attachment allows a certain amount of adjustment for the frame to suit the machine upon which it is used. The bracket also has a projection for attaching an oil cup.

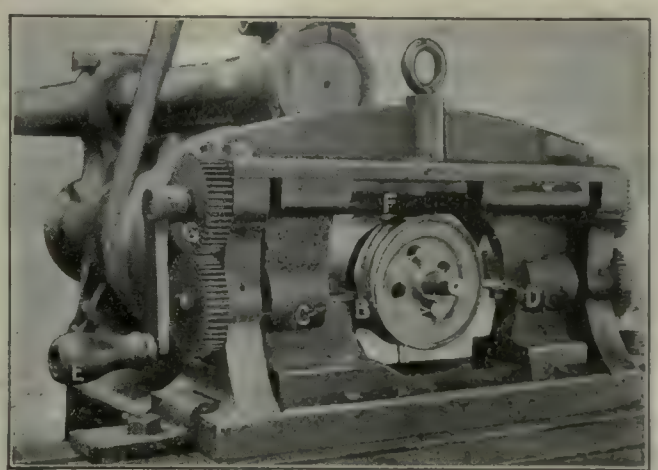
The guard is the invention of J. B. Holden of 14 Gifford St., Syracuse, N. Y.

Fixtures for Turning Grooves in Trolley Wheels

By J. Wright

The economical production of trolley wheels is an important factor in the large electric-railway systems, and the device which is illustrated herewith is one that has been developed by the Chicago Surface Lines to facilitate this work. It is designed to clamp onto the table of a milling machine, and when it is brought into alignment with the spindle the table is locked in position. The work-carrying device is a special head which screws onto the spindle of the machine.

In the illustration a wheel may be seen on the stud *A* which passes through the hole in the hub of the wheel.



FIXTURE FOR TURNING GROOVES IN TROLLEY WHEELS

A nut screwed on the threaded end of this stud tightens the work firmly in position. Two studs *B* passing through cored holes in the web of the wheel do the driving.

The tool bits *C* and *D* are carried on slides which are mounted on opposite sides of the fixture and are fed to the cut by turning the crank *E*. This turns the shaft *F*, which is geared to right and left hand screws operating their respective slides.

It is an easy matter to adjust the cutting tools to balance the cut, as the operator needs only to move the milling-machine table sufficiently in one direction or the other to accomplish this result. Consequently in sharpening these tools the matter of readjustment in replacing them is a minor consideration.

The fixture is quite heavy and an eyebolt is provided so that a crane may be used for lifting it on and off the machine. With this device the operator is able to turn the grooves of about 55 trolley wheels an hour.



Forming an Electrical Contact Plug

By Otto Vogetzer

The plug shown in Fig. 1 is used in conjunction with the rheostat that is shown in Fig. 2 for the purpose of controlling the intensity of light used in a machine for printing motion-picture film. That the reader may understand the function of the plug it will be necessary to go somewhat into detail in reference to the operation of the rheostat.

Under the printed card seen on the face of the rheostat are 18 copper bars insulated from each other and each having 21 holes for receiving the plugs. The cards serve merely as a guide for placing the plugs and are pierced with holes in accordance with the intensities of light required for printing the successive scenes of their corresponding film. Leads from these bars are connected through progressive steps of the resistance coils to the lamp used in the printing machine and thence to one side of the electric circuit, while the other side is connected to the movable brush bar to be seen at the right of the rheostat near the top.

The brush bar is hinged at this point to close across the face of the rheostat, where it is latched in place on the opposite arm of the lever, at the point which is adjacent to the indicating pointer to be seen at the left.

When the brush bar is in the closed position it may be moved downward over the face of the rheostat, contacting successfully with the plugs which have been placed in accordance with the chart. Thus if we wish to print scene No. 1 with light No. 4 and scene No. 2 with light No. 10 we place a plug in the corresponding holes, and so on down until all the scenes in the roll of negative film are provided for. We are then ready to make any required number of copies, the plugs remaining in their respective places until all are finished.

The dropping of the brush bar is controlled by the negative itself and is raised by means of the handwheel on the left after each copy.

From the foregoing it will be seen that the plugs must be easily removed and yet be sufficiently tight to prevent working loose when the brush bar passes from one to the other.

The plugs, a section of which is shown in Fig. 3, are made of 0.016-gage brass in four operations, the first being done with the combination blanking and drawing die

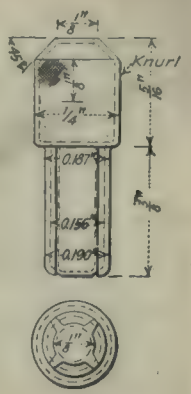
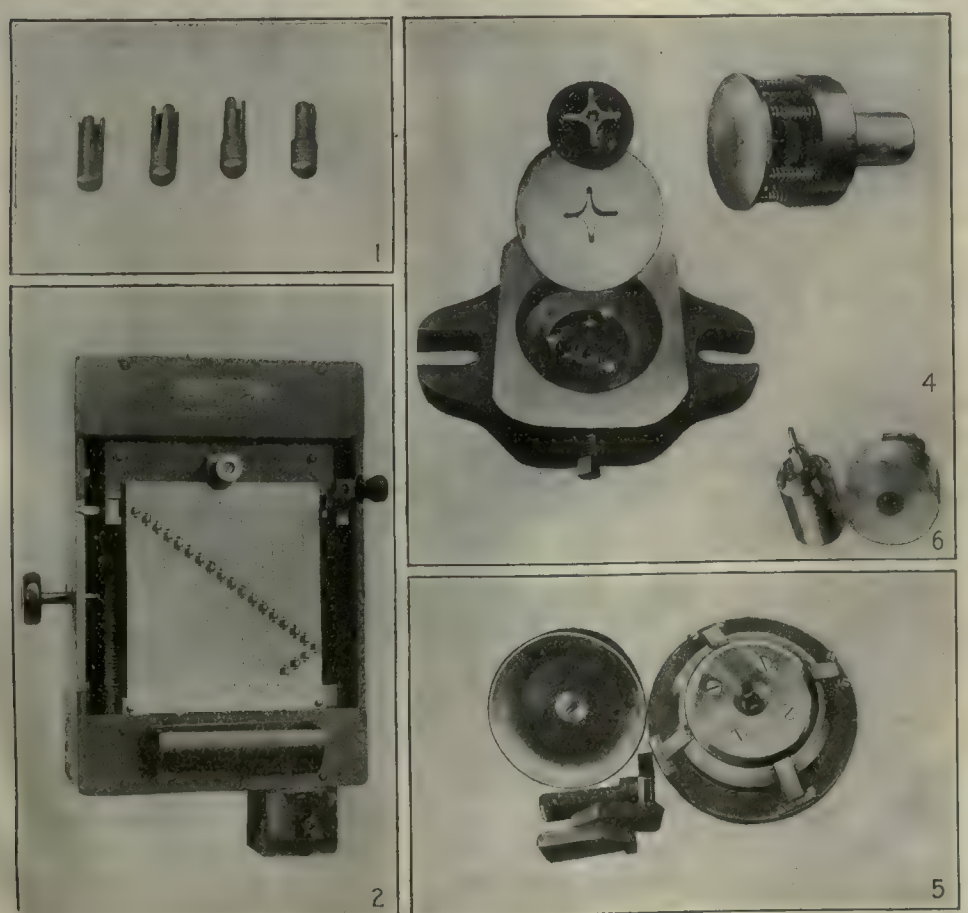


FIG. 3. SECTION ENLARGED



FIGS. 1, 2, 4, 5 AND 6. MAKING A PLUG FOR A RHEOSTAT

Fig. 1—Sequence of operations on plug. Fig. 2—The rheostat showing brush bar open. Fig. 4—The blanking and drawing die. Fig. 5—Tools for closing in and knurling. Fig. 6—Final closing tools

in Fig. 4. As the punch descends into the die a blank is punched out and drawn up by the drawing die which is in the center of the punch.

On the upstroke the shell is ejected by a spring-operated plunger. The blanking die is given very little clearance, which tends to keep the blank central, so that the four spring prongs may draw together evenly.

The second operation consists of knurling the shell, which is accomplished by means of four sliding jaws in the fixture shown in Fig. 5. These jaws are closed in simultaneously by the conical recess in the punch, a mandrel preventing the shell from being crushed.

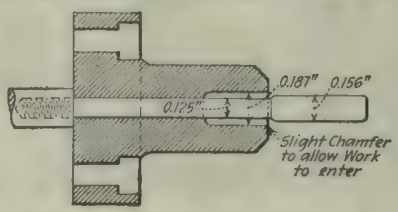


FIG. 7. SECTION OF CLOSING PUNCH

The third operation consists of partly closing in the four prongs. The same fixture is used as for the knurling operation, the knurling jaws being removed and another set is inserted having the same radius as the small end of the plug. The punch carries a mandrel in the center equal in diameter to the inside diameter of the plug. When the punch descends the mandrel enters the shell and the jaws close in. On the upstroke the shell is carried up by the mandrel and is easily stripped off by hand.

For the fourth operation the shell is placed in the die, Fig 6, the bottom of which has the shape of the head of the plug. The punch descends, forming shoulder and closing in the end. The work is ejected from the punch by the spring-operated plunger in the center.

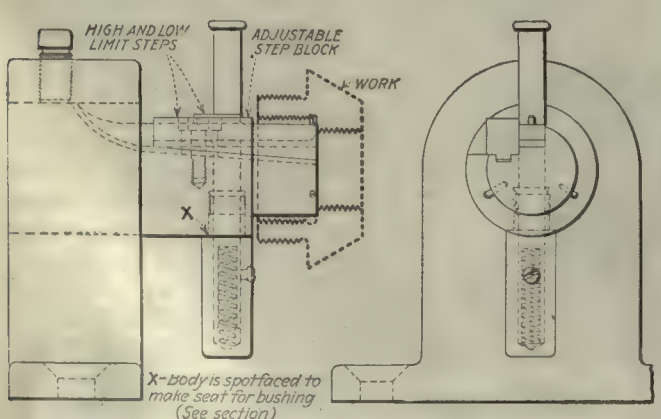
A section of the punch is shown in Fig. 7.

Gaging the Recess at Bottom of A Tapped Hole

By Daniel G. Meikle

Having had a number of pieces rejected by reason of variation in the diameter of the recess, or undercut, at the bottom of a tapped hole, said recess being merely clearance for the tap, we were obliged to devise some sort of gage which could be used by the women inspectors to keep tabs on this important [?] point.

We considered first an indicating gage to be slipped into the undercut, but as it seemed especially desirable to keep away from all delicate construction this idea was discarded and a special gage as shown in the cut was built.



GAGE FOR TESTING DIAMETER OF UNDERCUT

A sliding piece, provided with a point small enough to enter the undercut, two steps and a finger button, was set into a round block carrying two fixed points, the three points being set at 120 deg. to each other. An adjustable block sliding in a groove on a taper was fastened to the round piece by a screw in a slot in the block.

The points were set by a ring having an inside diameter equal to the high limit of the required recess and one step of the gaging piece ground flush with the block, after which the points were set by another ring equal to the low limit and the other step ground.

In use the gage was held in a cast-iron bracket screwed to the bench. The sliding piece was pushed down by the forefinger of the left hand and the work set over the pins with the right hand. The sliding piece was then released and the spring brought the points into contact. A glance at the steps on the gage showed at once whether the undercut was too large, too small or correct. The operation was very rapid and nothing on the gage was of delicate construction.

Every morning the master ring was slipped onto the pins, and if the pins were worn so the steps did not line up with the block the block was moved up the taper until it was flush and again tightened. The gage was thus always kept perfect without removing it from the bench.

Gaging Devices for Chasers

By J. B. Smith

In the manufacture of chasers for use in self-opening die heads it is necessary to hold them to extreme limits of accuracy to insure absolute interchangeability for quick replacement, when the occasion demands. Some of the gaging devices used for the inspection of these at the plant of the Modern Tool Co., Erie, Penn., are shown in the illustrations.

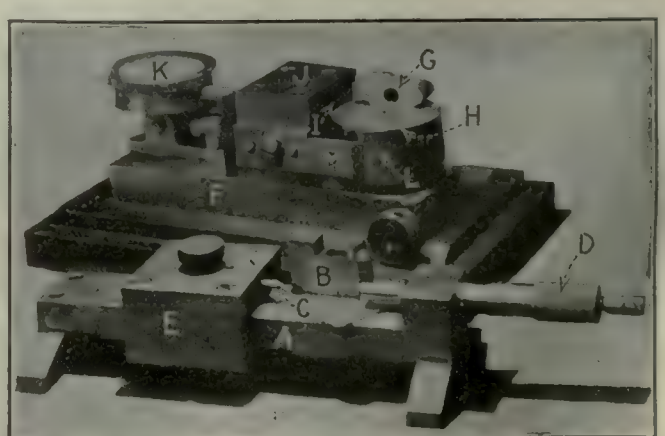


FIG. 1. DEVICES FOR GAGING LENGTHS AND CLEARANCE OF CHASERS

The length is gaged by means of a device shown at *A*, Fig. 1. The length of the blank *B* is measured from the bottom of the thread to the round end opposite. The chaser is therefore stood about in the position indicated in the illustration, but so placed that the cone point *C* on one end of the gage will fit into the root of the thread. A set of chasers is gaged for uniformity by means of the micrometer sleeve *D*. The block *F* is ad-

justable for different lengths of chasers and a reading is taken first from a master block when starting to gage sets of corresponding size.

Chasing the threads is done in a manner to provide clearance for cutting, and this clearance must be a specified amount in a given distance across the thread face. The gage shown at *F*, Fig. 1, determines whether this clearance has been cut correctly.

The chaser *G* is placed in the position shown on the polished top of the circular disk *H*, and pressed tightly against the right-hand face of the block *J*, so that the projecting lug *I* comes in contact with the face of the

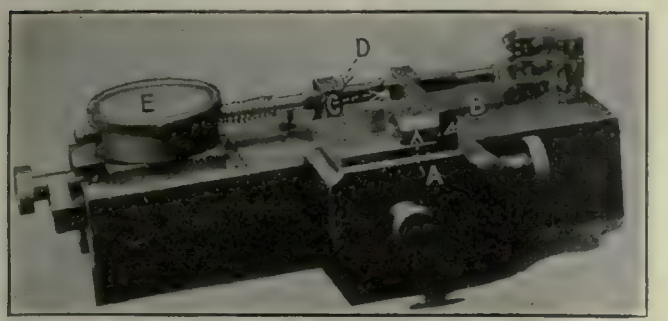


FIG. 2. GAGING RELATIONSHIP OF PIECES OF A SET OF CHASERS

thread. The pressure forces back the lug *I* until the outer corners of the thread come into contact with the face of the block *J*, the movement being gaged in thousandths by the dial gage *K*.

When making this first reading the dial indicator is set to read zero. The block is then turned upside down to bring the other flat face on the table and again pressed against the indicator. The difference between the two readings shows the clearance of the threads.

As this clearance will be variously proportioned to different sizes of chasers as they increase in thickness an adjustment has been provided so that the table *H* may be raised and lowered. Its height is observed from the relation of the line *L* to the scale on the outer end of the projecting arm *M*.

These chasers must also be checked to insure that each set of four has been so made up and consecutively numbered that each chaser is exactly 90 deg. from the preceding one. This is checked by means of the device shown in Fig. 2. The chaser *A* is pressed against the shoulder *B* and the position of the thread located by the pointer *C*, which is provided with a ball end that fits into the thread. The pointer *C* is attached to the rod *D*, which operates the dial gage *E*.

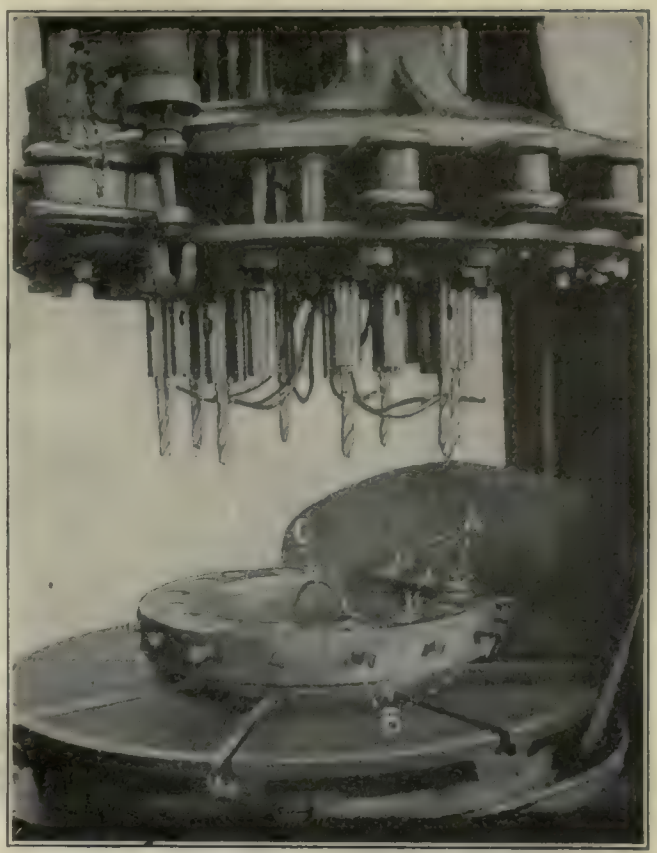
The reading of No. 1 chaser is first set at zero on the dial and the remaining three chasers are then successively gaged in the same manner. A chart which is furnished the operator indicates the thousandth variation which should be found in the successive chasers of each set of any one size.

A Simple Drilling Jig for Bushings

By E. V. Allen

In the Chicago shop of the Northwestern R.R. link bushings are drilled 16 at a time in a multiple-spindle drilling machine.

The jigging device consists of a large cast-iron disk, with holes like *A* in it slightly larger than the bushings. The bushings are slipped into these holes and locked by



A DRILLING JIG FOR BUSHINGS

means of setscrews like those shown at *B*. The handle *C* is provided to lift the jig off the table after the clamping bolts are removed, leaving the table clear for other work.

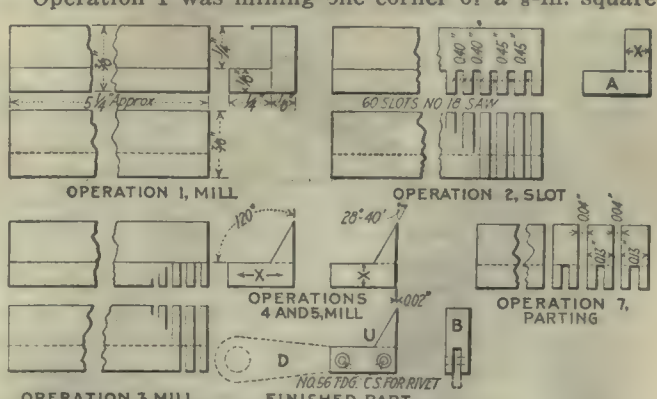
Experimental Production of Actuating Pawl

By Fred W. Stalker

The part here shown was used to actuate a coincident member at regular intervals, the timing of which was to be as accurate as practicable. The cam, or ratchet wheel, which the pawl engaged, was the driving member, turned and milled from No. 12 sheet steel, the teeth being polished before removing the parts from the arbor. The usual practice of leaving the ratchet wheel soft and hardening the pawl was followed.

The method used in machining proved quite satisfactory, leaving nothing to be desired either from a production standpoint or in uniformity and accuracy.

Operation 1 was milling one corner of a $\frac{3}{8}$-in. square



OPERATIONS IN PRODUCTION OF ACTUATING PAWL

cold-rolled blank, as shown in the illustration. The X double arrow indicates the portion held in the milling vise and the direction of the jaw pressure. The length of blank stock was approximate for the number of parts required, covering a possible loss in manipulation.

Operation 2, slotting, was a factor which governed the dimension 0.045 in. This was arbitrary and was selected to provide an even figure on the feed-screw dial. The slot 0.040 in. received an 18 B. & S. sheet-brass arm. A sheet of heavy paper was placed between the work and the top of the fixed jaw of the vise to allow the cut to go through without touching the jaw. A table of figures showing the set points for each cut was made to correspond with the dial on the cross-feed screw as follows; 85-170-5-90-175-10-95, etc. (the basic figure 85 is the sum of thickness of the cutter and the stock left between the slots).

The table is used in operation 7 by setting the dial at the second, fourth and sixth figures, etc.

Operation 3. Mill 120-deg. angle.

Operation 4. Mill 0.020 in. cut.

Operation 5. Mill 28-deg. 40-min. angle.

Operation 6. Carefully file and polish both angular faces to remove the tool marks. This provides the proper condition for contact with the ratchet-wheel teeth.

Operation 7. Parting (see operation 2 for use of table of figures).

Operation 8. After cleaning and drying, grain the sides (parting cut) on a fine lap wheel, afterward break all the corners with a No. 6 pillar file, care being taken not to touch edge *B*, which has been rounded slightly in operation 6.

Operation 9. Drilling. The jig for this operation was designed to locate the pawl with reference to the angular faces.

Operation 10. Countersink holes for rivets.

Operation 11. Caseharden.

Operation 12. Oil-stone face *C*.

In assembling with arm *D*, wire brads were used, and lapped flush with the surface.

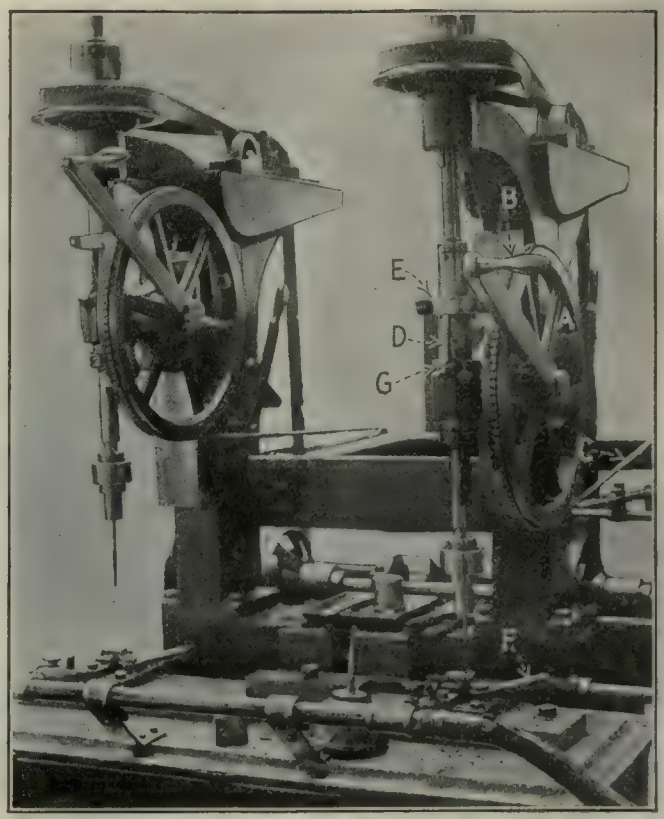
Weight-Regulated Feed for Drilling Machine

By J. V. Hunter
Western Editor *American Machinist*

Numerous devices have been noted from time to time for regulating the feed of high-speed sensitive drilling machines by means of pressure-feeding devices. An arrangement of this type, shown in the illustration, is in use in the plant of the Modern Tool Co., Erie, Penn.

The heavy wheel *A* has been placed on the shaft of the spindle pinion. This wheel has a handle *B* for lifting the spindle or starting the stroke as desired. The pressure of feed of each spindle is regulated by means of a weight suspended at the back of the machine. This weight acts through the flexible-steel chain *C*, which passes partly around wheel *A* and over a small pulley at the back of the machine.

After drilling a hole the operator takes the handle *B* and raises the spindle until the small dog *D*, which is controlled by a spring, snaps into place under the collar *E*. This holds the spindle up while the operator removes the work from the quick-action jig *F* and replaces it with another piece. When ready he releases



WEIGHTED FEEDING DEVICE

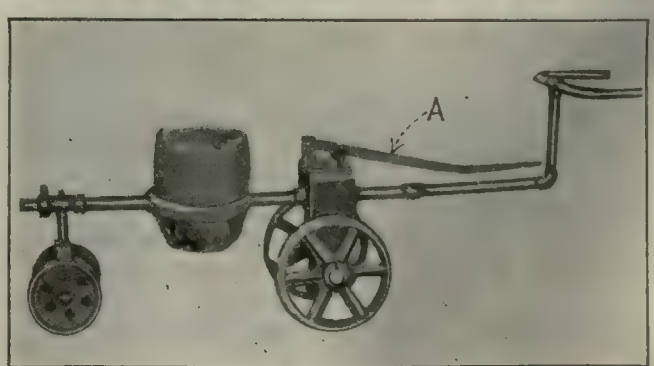
the spindle by pressing the release lever *G*, which trips the dog *D* and allows the drill to feed down. The pressure of the feed is regulated by the amount of weight hanging on the chain. The feed continues until the stop collar on the spindle sleeve reaches the top of the bracket. The operator runs two machines, and loads one jig while the piece in the other jig is being drilled.

A One-Man Crucible Truck

By E. A. Thanton

The general rule in a brass foundry is to employ two men to handle a crucible while pouring molds. Where the floor is in good shape a truck similar to the one shown may be used to advantage.

This is in use in the Northwestern R.R. shop in Chicago, and with it one man can easily handle a crucible after it has been placed in the truck cradle, as shown. A latch operated by the lever *A* keeps the crucible upright until the operator is ready to release it and pour a mold.



A ONE-MAN CRUCIBLE TRUCK

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

Shop-Production Diagrams

By Howard S. Rich

An efficient method of keeping tabs on the daily output of each department and the shop as a whole was faithfully worked out recently in a large industrial plant and gave some timely results. The effects were immediately shown by the extra efforts made by the backward departments as their sluggish ways were exposed every day to the other foremen who attended the executive meetings. For pride's sake a department that persisted in allowing work to lag behind the general average is urged to speed up to a level with the better work of the other departments and this generally has its good effects.

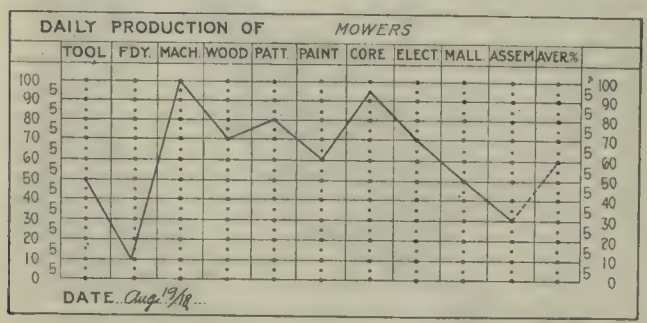


FIG. 1. DAILY BLACKBOARD DIAGRAM

The noonday meeting affords a good opportunity to assemble and tabulate the progress of work. An efficient clerk who takes full charge of the foremen's reports is in attendance and quickly calculates the necessary percentages. The results are shown on a blackboard, Fig. 1. Small cards, Fig. 2, for the daily production of any line of work in all departments are supplied to the foremen and between 11 a.m. and 12 m. these cards are hastily filled out, showing the approximate results of material in work up to the noon hour of each day. Regardless of the quantity of any particular article wanted the cards merely show the percentage of the work done on it.

The procedure is as follows: The foremen of the whole plant are informed of the line of data wanted and all parts pertaining to this line are looked up after 11 a.m. and listed. Thus, if at the next meeting the production of mowers is to be considered, all parts of mowers in work are tabulated in percentage and the clerk places each department's percentage on the blackboard. The result of this line of work throughout the plant is obtained by striking the average of all the percentages in a separate column, the outcome of which is instructive to all from the manager down to the slowest foreman. This diagram shows just who are behind and to what degree, and the slow ones are thus given an opportunity to speed up their departments during the afternoon and if necessary work overtime for good reasons. The graphic production line has been found very uneven at times, which proved that the departments were not pulling together.

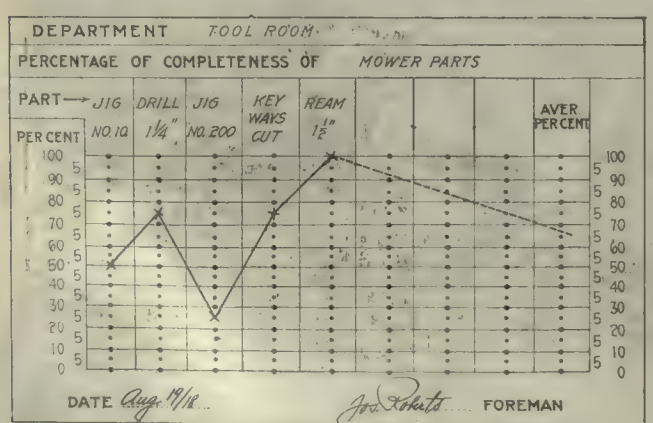


FIG. 2. DEPARTMENT DAILY REPORT CARD

These reports not only show the daily standing of work but they prevent the slow foremen from demanding bigger salaries than the results warrant, while the more efficient ones have nothing to fear from their good showings. The daily report card from each foreman is handed to the clerk at noon and is read off by him for any corrections. This shows just what parts are needed for any line of work or production wanted, and also shows which are receiving full, part or no attention when some discussion or excuses are likely to be forthcoming. The cards are signed and dated by the foremen and retained by the clerk for daily comparison, which means that they must be nearly correct in their estimated percentage or the foremen will have to answer. For instance, if Monday's card shows a jig 50 per cent. finished and Tuesday's card has the same figures, evidently no work has been done on it. If on Wednesday only 40 per cent. is shown then poor judgment has been used. If the jig is finished the card will show 100 per cent. in the jig column.

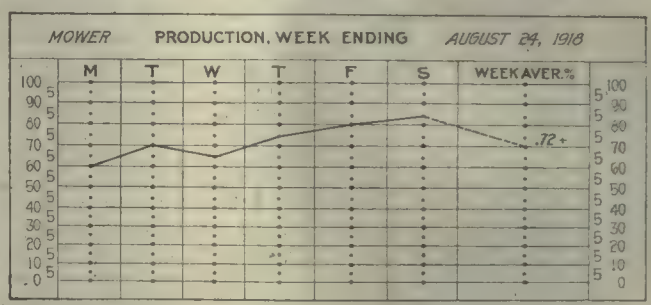


FIG. 3. WEEKLY AVERAGE BLACKBOARD DIAGRAM

Any foreman can easily mark the cards for any part wanted by judging if such parts, jigs or tools are one-quarter, one-half or fully finished and by making a small cross on the line representing 25, 50 or 100 per cent. in the proper column. Thus, if the foundry had an order to make 500 castings for mowers and by noon the foreman estimated that only 50 were ready he marked the card at 10 per cent. under the casting number. And if the toolroom had a jig that had to be used for mower drilling the foreman would estimate possibly that it was one-half finished and mark his card at 50 per cent. under the jig column. If the machine shop had 300 parts to be drilled and they were finished, the card would show 100 per cent. in the proper column.

Every Monday the general average for the previous week is shown by a separate blackboard diagram, Fig. 3, for any particular line of production, and when this falls very far below the preëstimated amount there are always some strong requests to speed up. By referring to all the cards that make up this average for the week the foremen that pulled it down are easily spotted.

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History of the Aberdeen Ordnance Proving Ground—III

By MAJOR F. P. LINDH*

The final installment of the Aberdeen Proving Ground History tells of the work done in the later months of the war after the various activities were in full swing. The development of the railway artillery, meteorological work and airplane bombing is taken up and some plans for future activities are discussed.

IN THE late spring of 1918, the first U. S. guns on railway mounts came through. In view of the great value of mobility in large guns and the success attained by European countries in developing railway artillery, the production of an American railway artillery was regarded as of the first importance, and everything possible was done to expedite the work. Railway guns of medium caliber had been designed and tested in 1916-17, notably the 6-in. pivot mount, but the shipping problem and the comparative adequacy of the Allies' supply of medium range guns caused it to be decided that the U. S. should concentrate mostly on large calibre, long range railroad artillery and hence these lighter guns were not developed during the war. By designing the early railway carriages to take guns already in use in the pre-war artillery, development work on ammunition was made possible by firing from fixed carriages at the same time that the new railway carriages were being constructed.



CAMOUFLAGED 16 IN. HOWITZER

Thus in the spring of 1918 an improvised fixed gun carriage was constructed at Sandy Hook and from it the 8-in. and 10-in. guns destined for the new carriages were range fired with new light-weight projectiles. In April the 14-in. naval gun was similarly set up and range fired at Sandy Hook. The 12-in. mortar was the next gun on a railway mount to be tested. Experiments on this did not proceed far, however, before all the railway artillery projects were transferred to Aberdeen where the construction of railroads and especially of firing tracks now enabled them to be handled. A series of spur tracks were laid out at the water range near Mulberry Point and preparations were made on a large scale for the reception of the expected guns. This site was chosen rather than the main front on account of the large space required for tracks, the operation of cranes, and the desirability of having a location where powder, fuse, and armor plate tests and range firing could all be conveniently carried out. In order to facilitate shipments a substantial wooden dock with railway approach was built at Mulberry Point and a channel was dredged into the deep water of the bay.

The first complete 8-in. railway mount arrived at Aberdeen about June 1, and shortly after the first 16-in. howitzer came in. These guns were fired with different powder charges, and at different angles with their tracks, they were star gaged, disassembled and reassembled, records were taken of the action of their recoil mechanisms, time studies made on the operations of firing, and in many other ways they underwent searching investigations. Meanwhile more 8-in. railway guns came in and the 7-in. naval guns and 12-in. mortars on railway carriages arrived. A new section of the Proof Department was organized under the direction of Capt. C. C. Stretch to carry on the work, and the once quiet cornfields at Mulberry Point presented scenes of ever-increasing activity.

Camouflaging operations commenced at Aberdeen

*The writer wishes to express his appreciation of the work done by Lieut. P. L. Alger in gathering the material for this history. The major part of the credit for its arrangement is due to him.

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under the direction of Mr. Goodwin almost as soon as the first railway gun appeared. All the railway mounts and their attendant cars were carefully decorated in outlandish designs and colors and studies were made of their visibility. Among other operations an artificial canopy of vegetation was constructed over a portion of a railroad spur and a 16-in. howitzer ensconced therein was searched for by airplane observers. It was found that viewed from above 2000 ft. the gun was invisible. This problem of rendering artillery invisible to enemy observers is one of the most fascinating of the newer scientific war problems and hardly a start has yet been made on its possibilities. It furnishes a fruitful subject for future investigation.

Another of the 14-in. naval guns was sent to Aberdeen about September 1 for range firing with a new projectile. Still later the 12-in. gun on a sliding railway mount which was designed and built in 85 days, and the 14-in. army gun, model 1919, came for tests and range firing. While most of this artillery was developed too late for use in the war, each type was thoroughly tested and brought from a theoretical basis to a practical or operating one and a large number of the 7-in. and 8-in. guns were tested, packed, and sent out for shipment overseas.



THE NEW MACHINE SHOP

Aviation was added to the proving ground activities in midsummer by the arrival of the 271st Aëro Squadron from Ellington Field. A landing field was prepared, and hangars and shops to the value of over a million dollars were built at a site about halfway between headquarters and the water range. The principal purpose of this project was to enable aërial drop bombs to be tested under actual service conditions. A bombing field of considerable extent was chosen near the shore of Bush River, inshore from the firing ranges and just north of the Edgewood Reservation, where high explosive bombs could be dropped without harm to lives or property. Here the aviators have dropped many hundreds of experimental bombs, the explosions or failures to explode being observed by Ordnance officers, from the air and from the ground. As a result of their coöperative efforts there were developed and put into production several satisfactory types of drop bombs and fuses, while experiments are now proceeding on a dozen improved varieties.

The aviators served other purposes both ornamental and useful besides the bomb dropping. They carried aloft meteorological instruments and observers who determined the upper air conditions so that the results observed in range firing could be properly corrected to normal atmospheric conditions. Beginning in November this service was performed three times daily and the results were used at Washington in constructing weather maps for the benefit of the mail planes as well as in the work of the Range Firing Section. Several of the pilots were very skillful in the air and their aërial stunts formed one of the most spectacular features of the proving ground on exhibition days. The airplanes used were at first all of the biplane training type equipped with Hispano-Suiza motors, but later two large Handley-Page bombing machines were received and made use of. The equipment of the field is of a permanent character and no doubt Aberdeen will become in the future an important government aviation center by reason of its favorable location.

The Proof Department as a whole was during 1918 in charge of the writer, and the work was divided into several sections, one of which has already been described. The Instrument Section should fittingly be described next as its work was necessary to all other sections. By it all photographic work, all velocity, time, and powder pressure measurements were made and electrical, drafting, and surveying work was performed. The section was organized in twenty separate units, each with its distinct functions. It carried on an enormous amount of routine work, in a year's time some 34,000 velocity measurements being made and about 2000 photographs taken. As many as 200 minor caliber guns have been star gaged in a single day. Its timekeepers measured with stop watches the times of burning of all time fuses and times of flight of ranging shots. Development work on improved pressure gages, recoil measuring devices, star-gaging apparatus, printing chronographs, and high-speed motion cameras was carried on with good results. The section is housed in a permanent brick building with well-equipped photographic laboratories, and is in a position to do excellent research work when the pressure of routine work decreases. The accumulated records of gun erosion, velocity dispersion, etc., furnish a wealth of data for future study. A separate Drafting Department is maintained which keeps on file all Ordnance Department drawings, and prepares sketches, maps, etc., for the Proof Department.

Each gun requires its own range table showing the normal range to be expected when the gun is elevated to any angle and also giving all the corrections necessary to apply to the normal range to allow for variations in atmospheric conditions, etc. In April, the Range Firing Section was established to conduct firing and computations to prepare such range tables and placed in charge of Capt. (now Major) O. Veblen, a very able mathematician. A staff of computers was built up by transfer of men from Sandy Hook, by obtaining college students, and by securing the services of talented enlisted men. Later several college professors of mathematics were called in to direct the computing and to devise new and improved methods and theories. This staff during the war reported upon some 10,000 shots fired for range, prepared and forwarded about 30 range

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tables and greatly advanced the state of ballistic theory. The services performed by Lieut. P. L. Alger, Prof. G. A. Bliss of the University of Chicago, and Prof. H. H. Mitchell of the University of Pennsylvania have been particularly valuable.

To measure the ranges of projectiles an extensive system of 16 observation towers stretching for 30 miles has been built and equipped on the eastern shore of the bay, temporary towers on the western shore being used during the construction of the permanent ones. Observers spot the splashes of falling projectiles from their posts over 100 ft. above the water level in the same way that forest fires are located in the Adirondacks, and in fact the towers will also be used for forest-fire location. The positions of the towers have been accurately determined by the Coast and Geodetic Survey. Communication between the observers and the gun platforms across the bay was by means of wireless telephones, which were installed by the Signal Corps at Aberdeen early in the summer of 1918. To carry men and material to and from the towers a number of boats were required, especially in the earlier days when much surveying, building, and inspection went on. To fill this need a small navy was maintained by the proving ground consisting of one 76-ft. cruising yacht equipped with a wireless telephone, and half a dozen smaller motor boats. When the 14-in. railway gun was range fired observers were placed in lighthouses of Baltimore Harbor and all shipping was warned away, on which occasion the navy played an important rôle. Usually safety to shipping is assured by not permitting a shot to be fired until the observers report a clear field.



FIRING 12-IN. GUN ON SLIDING MOUNT

Before the war the conditions of the upper atmosphere were seldom taken into account by the U. S. Artillery but the development of high-angle fire has made this a very important consideration. To obtain the requisite knowledge of air conditions daily a detachment of the Meteorological Section, Signal Corps, was sent to Aberdeen in March. This detachment was largely increased later and was fully equipped with sounding balloons, kites, and other apparatus. Measurements of wind aloft and later of density aloft were made several times daily and the station grew to be the best of its kind in the United States. At the present time it is possible to obtain accurately the change in position of the point of fall of a projectile in both range and deflection that would be caused by a wind aloft, however variable, within five minutes after a sounding balloon has been observed at the height desired.

In the conduction of range firing it was frequently found that projectiles did not behave as expected, and as a consequence one of the most important tasks fulfilled by the Range Firing Section has been the carrying out of experimental firings to determine the effects of changes in projectile design. By such experiments it was discovered that by slightly altering the forms of the rotating bands on the 6-in. and certain other projectiles the range could be greatly increased and the dispersion decreased by an even more important amount. These discoveries which were largely due to Lieut. P. L. Alger were of great importance and formed the subject of several cablegrams exchanged with the A. E. F. As is so often the case, parallel discoveries were made at about the same time by the Naval Proving Ground and by the A. E. F. Many other alterations in projectile design leading to improvements were suggested by the Aberdeen staff. When all the immediately hopeful possibilities had been tried out or set under way Major Veblen, who had initiated most of the experimental work, was sent overseas to learn at first hand the latest ideas of our allies with the intention that he should return shortly to Aberdeen and put them into effect, thus avoiding costly duplication of effort. He could not sail until October, however, and the armistice prevented his trip being of service in the present war.

Almost all experimental ordnance work was performed by the Development Section of the Proof Department, the sections whose work have been described, being originally subdivisions of this section. It was capably directed by Capt. (later Major) A. L. Loomis, a reserve officer who had seen service on the Mexican border. Its duties comprised the testing of all guns and gun carriages, tractors and tanks, development of fuses, boosters, explosives, trench warfare material, the testing of new inventions, and the conduction of all tests in any way unusual, such as the development of the Aberdeen Chronograph.

The most spectacular feature of the development work was the testing of tanks and tractors. The caterpillar tractor early in the war proved its value and quite a large variety of guns were put on tractor mounts, notably the 155-mm. G.P.F. gun, 3-in. anti-aircraft gun and 8-in. howitzer. These ungainly vehicles were put through many tests in the Aberdeen mud, through the woods and over obstacles with great success. In addition to the gun carriages there were several small tractors, designed to draw guns and limbers formerly horse drawn, which underwent tests. Tanks did not form an important feature of the work at Aberdeen as but very few were sent there. Other methods of supporting guns were tested, such as

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rubber-tired wheels, cast-iron wheels and finally no wheels at all. The development of these various gun mounts and caterpillar vehicles only entered its initial stage during the war and it seems certain that in future warfare the use of small armored tanks to draw light guns and the provision of caterpillar mounts with their own power for medium-sized guns will feature as much as will large guns on railway carriages.

The testing of anti-aircraft fuses formed the principal night activity at Aberdeen. To hit an airplane, reliance is placed on a time fuse set to explode a projectile near the plane, and the time of burning for any setting of such fuses must be ascertained by experiment. Since the flashes of shell bursts were much more visible at night, tests were usually conducted from midnight on. The star-like flashes were visible in the sky for many miles as also were the flashes of the blast from the gun, the combined illumination making a fascinating spectacle from Havre de Grace and other nearby towns. Over 10,000 anti-aircraft fuses and over 40,000 of other types of time fuses were tested at Aberdeen during 1918. The Acceptance Section of the Proof Department, headed by Capt. (now Major) J. E. Fullam, performed all tests of manufacturers' samples to determine the acceptance or rejection of the material represented. Its work comprised six principal divisions, the tests of powder, projectiles, cases, fuses, complete rounds and bombs. So great was the pressure of this work that frequently tests were carried on twelve and fifteen hours a day. Almost all the acceptance tests were of a routine character so that the question of how rapidly they could be done was paramount. Aided by telegraphic and messenger service it was usual for reports recommending acceptance or rejection of material to be received in Washington within 48 hours after the arrival of the ammunition at Aberdeen. The acceptance work involved the firing of about 200,000 rounds up to Jan. 1, 1919, the volume of firing increasing from 7716 rounds in March and 13,211 in May to 24,501 in August and 36,039 in October. These firings indicate that about 25,000,000 explosive projectiles were accepted by the Ordnance Department during the year 1918.



MAKING UP A 12 IN. POWDER CHARGE

Projectiles were tested by firing them under excess powder pressure to a chosen field 5000 yd. or so from the guns, and then digging them up for examination. It may be said with emphasis that the daily routine of digging up shells that are buried from three to six feet deep in clay-mud and water lacks all the elements of romance. The enlisted men who did the work had the added pleasure occasionally of dodging stray shots, but no casualties ever resulted. To lessen the arduous character of the recovery work projectiles were fitted with flat plaquettes that decreased their striking velocity and penetrative power, and also prevented ricocheting, but no other radical improvements in the recovery work were made. On account of the percentage of large shells lost beyond recovery by their penetration below the water level in the marshy soil, however, it was seen that an entirely different method of procedure would be desirable. Accordingly a concrete tank of large dimensions was built after some experiments and it is intended to fire projectiles into water contained in this tank at close range. It is expected the water will retard the shells without injury sufficiently to retain them within the tank and that they can be then lifted out with magnets. This device has just been tried for the first time and bids fair to be a great success. Recovery tests have proved of great value in many ways and they will form a feature of future proving-ground work, although they were rarely performed at proving grounds before the war on account of the limited space available. Over 40,000 percussion and detonating fuses were tested at Aberdeen in 1918. These tests were carried out on the detonating ranges by firing high-explosive shells down the range for distances of from 400 ft. to 8 miles so that they burst within 50 yards or so of observers stationed in bomb proofs just off the line of fire. These observers could tell by the appearance of the detonation how well the fuses functioned. This work is one of the most dangerous proving-ground occupations as fragments of shell frequently strike the bomb proofs and occasionally enter the narrow slits left open for vision. Lieut. Buffington lost the sight of one eye as a result of being struck by such a fragment and other officers have had narrow escapes. Another source of danger is the liability of experimental fuses to detonate prematurely, perhaps wrecking the gun. Quite a number of guns have been ruined in this way during 1918, but fortunately no serious injuries have resulted from these prematures, thanks to careful safety rules that were enforced. The loading, assembly, and handling of this explosive ammunition requires great care if accidents are to be averted.

The trench warfare work during the latter half of 1918 was carried on under the direction of Capt. S. K. Bushnell and was signalized by general improvements in early designs and a great volume of acceptance

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tests. Oddly shaped bombs with tails and fins that make them fly true and arrow-like replaced the cylindrical and tapered projectiles that tumbled in flight; while new and consistent powders replaced the erratic burning ones first tested. A very large number of trench mortars were given routine tests and packed for shipment overseas. One serious accident marred the work of this range when two men were killed by the accidental explosion of a shell in a Stokes mortar. Like the tanks and tractors, the trench warfare devices are all new elements of warfare and their possibilities for improvement are still unlimited.

The Future of the Proving Ground

The proving ground will be a permanent experimental firing ground which will provide for all possible peace-time needs. The major caliber seacoast guns will be transferred from Sandy Hook, and powder tests and armor-plate tests with them will be added to the Aberdeen projects. Permanent buildings are under way which will provide space for the activities now housed in cantonments. Substantial quarters, good roads, railroad facilities, and its pleasant location will make Aberdeen an attractive post at which to live after the construction work is finished, the temporary structures removed and the land graded. It is hoped to make it the center of ordnance activity and knowledge, and to establish here a good Ordnance School for officers, an ordnance library and a permanent staff of experts who will do research work leading to improvements in materiél. In England and France it is planned to provide attractive opportunities for men of ability to make permanent careers in ordnance work; and it is certain that such a policy will produce far better results than the old scheme of making the entire proving-ground personnel a continually changing one.

The experiences of the war of 1917 have shown that a large number of untrained men can be gathered, disciplined and made into trained fighters far sooner than the suitable amount of ordnance equipment can be developed and manufactured. Accordingly any preparedness scheme whatever should provide for an adequate number of ordnance experts permanently employed by the Government and the maintenance by them of complete plans and specifications for up-to-date materiél suitable for a large army. This would involve such a small number of men as to discount effectually arguments against militarism and at the same time would provide a most effective form of preparedness against possible contingencies of the future. Whatever decisions may be made at the Peace Conference the development of American ordnance will largely depend upon the results of experiments that will be made at the Aberdeen Proving Ground.

Abstracts of Recent Office Orders of General Interest

No. 573, Mar. 4. Col. James L. Walsh is appointed chief of the executive section, office of the Chief of Ordnance.

No. 551, Feb. 17. Lieut. R. E. Westervelt is designated contracting officer for the Chicago Ordnance District, succeeding Maj. F. R. Schanck.

No. 554, Feb. 18. Maj. A. S. Douglass is appointed Ordnance District Chief, Boston district, succeeding Mr. Levi H. Greenwood, resigned, to take effect Feb. 20.

No. 556, Feb. 18. Maj. Allan Copperthwait is appointed a member of the Detroit District Claims Board, succeeding Maj. P. C. Thomas, effective Feb. 3.

No. 559, Feb. 21. Maj. Paul Weeks is designated as chief of the Tank, Tractor and Trailer Division, succeeding Lieut.-Col. H. W. Alden.

No. 564, Feb. 26. B. Goldsmith is appointed Ordnance District Chief, New York, succeeding George J. Roberts, resigned, to take effect Mar. 3.

No. 565, Feb. 28. Capt. T. F. Geraghty is appointed alternate member of the Baltimore District Claims Board.

No. 568, Mar. 1. Maj. Sherman L. Depew is designated as alternate member of the Detroit District Claims Board.

No. 568, Mar. 1. Capt. George Featherstone is designated as alternate contracting officer for the New York District Claims Board.

No. 569, Mar. 3. Capt. James G. Dalgliesh is designated as alternate contracting officer for the Detroit District, with authority to approve vouchers, during the absence of Maj. Joseph A. Bursley.

No. 571, Mar. 4. C. E. Huyette is appointed Ordnance District Chief, Detroit District Ordnance Office, succeeding Fred J. Robinson, resigned, effective Mar. 15.

No. 577, Mar. 10. Maj. R. H. Hawkins, Maj. A. C. Hindman and Capt. E. D. Cooper of the Administration Division are authorized to execute, where necessary, contracts incident to the sale or disposition of material, equipment and property, in order to carry out the requirements of Supply Circular No. 117, P. S. & T. Div. dated Nov. 21, 1918.

No. 580, Mar. 12. Maj. F. B. DeGress is appointed member of the New York District Claims Board.

PERSONALS

First Lieut. Hugh J. Falvey has left the service. He was commissioned from Fort Sheridan Training Camp in November, 1917, and has served continuously at Rariton Arsenal as supply officer.

* * *

Second Lieut. Raymond W. Peters has been discharged. He is a graduate of both Washington and Missouri Universities, and was formerly employed by the Canvas Products Co., 15th and Olive Sts., St. Louis, Mo.

* * *

First Lieut. Arthur W. Wainwright has left the service. He is a graduate of New York University and was commissioned in December, 1917. Lieutenant Wainwright has been on duty with the Production Division.

* * *

Capt. William S. Trask has been discharged after one year of service. Before being commissioned he was employed by the American Hardware Co., New Britain, Conn. His service has been in connection with inspection work.

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Maj. John H. Barr, recently discharged, is a graduate of the University of Minnesota. He is a mechanical engineer, and before being commissioned was in charge of the engineering department of the Remington Typewriter Co.

* * *

Capt. Harry W. Cross, recently discharged after serving 14 months, has been on duty with the Procurement Division as head of the gage branch. He was formerly employed by the General Electric Co. as purchasing agent.

* * *

Second Lieut. William R. Flemming, who has been on duty with the Supply Division and has served at various camps, has left the service. He was formerly employed by the Connecticut Valley Lumber Co., 147 Milk St., Boston, Mass.

* * *

First Lieut. Ralph M. Davies has left the service. He graduated from the University of Minnesota as an electrical engineer and was formerly employed by Fairbanks, Morse & Co. on the sale and installation of gas and electrical equipment.

* * *

Maj. A. E. White, who was commissioned in August, 1917, and was on duty in Washington, D. C., has been discharged. He was a student at Brown University and Harvard University and was formerly employed by the Detroit Edison Co., Detroit, Mich.

* * *

Capt. Alexander H. Robertson has been discharged from the service. He is a graduate of Union College, and is a civil engineer. Previous to his being commissioned, Captain Robertson was employed in the designing department of the New York Central R.R.

* * *

Second Lieut. Frank S. Bonds, recently discharged, is a graduate of Clemson College and a mechanical engineer. He entered the service as an enlisted man in December, 1917, and served in the aircraft armament section, Engineering Division, until he went overseas.

* * *

Second Lieut. George W. Alsdorf, who is a mining engineer, has been discharged from the service. He is a graduate of the Ohio State University and prior to being commissioned was employed by the New Mexico-Colorado Coal and Mining Co., Raton, New Mexico.

* * *

First Lieut. William H. Wharton, who was commissioned in January, 1918, has been discharged. He was formerly with the Nashville, Chattanooga and St. Louis Railroad Co., Chicago, Ill., as commercial agent. His service has been with the Production Division on transportation matters.

* * *

Maj. Charles L. Pratt, who was commissioned as Captain in August, 1917, has been discharged. He was formerly employed as works superintendent by the Boston Gear Works, Norfolk Downs, Mass Major Pratt has been on duty at the Watertown Arsenal since being called to active duty.

* * *

First Lieut. Leonard J. Dibble, who was commissioned from Plattsburg in November, 1917, has left the service. He is a graduate of Trinity College and was formerly employed by Kissel, Kinnicutt & Co., 14 Wall St., New York. His services were with the artillery ammunition section of the Engineering Division.

* * *

Second Lieut. Albert Grobstein, who was formerly a student at the Carnegie Institute of Technology and specialized in mechanical engineering, has been discharged. He was formerly employed by Firth-Sterling Steel Co., McKeesport, Penn. Since being commissioned he has been on duty at the Aberdeen Proving Grounds on proof work.

* * *

First Lieut. C. H. Shattuck has been discharged. He was a student at Leland Stanford University, and was formerly employed by C. F. Braun & Co., San Francisco, Calif.

* * *

First Lieut. Ross H. Forney, who was commissioned in August, 1917, has been discharged. He was formerly employed by the Texas Power and Light Co., and is a graduate of the University of Kansas. Lieutenant Forney was assigned to proof work for the greater part of the time since he entered the service.

Distinguished Service Medal for Guy E. Tripp

THE processes of the War Department are sometimes slow but they generally arrive at their destination in course of time whether it be the apprehension and incarceration of a draft dodger or the decoration of an eminent reserve officer who has laid aside his uniform and returned to his old duties.

Mr. Guy E. Tripp, whose record in the Ordnance Department is well known, has resumed his work as chairman of the board of the Westinghouse Electric and Manufacturing Co., 165 Broadway, New York. He is a director of many important corporations and a member of numerous clubs and societies, a full account of which was published in our issue of Feb. 6, 1919. We take pleasure in publishing the citation which gives him the distinguished Service Medal.



GUY E. TRIPP

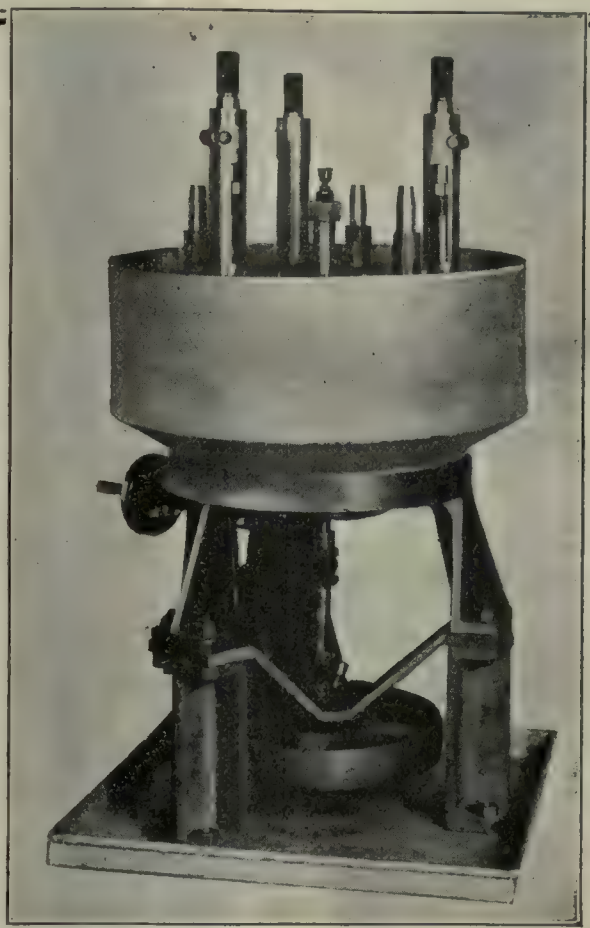
Formerly Brig.-Gen., Ordnance Department, U.S.A., "who, as Chief of the Production Division of the Ordnance Department, and later as Assistant Chief of Ordnance, displayed fine technical ability and broad judgment in systematizing methods and practices resulting in the efficient coöperation of industries producing articles of ordnance for the Army."

A Machine for Lapping Precision Gage Blocks

For ten years, the manufacture of precision gage blocks has been considered the great mechanical secret of the world and much mystery has surrounded the production of these blocks. As a matter of fact with proper equipment and the necessary skill, they are much more easily and accurately made than are precision screws when made to tolerances ten times as large.

THE illustration shows a machine for lapping precision gage blocks with flat and parallel opposite sides a definite distance apart, or other similar work. This machine is the latest of a series of machines designed and built by the inventor and patentee, E. A. Suverkrop, New York, for producing gage blocks of any contour but having two opposite sides flat and parallel and a definite distance apart.

After the rough-ground gage-block blanks are correctly placed in the workholder of the machine and it is set in motion, but little further attention is required. Blocks made on the original experimental machine some years ago and inspected by means of glass optical planes were found to be the same size, so far as this precision method of measurement could determine, and interchangeable with the master measuring blocks used.



A MACHINE FOR LAPPING PRECISION GAGE BLOCKS

The machine consists of three circular plates two of which are lapping plates. The lower lapping plate is stationary. The upper lapping plate is also stationary, so far as rotary motion is concerned, but is free to move by gravity toward or to be moved from the lower lapping plate. The guiding members for the upper lapping plate prevent it from rotating with the workholder but do not constrain it to move parallel to the lower lapping plate. They permit the upper lapping plate to automatically adjust itself to the inequalities of the rough-ground gage-block blanks which are being lapped.

The third circular plate is located between the upper and lower lapping plates and serves as a work carrier. Near its perimeter are openings similar in contour to the gage-block blanks. If these are cylindrical, the openings are cylindrical, and if they are rectangular or any other shape the openings in the work carrier are the same shape but slightly larger. The thickness of the work carrier is less than the thickness of the gages to be lapped so that their opposite faces can come in contact with the faces of the upper and lower lapping plates respectively. A combined rotary and oscillating or planetary motion is imparted to the workholder so as to carry the faces of each and all of the gage blocks being lapped over every portion of the entire lapping surface of the contiguous lapping plate.

In this machine measuring blocks or other mechanism can be used for determining or limiting the extreme travel of the upper lapping plate toward the lower lapping plate and the consequent ultimate size of the work. The lubricating system is entirely self-contained and is so arranged that any stoppage can be at once detected and the cause located. The cut lubricant is supplied by a centrifugal pump through a series of nozzles. The latter can be directed so that the fluid pour in a series of steady streams over the entire faces of both laps keeping them and the work thoroughly flooded. The waste lubricant after passing the work flows by gravity to a series of strainers and settling compartments through which it flows depositing all of the larger particles of grit. The cut lubricant passes finally through a filter system which entirely removes all foreign matter.

The coefficient of expansion of the parts of this machine which control the size of the gage blocks is the same as that of the steel used for the precision gage blocks, however to keep the work at constant temperature a simple refrigerating system, not shown in the illustration, is provided for the cut lubricant before it again passes to the circulating pump. The refrigerating system can be operated either mechanically, or with ice in the summer, or with cold water under city pressure in the winter.

Hardening, seasoning, detection of cracks and the positive determination of size are details of manufacture all of which have been successfully solved so there is now no mystery about the production of gage blocks of extreme accuracy.

EDITORIALS

Training for Increased Production

THE war brought us face to face with the necessity of training large numbers of unskilled workers in the shortest possible time. Training schools were established in many shops under various names, and the work they were able to accomplish, even under adverse conditions in many cases, astonished even those who originated them.

Now that the war necessity has disappeared, we stand at the parting of the ways with regard to their being dropped or their continuance under peace-time conditions. Few who have really studied the question will, we believe, fail to see the great necessity for their continuance.

Granting that the training school has its place, the question now before us is how to use it to the best advantage for the present and future of the industry. During the present readjustment period, the need for training new workers has largely disappeared, but we are finding what we might have expected had we given it sufficient thought, that it is fully as important to train the employees we already have to be more efficient in their work.

We have assumed that when a worker went into the shop and held the job, that there was nothing more to be done; that they either knew the business before or had acquired enough of it to be classed as good workers. Yet every shop has a full quota of workers who we know are less efficient than they might be, but who are enough above the "firing" line to hold their job in normal times. Through no fault of their own in many cases they seem unable to progress beyond the point of making it difficult to find a legitimate reason for dismissing them. This is in part due to the fact that we realize the new man may be no better. It is a case of keeping the faults you know rather than getting faults of which you know nothing.

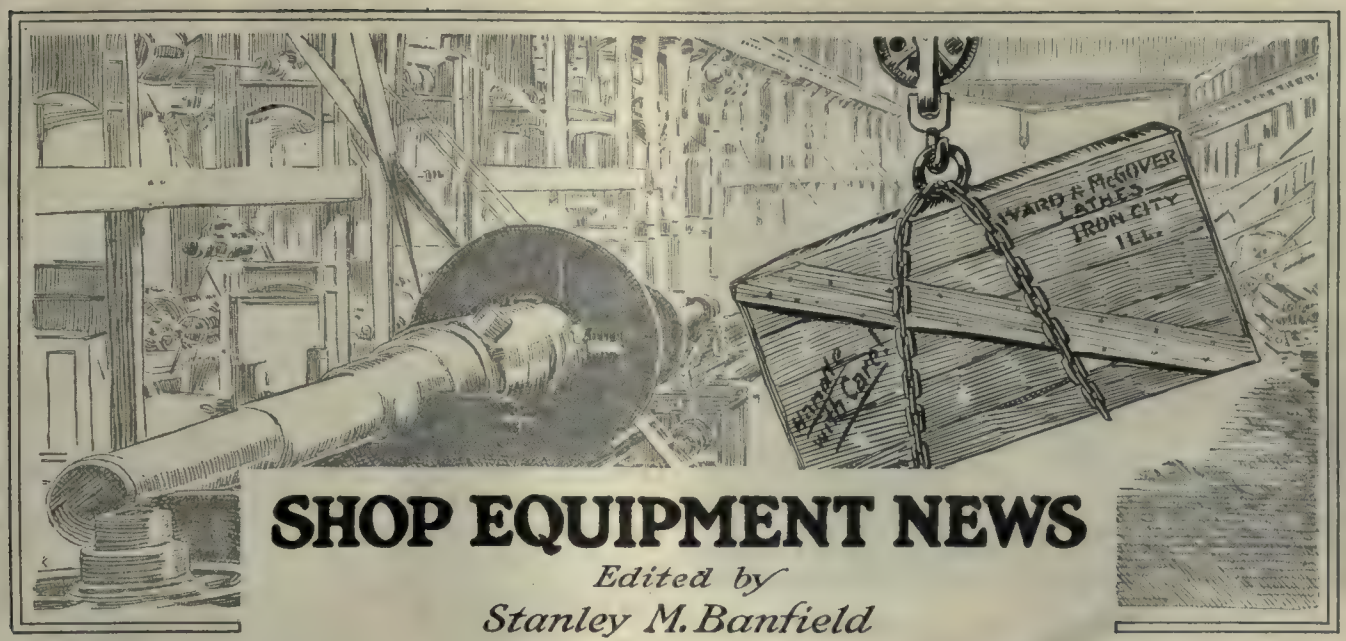
The training school offers an excellent opportunity for not only increasing the efficiency and consequently the earning power of employees, but at the same time securing their interest and coöperation along other lines. Some far-seeing managers are utilizing the present to re-train or "up-grade" the workers who seem to need it and who respond to such an opportunity. Those who believe that the only place to train workers is in the shop, and most of us have held to this fallacy at some time or other, have much to learn as to what proper methods, proper equipment and the right personality can accomplish in this line. Men and women who have failed to make good in the shop, or who fall even a trifle below a normal standard, are never secure in their positions. This adds to their mental anxiety and acts to prevent them from doing as well as they otherwise might.

Employees of this kind can be trained and are being trained to greatly increase their product. In some cases the foremen object to letting them go back into the training school, fearing that it may be a reflection on their ability to teach those under their care. But we are beginning to realize that showing how a piece of work is done and teaching how to do it are two very different things, and that while many can show the new worker, very few have the real teaching instinct. The foreman should be made to feel that the up-grading of his workers in the training school is no criticism of him, that his work in securing production leaves him no time for the real teaching which is necessary, and that you are trying to help him make a good showing in his department by relieving him of a burdensome part of his duties.

This work of up-grading is making itself felt even though it is so new in most cases. It is taking workers who are only of mediocre capacity and making them capable of turning out much greater product and earning much more money. In some cases workers who could barely turn out the minimum have more than doubled their production after a few weeks' instruction. Nor is this instruction all an expense as some might think. They are trained for the most part on the kind of work they have done in the shop and they turn out a commercial product while in the training school. In fact, wherever possible, all training even with beginners is on commercial work. There are cases of course where it is better to forget production during the training period, but on some kinds of work it is perfectly possible and practicable to combine the two. With the proper spirit behind the training school there is no question as to its effect on the morale or personal relations of the whole plant. It shows that there is an interest in helping workers to make good and to earn more money. It gives an employee in one department the opportunity of making good in some other place, saving for the company that intangible but nevertheless real value which comes from continued service and familiarity with its products.

The training school must carry a living wage in order to make it possible for those who need it most to avail themselves of it. This is not a serious problem when there is some product coming out of the school every day, and even in other cases it is usually less expensive than the loss in labor turnover. In some cases men who have earned good money ask to spend a short time in the training school at the lower rate of pay in order to make themselves worth more when they go back into the shop. Such a spirit cannot fail to make itself felt in the future product of any firm.

This up-grading of workers is not a fad or philanthropy. It is a paying business proposition and is proving itself in many places. It increases the earning capacity of the worker but it gives more production from the same shop equipment and the same overhead expense. It enlarges the productive capacity of the whole shop without the expense of new buildings, new machinery, more executives and more taxes. And last, but not least, it increases the coöperation and shop harmony which means so much in the total cost of operating any business. Up-grading of workers to secure more and better production will help greatly in our problems of readjustment.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Cadillac Double-End Drilling and Centering Machine

The Cadillac Tool Co., Dodge Power Building, 268 Jefferson Ave., Detroit, Mich., has just placed on the market the double-end drilling and centering machine shown in the illustration. The machine, although primarily intended for centering both ends of a shaft simultaneously, may be adapted to a wide range of work where it is desired to drill from opposite directions. The machine is of such construction that two ⅝-in. drills can be used simultaneously and the bed lengths are such as to take 12, 24, 36, 48, or 60 in. between centers, as desired. The belt-driven machine is shown in Fig. 1, but motor drive can be furnished, the motor being mounted under the pan at the right end of the machine and driving through a Link-Belt silent chain running in a bath of oil. The machine can be so arranged that the left-hand head is removable, enabling longer shafts to be centered, or if desired it can be furnished with only one drilling head. In Fig. 1, the standard machine is shown arranged for countershaft drive but if desired tight and loose pulleys can be furnished to drive direct from the lineshaft. In this case the loose pulley and countershaft bearings are arranged with Hyatt high-duty bearings. The drive from the pulley shaft to the spindle shafts is through Link-Belt silent chains running in oil baths, the end thrust being carried on ball thrust bearings. The spindles are made from hammered crucible steel, heat treated and ground to size. Fig. 2 shows the standard vise furnished, which has a capacity for round stock up to 4 in. in diameter. The screws are provided with end adjustment to enable the vise jaws to be set off center if desired. The vise jaws are of tool steel hardened and ground, and are removable, so that special jaws can be substituted. The manufacturers are also in a position to furnish special fixtures in place of the standard vises. The machine is regularly furnished with an oil pan, pump, and piping for circulating cutting lubricant. Special attention is called to the fact that the customary type of drum countershaft has been eliminated.

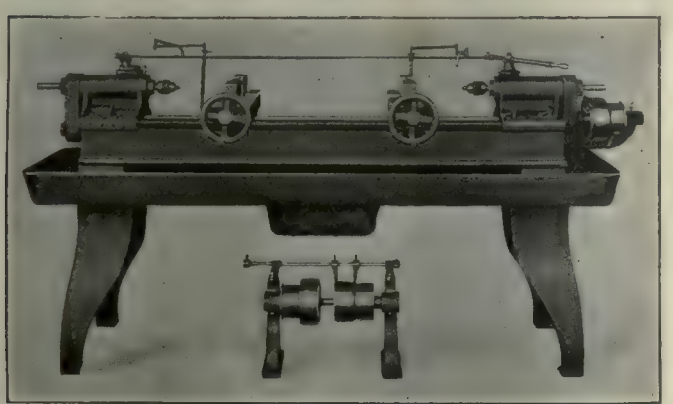


FIG. 1. CADILLAC DOUBLE-END DRILLING AND CENTERING MACHINE

Capacity, round stock up to 4 in. in diameter; maximum drill size, ⅝ in.; distance between centers, 12, 24, 36, 48, or 60 in. as desired; spindles, hammered crucible steel, heat treated and ground

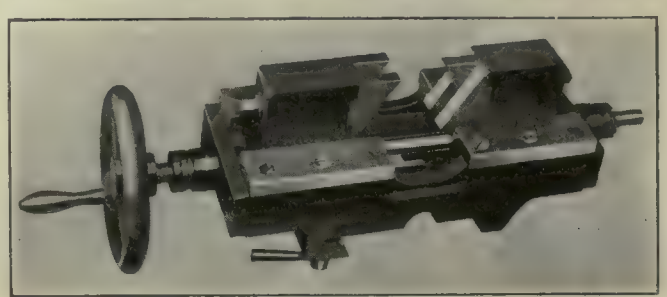


FIG. 2. THE STANDARD VISE

Automatic Milling Machine

A new adaptation of the small special purpose milling machine built by the Automatic Engraving and Manufacturing Co., of 2033 Fifth Ave., New York City, is shown in Fig. 1. A two-position holding fixture is shown attached to the reciprocating table and the work for which it is adapted is the routing of the peculiar-shaped slot in a special form of locknut shown in Fig. 2.

The spindle of the machine runs in bronze bearings the latter being tapered on the outside to allow com-

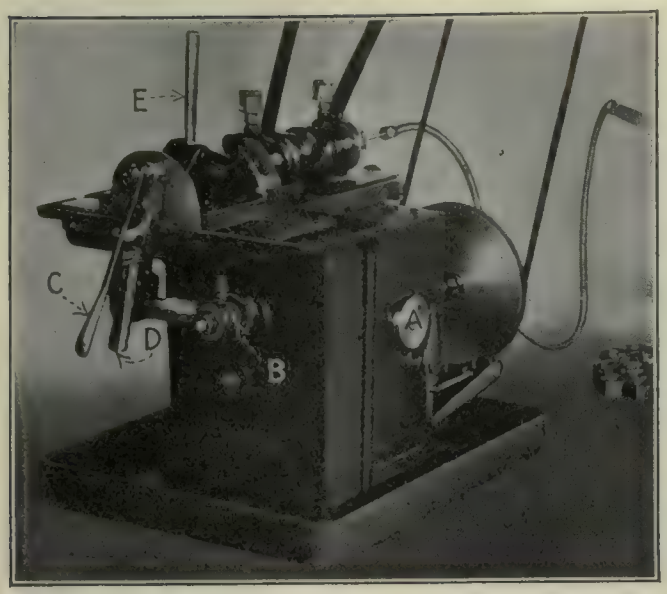


FIG. 1. AUTOMATIC MILLING OR ROUTING MACHINE

pensation for wear by endwise adjustment in the usual manner. A ball thrust bearing is provided to sustain the endwise pressure imposed by the work. This bearing is inclosed by a dust-excluding cover which is made as a part of the driving pulley in order to make the head as compact as possible.

The working end of the spindle is provided with a spring collet to hold the cutter which in this case is an end mill ¼ in. in diameter. Both spindle and cutter are hollow and lubricant is supplied through the spindle directly to the cutting point by means of a small pump and flexible tube connection. The spindle runs 3500 r.p.m. for this work, the material being cold-rolled steel.

The movements of the head and work table are derived from a horizontal shaft driven by the large grooved

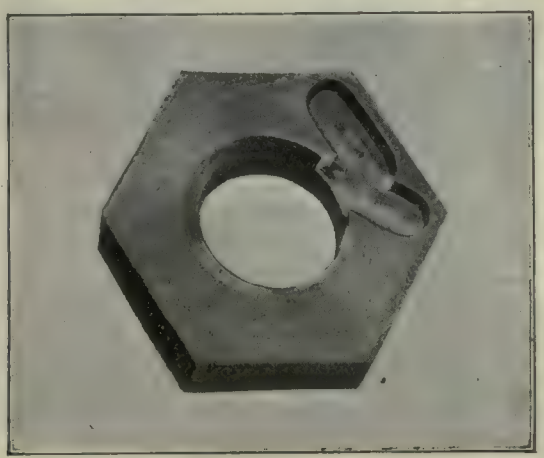


FIG. 2. WORK DONE BY THE MACHINE

pulley which may be seen at the rear of the machine. The pulley runs idly upon the shaft but may be clutched to it by a movement of the starting lever. A worm-driven cam mounted upon a transverse shaft the end of which may be seen at *A*, Fig. 1, furnishes the forward or feeding-in movement of the head. The disk on the end of shaft *A* is a knockout device that releases the clutch and stops the movements upon completion of the cycle of operation. To the right of, and below this disk in the illustration may be seen the latch levers that hold the operating clutch in engagement until released by the knockout. The work table is given a slowly reciprocating movement through the medium of a crank at *B* which is the usual slotted disk and movable stud, providing for the adjustment of the table stroke within reasonable limits.

The work shown in Fig. 2 requires two cycles to complete it and the fixture shown in place on the table in Fig. 1 is so arranged that when one cycle is completed the operator has but to shift the position by pressing the latch release lever *C* and pushing the handle *D* through an arc of about 20 deg. where it will latch into the second position. A touch of the clutch lever starts the machine upon its second cycle. The handle *E* is the clamping lever for holding the work.

The machine is very compact, occupying a space about 14 x 18 in. square and 12 in. high. The weight is approximately 200 lb. The time of each cycle on this work is 28 seconds.

"Triad" Three-Purpose Heat-Treating Furnace

The W. R. Bennett Co., Elmwood, Conn., has just placed on the market the "Triad" three-purpose heat-treating furnace shown in the illustration. In this furnace three heating operations can be carried on at one time by three men without interference; namely, heat-



"TRIAD" THREE-PURPOSE HEAT-TREATING FURNACE

Floor space, 2 sq.ft.; height, 31 in.; weight, 550 lb.; burner for oil, ⅜ in.; burner for gas, 1 in.; size of pot, either 6 or 7 in. in diameter and 11 in. deep; time taken to obtain tool-steel temperature from cold start, 35 minutes.

ing for hardening in a lead or cyanide bath, heating for hardening in a semi-muffle furnace, and heating for forging in the combustion compartment. It is stated that the furnace in no way resembles the numerous lead-bath or pot furnaces on the market at the present time, except in exterior appearance. In spite of the fact that these three operations may be carried on at one time, only one burner is used, which may be operated with either gas or oil. The lead pot does not rest on a pedestal or supporting brick, but hangs in

suspension from the heavy split iron covers forming the top of the furnace, a feature that is said to give a uniformity of temperature from the bottom to the top that is not possible when the pot rests upon a supporting base. The flame itself does not come into contact with the lead pot, as the combustion chamber is an entirely separate unit. The products of combustion pass upward into the pot-heating chamber through openings around the inside periphery of the brick top of the combustion chamber. This method distributes the heat to the heating chamber, and is said to insure absolute uniformity of temperature over the entire pot area at all times. It also serves to eliminate oxidation to a very large extent, making the life of the pot considerably longer than that in other types of furnace. The pot-heating compartment also performs the function of a semi-muffle furnace, and the operator at the right is using this feature. An opening at the base of the compartment allows dies and tools to be heated on the brick roof of the combustion chamber. There is another opening into the lower part of the combustion chamber where pieces of work can be heated for forging. Aside from the fact that the life of the lead pot is considerably longer, it is claimed that the fuel consumption is also reduced to a very marked degree, on account of the more perfect combustion. Two sizes of lead pots may be used in the furnace, either 6 or 7 in. in diameter and 11 in. deep. It is stated that tool-steel temperatures may be obtained in the furnace from a cold start in 35 minutes.

Logan Air-Operated Chucks

The air-operated chucks shown in the illustration have just been placed on the market by the Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., being manufactured by the Logansport Machine Co.

Fig. 1 shows a sectional view of the three-jaw, air-operated, combination chuck. It is said to combine maximum power with minimum weight and simplicity of operation. The body of the chuck is a one-piece casting, eliminating all bolts, screws, or other parts, and it is said that the jaw-operating mechanism is new to

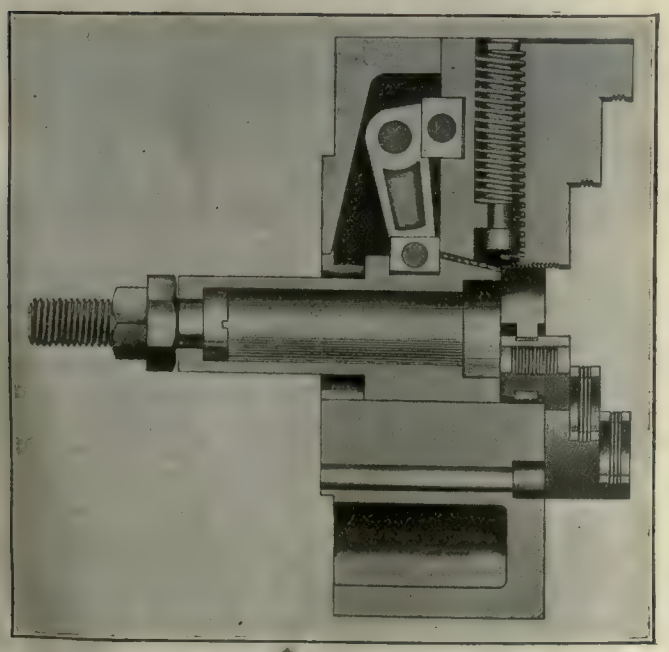


FIG. 1. LOGAN AIR-OPERATED COMBINATION CHUCK

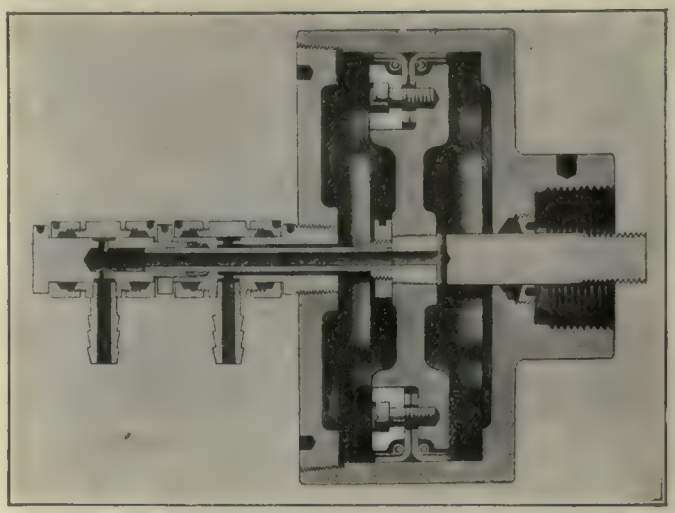


FIG. 2. LOGAN DOUBLE-ACTING AIR CYLINDER

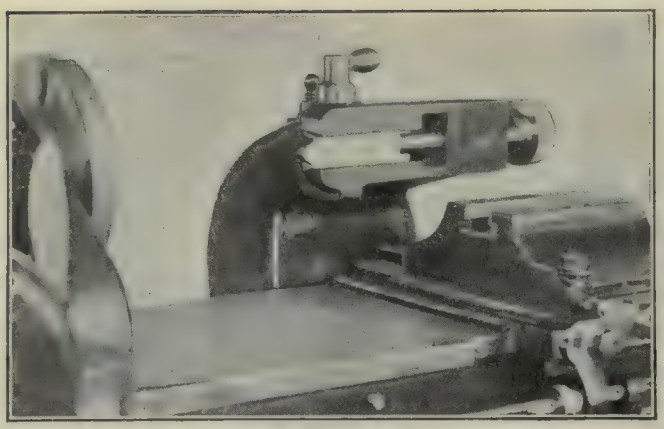
air-chuck construction. A special heat-treated lever is used, to which are pivoted hardened- and ground-steel blocks which engage in hardened and ground ways in both the draw tube and chuck draw slide, thus eliminating wear and friction to a great extent. The mechanical advantage obtained by the lever used is three to one. The chucks are as near dustproof as it is possible to make them. In order to reduce friction and wear a piece of felt is inserted between the draw tube and the chuck-jaw slide, this also serving to make a dustproof joint and eliminating chips and dirt from the operating mechanism. Provision is also made in the draw tube for inserting a bushing for supporting the boring bars.

Fig. 2 shows the double-acting air cylinders used. It is stated that packings have been made accessible for quick adjustment. The piston embodies the use of the Johns-Manville air-cylinder packing cup and expander ring. The base of the packing cup is woven asbestos. The cold-rolled-steel spring expander ring holds the packing up against the bore of the cylinder, giving a pressure surface $\frac{1}{2}$ in. wide around the bore of the cylinder. When the air is applied to the cylinder, it enters the channel between the outside of the piston and inside of the expander rings, thereby increasing the pressure of the packing cup against the bore of the cylinder and giving a tight joint. The Logan air valve for operating the cylinder is made from a semi-steel casting fitted with a hand-lapped bronze tapered plug and is piped direct to the cylinder without the use of elbows or any other fittings. All internal parts are accessible for cleaning and oiling by unscrewing the cover. The handle is reversible so that the valve can be located in any position on the machine.

These Logan double-acting air cylinders are regularly made in 3-, $4\frac{1}{2}$-, 6-, 8-, 10-, 12-, 14- and 16-in. bore.

Porter-Cable Tailstock

The Porter-Cable Machine Co., Syracuse, N. Y., has recently brought out a new tailstock and center for their lathe, which will be found valuable on many lathe operations. In this construction the usual tail-spindle is omitted and the ordinary center is replaced by a dovetail slide having a center point formed on one end. The illustration shows the means provided for moving the center in and out, and also the usual manner of clamping it in position. No portion of the center



PORTER-CABLE TAILSTOCK

or adjacent parts projects forward toward the operator more than $\frac{5}{32}$ in. from the center point, so that when turning a part as small as $\frac{5}{16}$ in. in diameter, it is unnecessary to draw back the cross slide when it is desired to run the carriage and tool to the right past the tailstock for the purpose of measuring or filing the work. The device is especially valuable when using a gang toolholder with multiple tools for turning parts having several diameters, one or more of which may be smaller than the ordinary round tail spindle, and the over-all length sufficient to preclude the use of a gang of tools if it were not possible to run past the tailstock as shown. It is also convenient in connection with a turret toolpost as it is unnecessary to draw back the cross slide to provide room for swinging the tool when indexing.

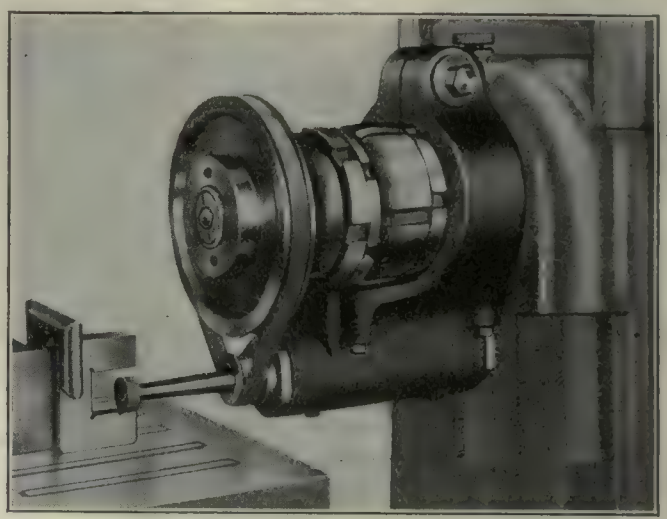
The center may be ground back $\frac{3}{4}$ in. before renewal is necessary, but it is recommended as a matter of economy that several centers be kept on hand ground ready for use. A special fixture for grinding is furnished with each equipment. This improved tailstock can be readily applied to Porter-Cable lathes now in use, due to the fact that the grinding fixture is adjustable to conform to the alignment of the lathe on which it is to be used. A setting gage and complete information goes with each outfit.

Liberty Grinding Attachment

The grinding attachment shown in the illustration is now being marketed by the Liberty Tool and Gauge Works, Woonsocket, R. I. This attachment is designed to be attached to surface grinding machines for the purpose of using wheels of small diameter running at high speeds. The device is so constructed that it can be quickly secured to the machine, and when fastened in place is rigid. The design is so compact that the regular capacity of the machine is dimished but slightly. It is stated that the attachment can be removed and the machine restored to its original condition for surface grinding with a large wheel in less than one minute.

The attachment consists of a combination bracket and spindle housing, grinding spindle, driving pulley, and driving belt. The spindle is made of special steel and mounted on self-aligning ball bearings, these bearings permitting the use of high spindle speeds that enable the correct surface speeds for wheels as small as $\frac{3}{8}$ in. in diameter to be secured. The spindle housing is enclosed to exclude dust from the bearings, but the construction is such that should examination be necessary at any time the spindle and bearings can be readily removed. The bracket that holds the attachment in position is of the clamping type and fastens to the grinding machine in place of the regular wheel guard, which is not required while the attachment is being used. The whole device is secured in place with one screw. The driving pulleys, of which two are furnished, are placed in the position regularly occupied by the grinding wheel, and motion is conveyed to the high-speed spindle by means of an endless elastic belt.

It is claimed that the device is particularly valuable in gage and other such work where it is generally necessary to use the side of the grinding wheel on the regular spindle. This attachment obviates the necessity of the frequent dressing of the sides of the wheel and the consequent waste, and also overcomes the scratches that are sometimes left when grinding with the side of the wheel. If particularly desirable, it is possible to reduce the size of the spindle so that even smaller openings than $\frac{3}{8}$ in. can be ground in a satisfactory manner. It is also stated that diamond-charged laps can be used advantageously for lapping out narrow slots and irregular forms. The high speeds available make it possible to use the small laps to much greater efficiency than would otherwise be possible.



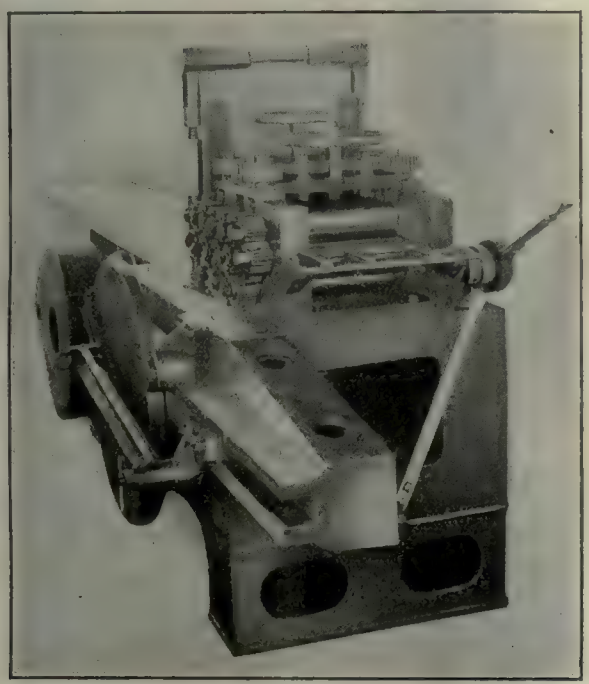
LIBERTY HIGH-SPEED GRINDING ATTACHMENT

Speed of spindle, 15,000 or 20,000 r.p.m. with the grinding-machine spindle running at 3300 r.p.m., the speeds being changed by means of the two large driving pulleys furnished; wheels used, $\frac{3}{8}$ to $1\frac{1}{2}$ in.; equipment includes belts and extra wheels.

Hallden Sheet-Metal Straightening and Cutting-Off Machine

The machine shown in the illustration has been designed to straighten and cut sheet metal into lengths with rapidity and accuracy, and is the product of the Hallden Machine Co., 27 Benedict St., Waterbury, Conn. The feed mechanism consists of a reciprocating rack connected to an eccentric crank disk, the rack meshing with a gear connected to a one-way clutch, the shaft of which is in turn geared directly to the straightening and feed rolls. The crank disk is graduated and by adjusting the eccentric along these graduations any desired length of stroke can be given to the rack. This in turn causes the machine to cut the sheet metal to the length desired. The crank feeding device gives an accelerating motion when starting the feed rolls

and a decelerating motion in stopping them, and this, it is stated, makes it possible to run the machine at a very high speed without the shock when the feed rolls are either set in motion or stopped. The gate shear is connected to the crank-disk shaft by means of two eccentric cams and is so timed that during one half of the revolution of the crankshaft the metal is fed through the shear, while during the other half the cutting-off operation is accomplished. The machine is directly connected to a 5- or 7½-hp. motor, as desired, with a flywheel on the first shaft. A double clutch gives two speeds to the machine, a second clutch being provided for cutting out the feed rolls when squaring off the front end of the metal to be operated upon. It is stated that the whole machine is very ruggedly built

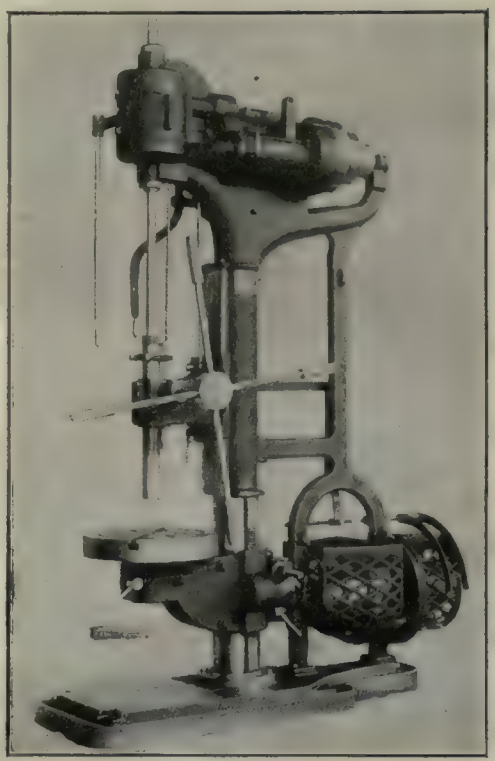


HALLDEN AUTOMATIC SHEET-METAL STRAIGHTENING AND CUTTING-OFF MACHINE

and that small and delicate parts and springs have been eliminated. It is stated that the rapidity with which work can be turned out is very great and that the machine will cut accurately to $\frac{1}{32}$-in. lengths. Two sizes are made, the No. 2 taking metal up to 14 in. wide and $\frac{1}{8}$ in. thick, and cutting any lengths up to 12 ft.; while the No. 3 machine takes metal up to 18 in. wide and $\frac{1}{8}$ in. thick, and will cut any length up to 12 ft.

Weigel 21-In. Drilling Machine.

The drilling machine shown in the illustration is manufactured by the Weigel Machine Tool Co., Peru, Indiana. It is of the 21-in. size and is equipped with back gears, tapping attachment and plain quick return. On this machine the standard friction quick return and power feed has been eliminated and a plain quick return substituted. The quick-return shaft carries four long levers mounted in the form of a pilot wheel giving a powerful hand feed and enabling the operator to produce work much more rapidly where power feed is not required. The machine is also built without the tapping attaching or back gears. When back gears are not included, the machine is equipped with a friction drive for starting and has a brake to stop the machine



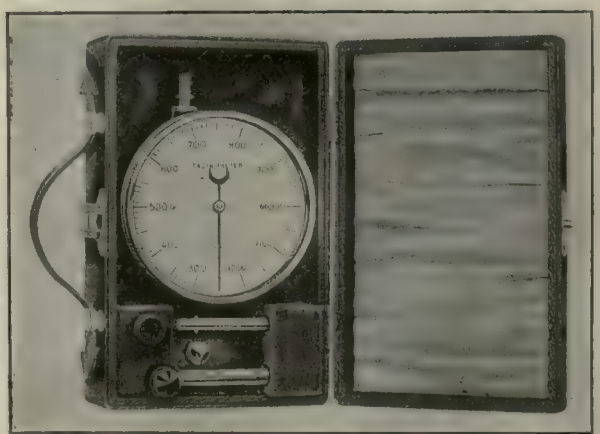
WEIGEL 21-IN. DRILLING MACHINE WITH BACK GEAR TAPPING ATTACHMENT AND PLAIN QUICK RETURN

Extreme height with spindle extended, 9 ft. 10 in.; distance from base to spindle, 46⅛ in.; distance from table to spindle, 30⅛ in.; drills to center of 21⅝ in. circle; traverse of table on column, 13⅜ in.; traverse of head on column, 21 in.; traverse of spindle, 9 in.; diameter of table, 19 in.; diameter of column, 7 in.; diameter of spindle above sleeve, 1⅞ in.; diameter of spindle in sleeve, 1¼ in.; diameter of sleeve, 2⅝ in.; spindle bored, No. 4 Morse taper; ratio of bevel gears, 2.5 to 1; ratio of back gears, 6.44 to 1; speeds with open belt, 400, 200 and 100 r.p.m.; speeds with back gears, 63, 31 and 16 r.p.m.; net weight, 2100 lb.

instantly. The control lever for starting and stopping the machine is located at the front in the same position as the back gear lever shown in the illustration. A similar machine is also made in the 25-in. size.

Jones Type H-2 Hand Tachometer

Jones-Motrola, Inc., 29-33 West 35th St., New York, has recently placed on the market the type H-2 hand tachometer shown in the illustration. This device is useful where it is desired to be able to test the speeds of shafts, engines, etc., directly by the use of a portable instrument. The device is intended to be held in the palm of the hand, but a handle can be supplied at addi-

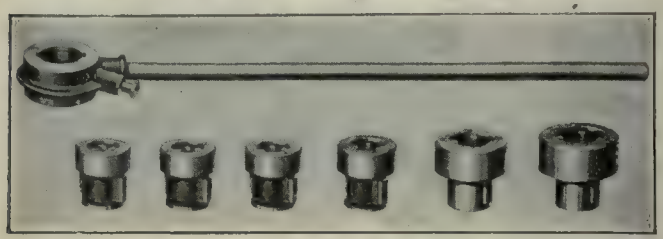


JONES TYPE H-2 HAND TACHOMETER

tional cost if desired. The instrument is supplied with a set of couplings comprising a triangular steel tip, a center punch for the triangular tip, a rubber tip, a rubber funnel cup for pointed shafts, and an extension rod. The body is finished in black japan with nickel-plated trimming, and the case is covered with morocco. Three different types of instruments are provided, No. 1 for indicating revolutions from 100 to 1200 per minute, No. 2 for revolutions from 500 to 2500 per minute, and No. 3 for revolutions from 1000 to 5000 per minute. The size of the dial of all instruments is 4 in. in diameter.

Beaver Jr. No. 3 Pipe-Threading Tool

A compact ratchet pipe-threading device called the "Beaver Junior No. 3" has been added by the Borden Co., Warren, Ohio, to their line of die stocks and square end cutters. It is built on the unit plan as shown and

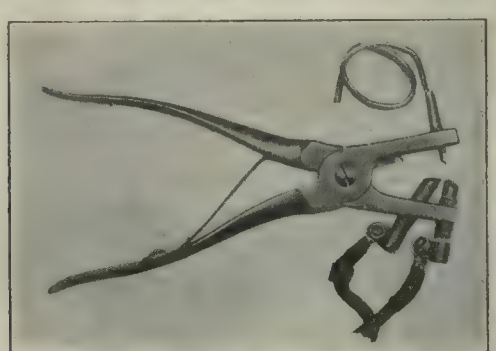


NO. 3 BEAVER JR. PIPE-THREADING TOOL

can be purchased complete or in separate units. The units will cut $\frac{1}{8}$-in., $\frac{1}{4}$-in., $\frac{3}{8}$-in., $\frac{1}{2}$-in., $\frac{3}{4}$-in., and 1-in. pipe threads. The complete outfit consists of a ratchet handle with dustproof casing about the ratchet and separate die heads to thread each size of pipe.

Hendrick Electric Soldering Device

The device shown in the illustration is for light soldering work and is being marketed by F. H. Hendrick, 513 Congress Building, Detroit, Mich. The metal to be soldered is heated between two carbon points by the resistance established. Closing the tool brings the solder into contact with the hot metal and does the soldering. The device is intended to be used with an ordinary 6-volt storage battery, but

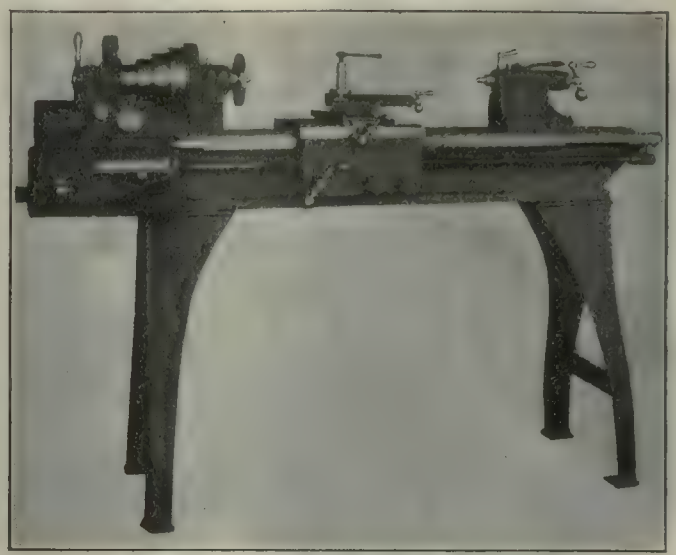


HENDRICK ELECTRIC SOLDERING DEVICE

ordinary lighting voltages can of course be used if stepped down. It is stated that as the heat is applied directly to the point where it is needed and is only used during the time necessary for soldering, the energy consumed is only about one-tenth of that required by other soldering irons of equivalent capacity. It is ready at all times and the workman does not have to wait until the iron becomes hot.

"Star" 11-In. Quick-Change Lathe

The Seneca Falls Manufacturing Co. Inc., Seneca Falls, N. Y., has just brought out the 11-in. lathe illustrated. This lathe has a quick-change gear equipment, consisting of a train of nine gears in the form of a cone mounted on the lead screw, the whole being en-



"STAR" 11-IN. QUICK-CHANGE LATHE

closed in the main gear box and controlled by one tumbler handle. By means of another tumbler carrying a set of compounding gears, 45 different changes of feeds and threads, from 3 to 96 including 11½, are secured. Any desired thread not given on the index plate may be obtained by using the necessary change gears on the feed stud. The web-pattern headstock has a hollow spindle with 1 in. hole and is made from 60-65 point carbon crucible steel. The carriage is gibbed front and rear and has power cross feed. The apron has a safety device so that opposing feeds cannot be engaged at the same time. This lathe may be used with any of the usual line of extra attachments.

Fitting a New Nut Under Difficulties

By J. B. Gray

A few days ago the nut on the vertical adjustment screw on our Lucas boring mill was stripped by reason of the head being run down too far. Our job was to replace this nut, and as the foreman did not want to remove the screw and no gage was available, this is the way the job was done.

A piece of cast-iron scrap was chucked in the lathe and bored to within $\frac{1}{8}$ in. of the outside diameter of the nut. It was then removed, drilled and tapped for a $\frac{5}{8}$-in. setscrew near the outer end. The piece was then rechucked and bored to a slip fit for the nut. In the meantime one of the boys had bored and turned the blank which was then placed in the chucked bushing, the $\frac{5}{8}$-in. hole scribed off and the blank countersunk enough to securely seat the screw. This of course rendered it possible to remove the nut at any time for trial on the end of the screw which was still in position on the boring mill, and to replace it in the lathe for further cutting without danger of it "running out" or of the thread tool not taking the lead properly. The nut was removed and tried five or six times, before a satisfactory fit was obtained.

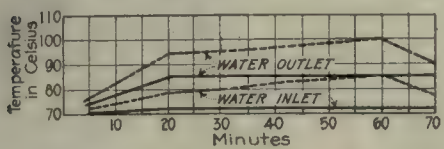


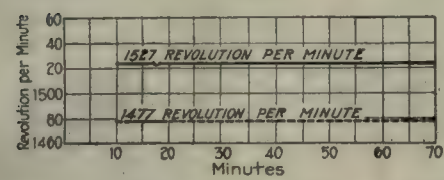
LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft - Motor Trucks - Tractors



To test both a generator-battery ignition system and the magneto-ignition system a 12-cylinder airplane engine was tested for 1 hr. and 10 min. The comparative results are





shown in the diagrams. The magneto-equipped motor gave 50 more revolutions per minute, using 3.13 gal. less gasoline and 0.75 gal. less oil than the other.

The recommendations of the National Advisory Committee for Aeronautics for legislation, placing the licensing and regulation of aerial navigation in charge of the Department of Commerce, has been submitted to the House of Representatives fully approved by President Wilson. The legislation would give the Department of Commerce authority to issue licenses for civilian operation of aircraft and provides an appropriation of $25,000 for necessary expenses.

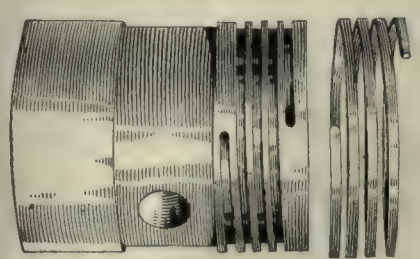
The Standards Committee of the S. A. E. has been considering the uniformity of the present practice for industrial truck-tire sizes. The tire and rim division of the committee recommends that the following truck tire and wheel dimensions be adopted as S. A. E. standard:

—Tire Dimensions— Nominal Diameter, In.	Sectional Widths, In.	—Wheel Dimensions— Wheel Diameter, In.	Width of Felloes, In.
10	3½	6	2¾
10	5	6	4¼
16	3½	12	2¾
16	5	12	4¼
20	3½	16	2¾
20	5	16	4¼
24	3½	20	2¾
28	3½	24	2¾

Wheel diameters shall be 4 in. less than the nominal tire diameters. The thickness of the finished tire is to be 2 in. for all sizes. The width of the wheel felloe is to be in accordance with the present S. A. E. standard truck-tire practice and the rim diameter tolerances will be plus 0.005 minus zero.

According to an Associated Press report, Harold Wolf has constructed an airplane which is driven by six 300-hp. motors. For performance it is sufficient to use only four motors. The six motors, which drive two four-bladed tractor and two four-bladed pusher propellers, are connected in such a way that it is possible to switch in or out any of the motors without affecting the speed of the propellers. It is further said that the airplane is equipped with a turn indicator to enable the pilot to keep the desired direction while flying on the darkest night or in the thickest fog. The machine has a span of 165 ft. and an overall height of 23 ft.

A new piston ring, as shown in the illustration, called the "Four in One Helix" was placed recently on the market. It is a coil of four complete circles in one continuous piece, giving an equal distribution of expansion over the full length of the ring and taking up the wear in the cylinder without



leaving any gaps. Another advantage of this ring over the usual piston-ring types is that sharp points and weak places that may break off and scar the cylinder are eliminated. Recently a large Holt tractor equipped with this piston ring was operated 24 hours a day for 32 days. When it was overhauled the rings were found to be in perfect order.

More than a score of aircraft types were exhibited at the Aeronautical Exposition held in New York, Mar. 1 to 15. Although the exhibits were for the most part essentially warlike in character, there were indications that the manufacturers are preparing to make strong bids for commercial orders in the very near future. A comparison of this show with the previous one brought out marked contrasts both in the developments which have taken place in motor and construction details and in the purpose back of the respective exhibitions. The first one was an endeavor to stimulate our preparations for war in the air while the present one is an attempt, and apparently a successful one, to interest the public in the peaceful possibilities of both heavier- and lighter-than-air machines. Close inspection of the planes brings out the fact that the use of standardized parts and fittings is growing with a speed that augurs well for the reduction of prices to a point within reach of the pocketbooks of others besides millionaires. Details of construction which indicate the opening of new fields for the machinery manufacturer include the large use of ply woods for which special machines must be developed, all steel wing construction the possibilities of which have hardly been realized, improvements in metal fittings which make them better suited to quantity production operations, and the introduction of balsa wood which has half the strength of spruce although it is extremely light. One manufacturer of large planes is using 3 per cent. chrome nickel steel for his fittings and sockets, and other examples of the use of the finest materials and the best workmanship are numerous. There are several different planes at the show with an official performance of better than 160 m.p.h. and with almost unbelievable rates of climb. In these machines the high development of streamline design and the location of the radiators either in the center section of the upper wing or alongside the fuselage are significant features. Better design of landing gears is evident in many cases. The Army and Navy exhibits were very complete and held the crowds, while the model exhibits of the Curtiss Company's research department and the instruments and scientific apparatus shown by the National Advisory Committee for Aeronautics attracted the technical men. The development of radio-communication, gunnery and gunnery training, and aerial photography were shown by the Army, and a small gage testing apparatus exhibit and a flock of carrier pigeons formed part of the Navy side-show. Foreign makers were represented and also the makers of spherical, kite and dirigible balloons. Engines exhibited ran from the two, three and four cylinder air-cooled models not much larger than motor-cycle motors through a wide range of sizes up to an 850-hp. model with 16 cylinders. Lightness of weight for the power developed and excellent materials and workmanship distinguished the larger ones which had been designed purely for war conditions. The general feeling except among some of the engine makers was one of optimism which bids well for a bright future for the airplane as a rapid conveyance for commercial purposes as well as that of pleasure.



Sparks from the

Polish Engineers Organize To Assist Trade

Will Give All Possible Information to American Business Men as to Polish Markets

Of all the so-called new countries in the peace conference, the most neglected, the least heard of, and the country which suffered most from German and Russian cruelty, is Poland. We all know about devastated Belgium but forget entirely that retreating German armies robbed Poland even of telegraph wires and left behind but 50 locomotives in a country of 21,000,000 inhabitants.

In spite of the cruelty of the three barbaric governments which ruled Poland before the great war, it was a good country to live in and offered good opportunities for the enterprising manufacturer. Its geographical location makes it the unloading center of the east European commerce. It is very rich in mineral resources, having plenty of coal, iron, copper and silver, and an ample supply of skilled labor to draw upon. Poland, before the outbreak of the war, was developing its manufacturing facilities and was supplying eastern Europe with the products of its manufacture.

This country, now free is showing a wonderful spirit of organization contrary to all expectations of her short-sighted enemies. The new government is fairly conservative to insure its stability, but progressive enough to satisfy the radical elements, and is gaining strength every day. She will soon need help to put her industries in shape, to give the farmer his tools, to give the laboring classes work, and as any dealings with her nearest neighbor are out of the question for years to come, it is timely and imperative to create a close commercial intercourse with the U. S. A.

The Society of Polish Engineers and Business Men recently organized with headquarters at the Engineering Societies Building, New York, and having among its members many men favorably known to American manufacturers, is working hand-in-hand with the present Polish government to create and facilitate such intercourse. A specially appointed committee collects such material and data as catalogs, descriptions and models of American products. These will be placed at the disposal of buyers from Poland and will inform the manufacturers in Poland as to prices, possible deliveries, best sources of supply and the like.

The society will gladly give all possible information to American business men as to Polish markets and selling possibilities. It is expected that this young institution will do its share in the great work of reconstruction of Poland and at the same time prove very useful to the business man and manufacturer of the country.

Kansas City Tractor Show

At the Fourth Annual Tractor Show held in Kansas City, Mo., Feb. 24 to Mar. 1, about 70 tractor manufacturers, nearly 40 manufacturers of tractor-tractors shown for the first time and drawn tools and tractor-driven machinery and more than 220 makers of tractor parts and equipment had exhibits in the temporary building erected for this purpose, containing 110,000 sq.ft. The main interest of the show was centered around the many new models of tractors shown for the first time and there were few tractors that did not have at least one new feature or improvement since last year. The show was characterized by the refinements of tractor design such as the inclosing of all running parts, proper lubrication and the installation of bearings.

When Fellers Needs Friends : : : By BRIGGS



Reprinted from New York Tribune

Business Items

The Betts Machine Co., Rochester, N. Y., has recently opened branch offices at 50 Church St., New York, with F. C. Severin in charge and also at 549 Washington Boulevard, Chicago, in charge of A. W. Van Buren.

The Aborn Steel Co. has opened an office and warehouse in Boston, Mass. This branch will be in charge of R. H. Smith as district manager. Mr. Smith was formerly with the Colonial Steel Co. and the Brown Wales Co.

The American Standard Metal Products Co., formerly the American Munition Co. of Bordentown and Paulsboro, N. J., has removed the machine and stock of the Bordentown plant to Paulsboro where it will continue to do business.

The Sullivan Machinery Co., Chicago, Ill., has established a branch office and warehouse at Edificio Oliver, No. 3, Mexico City, Mexico. Joseph F. Bennett for a number of years, sales engineer in Mexico, associated with the El Paso branch of this company, has been placed in charge of the Mexico City office.

The International Oxygen Co., Newark, N. J., has opened offices in the First National Bank Building, Pittsburgh, Penn., in charge of R. A. Cornwall. Philip Wesley, whom Mr. Cornwall succeeds, has been placed at the head of the Chicago sales office in the Railway Exchange Building.

Moltrup Steel Products Co., Beaver Falls, Penn., manufacturers of cold-drawn-steel shafting and screw steel, finished machine keys, finished steel plates and other steel specialties, announces the opening of its eastern branch office, Woolworth Building, New York. The agency is in charge of J. J. Callahan.

The Chicago Pneumatic Tool Co. has moved its Detroit office from 236 Hancock Ave. to 502 Farwell Building, Detroit, Mich.

The W. A. Jones Foundry and Machine Co., Chicago, Ill., manufacturers of power transmission apparatus, special foundry and machine work, and also the Jones spur gear speed reducer, has opened an eastern office at 30 Church St., New York, under the direction of Lemuel C. Bigelow, who for a number of years held a similar position with the Morse Chain Co., Ithaca, New York.

World's Industrial Forge

By E. C. Porter, News Editor

Personals

GRANT J. WOOLSTON, formerly of the Fulton Steel Corporation is now associated with the Aborn Steel Co., 22 Clarke St., New York.

THOMAS PRICE, who has been with the Midvale Steel Co., for over 20 years, is now with the Aborn Steel Co., Inc., at 22 Clarke St., New York.

NELSON B. GATCH was recently made district manager of sales for the Chicago Pneumatic Tool Co., Minn., with offices at 301 Metropolitan Bank Building.

J. K. HAIGH has recently been appointed assistant district manager of sales for the Chicago Pneumatic Tool Co. at the San Francisco office, 175 First St.

E. W. SNYDER, for many years with J. B. Sipe & Co., is now with the Hilo Varnish Corporation, Brooklyn, N. Y. He will make his headquarters in Pittsburgh and serve the trade in western Pennsylvania, eastern Ohio and northern West Virginia.

F. J. HENDERICK, formerly chief engineer of the Davenport Manufacturing Co., Davenport, Iowa, which during the war was engaged in making 240-mm. howitzers and the Blackhawk aeroplane for the Curtiss company, has joined the engineering department of the Hart-Parr Co., Charles City, Iowa.

EDWARD N. HAY, recently discharged from his commission of Captain of Ordnance, U. S. Army, has joined the Robert T. Pollock Co., 68 Devonshire St., Boston, Mass. He comes to this company after a thorough study of the latest manufacturing processes and methods of organization of some of the best known concerns in France, England and Scotland.

CALVERT TOWNLEY, assistant to the president of the Westinghouse Electric and Manufacturing Co., at the annual meeting of the Engineering Council, held Feb. 20, was reappointed chairman of the Water Conservation Committee for one year. He was also made a member of the Reconstruction Committee for the year terminating February, 1920.



Reprinted from Graphite

CHESTER MOTT has been appointed manager of the Denver, Colo., branch of the Sullivan Machinery Co., Chicago, Ill., succeeding Wallace T. Roberts, recently resigned. Mr. Mott has been associated with this company for several years past in the capacity of sales engineer at its Spokane, Wash., office.

SAMUEL ARONSON, formerly a member of the editorial staff of the *American Machinist*, and for the past two years secretary and sales manager of the Presto Machine Works, Inc., has acquired an interest in the newly organized Presto Phono Parts Corporation, 124 Pearl St., Brooklyn, N. Y., of which he has been elected president. The two corporations have been merged for manufacturing purposes.

The British Machine-Tool Situation

Preparations Being Made for Exhibitions Next Year—Good Prices Obtained for Used Machine Tools

The Machine Tool Association has been postponing its proposed exhibition from time to time during the war, and, while it has not as yet settled on a definite date, there seems to be indications that an attempt will be made to hold it this year. Whether the place of exhibition will be in London or not does not seem to have been settled. The municipal authorities of Glasgow, however, have apparently decided to hold an engineering exhibition during the spring of 1920, and this will include machine tools appropriate to the industries of that locality.

The postponement, if not abandonment, of several promising engineering plans, has increased the amount of unemployment in the vicinity of Glasgow. It is quite probable, however, that as soon as the present uncertainty can be relieved to some extent, considerable improvement will be made in many of the plants of various kinds in this neighborhood.

GLASGOW UNIVERSITY GETS $15,000

The Glasgow University has received about $15,000 for the founding of a lectureship on engineering production, which is to embrace the study of machine tools, the art of cutting metals, and the method of production. This is the gift of Mrs. Todd Loudon, and a similar sum is to come from the estate of her late husband. Whether this will include the installation of actual machine tools or not is not stated.

The shipbuilding trade of the Clyde is reported to be busy and a new concern known as the Greenock Dockyard Co., Ltd., with a capital of about $500,000, has been formed to build and repair ships at Greenock and Grangemouth. W. Beardmore & Co., Ltd., is beginning to manufacture locomotives at Clydebank. Other locomotive builders and all the makers of motor vehicles in this vicinity are full of orders, and some interesting new models are soon to appear.

Machine-tool builders are also in full operation, including machines for shipyards, and also jigs, fixtures, gages, and special tools. Even standard lathes and gear-cutting machinery are in good demand, as well as makers of motor-truck transmission.

The Manchester district is to a certain extent marking time, although, after allowing for canceled and modified orders on both government and private work, many orders for machine tools still remain on the books. There

is also a fair inquiry for machine tools from concerns which are readjusting themselves from war-time to peace products. There is a noticeable interest in appliances for handling material in and around the shops.

Smith and Coventry, Ltd., are building high-speed planing and powerful vertical milling machines, as well as lathes for relieving milling cutters. J. Spencer & Co., Ltd., Hollinwood, is busy with vertical drilling machines, especially for army transport repairs. They are also building other machines for this work. Dronsfield Bros., Ltd., are again building textile machinery and accessories and report an insistent demand from textile mills in both France and Belgium.

Conditions Around Birmingham

Conditions in and around Birmingham are gradually improving. One of the drawbacks is the difficulty of shop managers in accurately estimating the cost of their product as well as forecasting delivery dates which can be met. This is, of course, due to nearly everything being more or less indefinite, and the fact that the prospective buyer is not disposed to accept unlimited risks in either case. A rise in the price of iron and steel is looked for. In the iron and steel field, at least, it is reported that in spite of the rapid release of men from the army, the labor supply continues inadequate to balance the reduction of working hours. This does not seem to agree with the experience of machine builders, and may be partially due to the fact that the iron and steel industry, as carried on, is not an attractive occupation, and is in most cases only taken up when the man fails to secure satisfactory employment elsewhere.

Much repair work is being done in the readjusting of manufacturing plants to their old-time or at least to peace products of some kind. This is making an active demand for some lines of machine tools. Some of this demand is quite sure to be satisfied by the second-hand machinery which is being released by the demobilization of the national factories, and, while some of the special machines are of little value, there are many which can be used on regular products.

Auction Prices of Machinery

It is stated by the auctioneers of the National Shell Factory at Washwood Heath, that some of the machinery there sold for more than its cost, this being notably true in the case of electric motors and time-recording machines. Radial drilling machines sold for $1800, a 150-ton hydraulic press brought $850, and a double-sided power press $2500. In the toolroom equipment a 14-in. lathe sold for $800, an 18-in. lathe for $1500, and a 25-in. lathe for about the same price. A Cincinnati milling machine brought $1500, an unnamed vertical milling machine, $1100, and a 14-in. shaping machine, $850, while turret lathes of all kinds were in great demand.

London, Mar. 17, 1919.

British National Shell Factories Being Sold

Advertisements are appearing in the British daily papers with regard to the disposal of British shell factories and their equipment. One of these refers to the National Shell Factory at Grimsby, in which the plant and machinery are being sold at auction by direction of the Disposal Board. The equipment includes 80 lathes, six 8-in. bar cutters, 5 thread milling machines, and various items of electric motors, shafting, pulleys, hangers, chucks, gages, grinding wheels and the like.

The National Ordnance Factory at Armley-Road, Leeds, is also advertised for sale. The equipment comprises some 189 single-purpose lathes, 26 boring machines, 7 horizontal milling machines, 16 drilling machines, 30 grinding machines of various types, 9 turret lathes, 12 cutting-off machines, and other equipment in proportion.

The National Shell Factory at Barnsley is advertised together with 76 turret and single-purpose lathes, varying from 12 to 25 in. swing, 7 radial and sensitive drilling machines, 5 thread milling machines, 7 bar-cutting machines, 2 milling machines, 6 grinders, 1 slotting machine. At this plant one item of stores includes 3 tons and 17 cwt. of high-speed steel.

Export Opportunities

EXPORT OPPORTUNITIES

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A man in France desires to secure an agency for the sale of machine tools, tools, hardware, belts, oils, greases. Correspondence should be in French. Reference. No. 28,729.

A man in England desires to purchase and also to secure the exclusive agency for the sale of bright steel pins, milled both ends, in quantities of 2 cwt., ⅞ in. x 14 gage; 4 cwt., § in. x 14 gage; and 2 cwt., § in. x 17 gage. References. No. 28,725.

An engineer in France desires to secure a general agency for the sale of pneumatic hammers and woodworking machines. Correspondence should be in French. Reference. No. 28,689.

A commercial agent in France desires to secure an agency for the sale of machines, machine tools, steel, and motors. Correspondence should be in French. Reference. No. 28,709.

A man in France desires to secure an agency for the sale of motor cars, electrical appliances and supplies, hardware, tools, machinery for contractor's plant, carriage, hardware, etc. Correspondence may be in English. References. No. 28,670.

A company in Norway desires to secure an agency for the sale of wrought iron, T-irons, channel iron, rails, plates for shipbuilding, etc., and iron and steel. Payment against documents in New York. Reference. No. 28,666.

A firm in Norway desires to secure an agency for the sale of electrical materials, such as cable, wire and accessories, and insulating materials; woodworking, metal, and ironworking machinery and tools; concrete-making machinery (molds, mixers, etc.); belting, packings, hose, etc.; raw materials, as carborundum, corundum, emery; oils, greases, wax, paraffin, varnishes; bookbindery machines; and engineering and building equipment. Correspondence may be in English. References. No. 28656.

A firm in Italy desires to represent manufacturers of metal-working machines, woodworking machines, hand tools, motors and implements for motorboats and aircrafts, and other industrial supplies. No. 28628.

Obituary

Clarence W. Hobbs, former president of the Hobbs Manufacturing Co., died of heart disease at his home in Worcester, Mass., Feb. 20, 1919, at the age of 67 years.

F. A. Falkenbach, sales manager of the Modern Tool Die and Machine Co., Columbus, Ohio, died on Mar. 14, 1919, at Youngstown, Ohio.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, April 15, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, New York.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

New Jersey Foundrymen's Association. Regular meeting, Apr. 2. An illustrated lecture on sand-blast equipment, to be given by H. D. Gates of the Pangborn Corporation, Hagerstown, Md.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, Apr. 28, 29 and 30.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

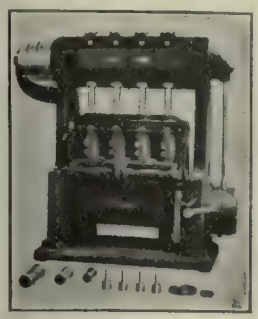
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Boring Machines, Gasoline-Engine Cylinder

Defiance Machine Works, Defiance, Ohio

"American Machinist," March 6, 1919



These are single-purpose production machines and are very similar except in size, the No. 7 machine taking 36 in. between housings, the No. 8 machine 48 in. between housings and the No. 9 machine 60 in. between housings. The machines are for rough, semi-finish or finish boring gas-engine cylinders of either single units or with any number of units cast en bloc. The drive to the spindle is transmitted from a three-step cone pulley through steel worms and bronze worm gears. The spindles are made of hammered stock and each one is supported by three bronze bearings. The boring tool is fitted to the spindle by means of a tapered shank and is held securely in place by means of a long bolt passing up through the spindle to the top. The oiling system is a particular feature of the machine.

Demagnetizer, "Bulldog"

Electric Brazing and Welding Machine Co., 30 Church St., New York City

"American Machinist," March 6, 1919

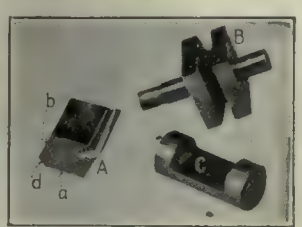


The purpose of this machine is to demagnetize cutters, flat tools, gages, rings, bearings, etc., that have been magnetized by being placed on magnetic chucks or by other causes. The device is intended to be attached to the ordinary electric-light circuit and the only operation necessary to demagnetize a piece of work is to pass it over or between the pole pieces as shown in the illustration.

Thread Tool Accessories

Arrow Tool Co., 200 Cannon St., Bridgeport, Conn.

"American Machinist," March 6, 1919



Three devices for the accurate grinding and setting of threading tools. At *A* is a jig for grinding the ordinary form of tool used in the P. & W. holders. With the jig resting on the surface *a* one angular face of the tool may be ground, and turning the jig to rest on surface *b* the opposite angle is brought into position. Setting the jig on surface *c* the tool is ready to be ground on the top to the correct angle, while resting it on surface *d* enables the operator to remove the apex of the angle to conform to the U. S. standard form of thread. The width of the flat can be computed from micrometer measurements taken over the surface *d* and the apex. At *B* is a setting gage with grooves of four different angles. In use it is mounted on a mandrel, as shown, and placed between centers in the lathe. Before setting the threading tool to gage *B* the gage *C* is used to bring the top of the tool exactly to center.

Racks for Long Bar Stock

Kent Machine Co., Kent, Ohio

"American Machinist," March 13, 1919

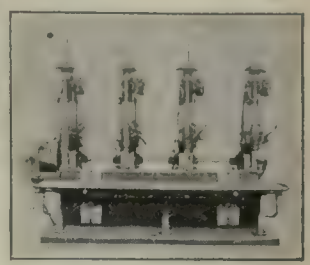


The arms are made in single sectional units which may be spaced any distance apart to accommodate the length of stock to be held. Each unit is made of a number of interlocking sections so that any number of arms and any height of unit may be obtained. The base is heavy and projects out beyond the longest arm, thus keeping the center of gravity of the load within the area of footing. The base is provided with a projection at the outer end in order that it may be used for holding stock. The spacing of the arms is varied by using interlocking space collars and large spaces may be obtained for light bulky material, such as tubing. All arms and spacing collars interlock with the base and with the combination of adjustable spacers and arms furnished, practically any rack size can be secured.

Drilling Machine, Multiple-Head, Gang

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.

"American Machinist," March 6, 1919



A 26-in. adjustable-head, gang drilling machine of the four-spindle type, one of the chief features being the lateral adjustment, which gives a spindle range from 18 in. minimum between any two adjacent spindles to a maximum of 96 in. between the two outside spindles. The first spindle at the left next to the driving pulley is fixed. The machine is all-geared, there being eight geared speeds and eight geared feeds for each spindle and all are independent of one another. The capacity is up to 2 in. solid drilling in steel and it will bore out cast-iron cylinders up to 8 in. in diameter.

Pumps, Lubricant, "Little Niagara"

Hudson Pump Co., 17 Merseles St., Jersey City, N. J.

"American Machinist," March 6, 1919



At present made in two sizes, No. 0 and No. 1, having capacities of 5¼ and 11 gal. per min. respectively. The idea in bringing forth this pump was to provide a device with a large delivery at slow speed and containing no parts such as check valves, springs, gears, sliding blades, etc. The piston is made from a single casting having two openings, one on each end, these being larger than the suction or discharge to eliminate the possibility of clogging. The piston is driven by the rotor, and the ends being machined at an angle impart a back-and-forth motion that gives the pumping action. The unique feature is the fact that the flow can be reversed with the pulleys running in the same direction by simply turning the heads of the pump 180 deg. Size 0—Capacity, 5¼ gal. per min.; pipe size, ¾ in.; size of pulley, 3½ in.; belt width, 1 or 1¼ in.; weight of complete pump, 12⅜ lb.; extreme length, 8½ in. Size 1—Capacity, 11 gal. per min.; pipe size, 1 in.; pulley size, 4 in.; width of belt, 1¼ or 1½ in.; weight of complete pump, 23 lb.; extreme length, 10¾ in.

Racks for Short Bar Stock

Kent Machine Co., Kent, Ohio

"American Machinist," March 13, 1919

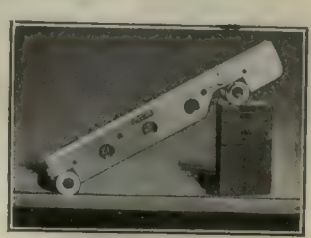


A three arm sectional interlocking unit complete in itself for the storage of short lengths of stock. Each unit is made up of a number of interlocking sections so that any number of arms and any height of unit may be obtained. The base is heavy and projects out beyond the longest arm, thus giving stability and keeping the center of gravity of the load within the area of footing. The spacing of the arms is varied by using interlocking space collars and large spaces may be obtained for light bulky material, such as tubing. All arms and spacing collars interlock, and with the combination of adjustable spacers and arms furnished, practically any rack size can be easily secured.

Sine Bar, "Loway"

A. F. Way Co., Inc., Hartford, Conn.

"American Machinist," March 13, 1919



The material used in the construction of the bar is all heat treated. The two rolls on which all measurements are made are inserted in two right-angled notches cut in the side of the sine bar and held in place by small coil springs passing through the sides of the rolls and into the sine bar, the ends being held by small pins. This construction is used to prevent any distortions and to keep the rolls in place at all times. The bar is provided with three holes, by which it can be attached to an angle plate. A feature of the outfit is the table of vertical setting constants, which gives at a glance the distance the high end of the bar must be raised in order to give any desired angle, this distance generally being secured by means of size blocks.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$34.60	$34.60
Northern Basic	31.80	31.80
Southern Ohio No. 2	32.80	32.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	36.15
Southern No. 2 (silicon 2.25 to 2.75)	39.95	39.95
BIRMINGHAM		
No. 2 Foundry	31.00	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	33.35*	36.15*
Virginia No. 2	35.10†	38.10†
Basic	33.90*	33.90*
Grey Forge	33.90*	33.90*
Bessemer	.....	.....
CHICAGO		
No. 2 Foundry Local	31.00	31.00
No. 2 Foundry Southern	37.25	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	31.00
Basic	30.00	30.00
Bessemer	33.60	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.07	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	3.97	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	3.97	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.27	4.27	4.45	4.47*	4.39	4.27	4.45

* For ⅜-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$2.25	$3.50
Warehouse, New York	4.17	4.70
Warehouse, Cleveland	3.82	3.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.22	6.45	5.40	6.385	6.22	6.45
*No. 26 black	4.60	6.12	6.12	6.35	5.30	6.285	6.12	6.35
*Nos. 22 and 24 black	4.55	6.07	6.07	6.30	5.25	6.235	6.07	6.30
Nos. 18 and 20 black	4.50	6.02	6.02	6.25	5.20	6.185	6.02	6.25
No. 16 blue annealed	4.10	5.37	5.37	5.65	4.80	5.585	5.37	5.65
No. 14 blue annealed	4.00	5.27	5.27	5.55	4.70	5.485	5.27	5.55
No. 10 blue annealed	3.90	5.17	5.17	5.45	4.60	5.385	5.17	5.45
*No. 28 galvanized	6.05	7.57	7.57	7.70	6.75	7.635	7.57	7.70
*No. 26 galvanized	5.75	7.27	7.27	7.40	6.45	7.335	7.27	7.40
No. 24 galvanized	5.60	7.12	7.12	7.25	6.30	7.185	7.12	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 10%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
3/16, 11/64, 5/32, 1/8, 7/64, 3/32 No. 8, 7/64 and No. 10	25.50 to 33.00	3/16 by 12 in. long	14.00
No. 12		1/8 by 19 in. long	12.00
7/64, No. 14 and 1/16		3/16 by 19 in. long	10.00
No. 18		1/4 by 21 in. long	10.00
No. 20		Special Welding Wire, Coated	
Domestic 20c. for 1/16, 15c. for 1/8 to 5/32.		1/16	33.00
		5/64	30.00
		1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.57	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Jan. 1, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	47%	20⅓%	⅜ to 1½	36%	20%
½	51%	36⅓%			
¾ to 3	54%	40⅓%			

LAP WELD

2	47%	34⅓%	2	29%	15%
2½ to 6	50%	37⅓%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25⅓%	⅜ to 1½	36%	21%
½	48%	35⅓%			
¾ to 1½	52%	39⅓%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33⅓%	2	30%	17%
2½ to 4	48%	36⅓%	2½ to 4	32%	20%
4½ to 6	47%	35⅓%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	43%	27%	43%	26%	44.9%	29.9%
3½ to 6 in. steel lap welded	38%	23%	39%	23%	40.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.00	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.25	5.10	7.75
Spelter	6.47½	6.85	7.75
ST. LOUIS			
Lead	5.00	4.80	7.10
Spelter	6.12½	6.50	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	24.50	32.50	28.50	36.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	28.50	22.00	33.50
Brass sheets	18.75	23.75–28	30.75	25.00	32.00	23.50	33.50
Brass pipe	28.00	34.00–37	36.50	33.00	38.00	30.00	38.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	41.50	48.50	39.00	40.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	28.00	35.00

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MANUFACTURE OF HOKE PRECISION GAGES AT THE BUREAU OF STANDARDS



By H. L. VAN KEUREN

Chief of Gage Section, Bureau of Standards, Washington, D. C.

Here is the first published account of the manufacture of precision-gage blocks at the U. S. Bureau of Standards. This process up to now has been considered a military secret. Gage blocks are being produced at the bureau with an accuracy limit of a few millionths of an inch.

OF PARTICULAR interest to mechanics, manufacturers and engineers is the development and perfection of a commercial manufacturing process for making precision gages to within an accuracy of a few millionths of an inch. Fig. 1 shows one of the several sets of precision gages which have been completed at the Bureau of Standards. The gages are of cylindrical cross-section rather than of rectangular cross-section, for the reason that greater wearing surface is secured, additional application for direct measurements are possible and, furthermore, the cylindrical gage is more economically manufactured. The qualities of these flat end gages which permit their being wrung together and built up, as shown in Fig. 2, is quite generally understood. It is apparent that the cylindrical gages may be readily wrung from any direction and, therefore, the wear tends to be more uniform than with oblong shape where the blocks are wrung from the ends.

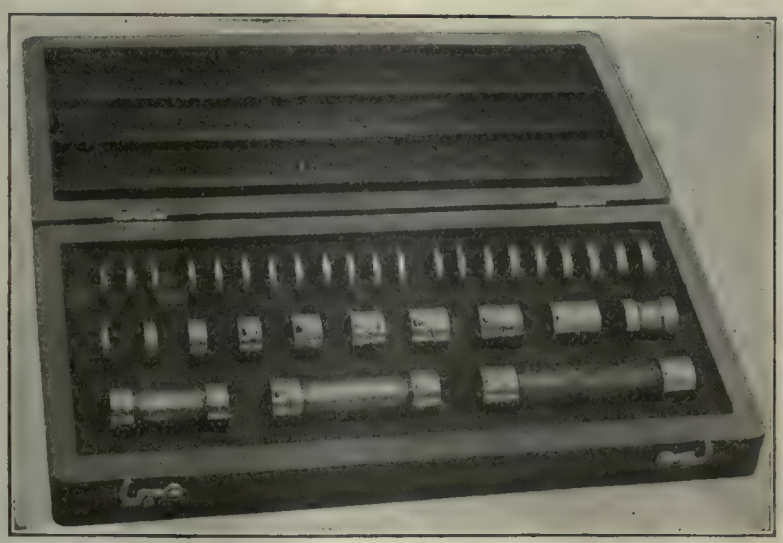


FIG. 1. A TYPICAL SET OF PRECISION GAGE BLOCKS MADE AT THE U. S. BUREAU OF STANDARDS

When it is considered that these gages are being produced to within five-millionths of an inch (0.000005 in.) for length, flatness and parallelism of end surfaces, and that the development of the process of their commercial manufacture has taken place in a period of about six months, the achievements represented in the development of the manufacturing process will be realized. In the Hoke gages manufactured at the Bureau of Standards, the unit of measure has been one-millionth of an inch (0.000001 in.). While it is comparatively easy to produce blocks the surfaces of which are flat and parallel within 0.000001 in. or 0.000002 in., it is more difficult to retain the absolute length within this amount owing to the variation in the material, temperature conditions, and conditions in the abradants used. However, with special care, gages can be produced accurate in length to within 0.000001 in. or 0.000002 in. As a commercial product, gages which are accurate to within 0.000005 in. are of more than the required accuracy.

One of the investigators of this problem was Mr. William E. Hoke of St. Louis, Mo., who began experimenting and studying the production of these blocks about four years ago. Like many other similar problems, impetus was given by the needs of the government and American manufacturers in carrying out this program for producing munitions during the recent war.

In a letter under date of May 4, 1918, Mr. Hoke advised the Bureau of Standards that he had, after spending about three years in experimental work, de-

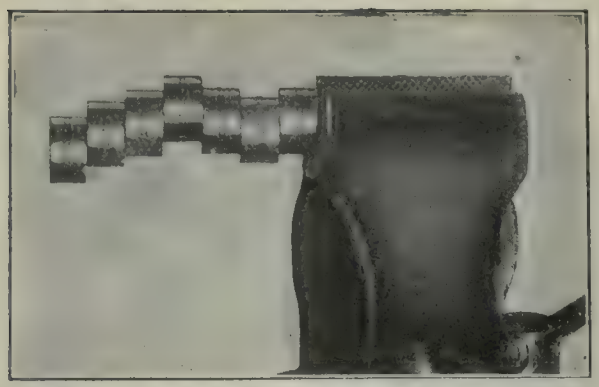


FIG. 2. A NUMBER OF "HOKE" GAGE BLOCKS WRUNG TOGETHER

vised a method for producing gage pieces in quantity for a system of gages similar in principle and use to the Johansson or Swedish gages but entirely different in form. This matter came to the attention of the writer, with the result that in a letter of May 15 it was suggested that sample blocks be submitted to the Bureau of Standards for investigation and, if possible, a conference be arranged. In a subsequent letter of June 17, an invitation was extended to Mr. Hoke to visit the Bureau of Standards as the bureau was equipped to be of service in the way of perfecting the manufacture and test of the gages in the shop organized by the gage section. As a result of this invitation work was immediately started on the design of an experimental machine for demonstrating the manufacture of gages of the required accuracy.

During the period that the experimental machine was being developed at the Bureau of Standards, the utility of the invention for the use of the War Department was being considered. The patents branch, contract section, procurement division, forwarded the description of the device through military channels to Lieut.-Col. E. C. Peck, gage section, engineering division, Ordnance Department. As a result of this investigation by the War Department, Colonel Peck on July 8 reported that the invention looked feasible and suggested that a sum of money be provided to equip a shop for the manufacture of these gages and for the use of the government inspectors. On July 20, the operation of the preliminary machine was demonstrated to Colonel Peck. In a letter under date of July 22, it was stated that 0.112-in. samples were produced of the same length within 0.000002 in. and with flat surface within 0.000004 in. at 20 deg. C. measuring 0.112008 in. On Aug. 8, an allotment of $50,000 was set aside to cover the cost of the work to be done by the gage section of the Bureau of Standards. The work was immediately started to secure the necessary machine tools and other equipment for producing the gage blanks and for performing the various finishing operations. Experimental work was also initiated in connection with the various problems to be solved, such as, proper material, heat-treatment, finish, permanency and measurement. Up to Feb. 1, 1919, there have been produced at the Bureau of Standards in the neighborhood of 1700 gages which are accurate in flatness, parallelism and dimension within about 0.000005 in. This has been accomplished in spite of the fact that the delivery of the machine tools required for the production of the gages was considerably delayed, the complete equipment not being available until about Dec. 15; and also in spite of the fact that it was necessary to overcome many difficulties arising in connection with securing the proper steel, heat-treatment, seasoning and in securing the proper degree of finish on the gages. The full coöperation extended by Dr. S. W. Stratton, Director of the Bureau of Standards and the advice extended by Lieut.-Col. E. C. Peck, Ordnance Department, on many problems arising in the manufacture of the gages, has made it possible to overcome the many difficulties and realize success at an early date in the undertaking. The experimental work in developing the manufacture has been carried out entirely at the Bureau of Standards under the supervision of the gage section. In this experimental work, Major Hoke, representing the gage section of the engineering bureau, Ordnance Department, and Mr. H. N. Mercer of the gage section of the Bureau of Standards have contributed very largely towards the success of the development. The measurement of the gages by the light wave interference method was worked out and applied by Mr. C. G. Peters of the optical division, Bureau of Standards.

Manufacture

One of the first problems which arose in the manufacture of the gages was the selection of a suitable material. An analysis of the conditions to be fulfilled is shown in the following list, which gives the qualities of the material desired in order of their importance: 1. Suitable coefficient of expansion. 2. Permanency. 3. Wearing qualities. 4. Resistance to corrosion. 5. Susceptibility to high polish. 6. Ease of machining. 7. Uniformity of material.

In the selection of a suitable material, many possi-



FIG. 3. MARKING THE GAGE BLOCKS IS SHOWN AT THE LEFT. AT THE RIGHT THE OUTSIDE DIAMETERS ARE BEING GROUND

bilities such as, agate, fused quartz, stellite, invar, packhardened machine steel and tool steel, were given careful consideration. Agate, fused quartz, stellite and invar may be eliminated, owing to the fact that their coefficients of expansion differ very materially from that of steel. While invar was suggested on account of the fact that it does not expand when heated or cooled or, in other words, under ideal conditions has a coefficient of expansion of zero, it is in reality least suitable of any of the previously mentioned materials for use in making precision gages. In practically every case these precision gages are used for verifying or measuring other gages which are of steel or pieces and parts made of steel. If it is desired to ascertain the length of a gage or part at a standard temperature of 68 deg. F. and a standard made of invar was used, it will be necessary that the measurement be made exactly at the standard temperature or that the temperature be recorded and a correction made for the amount the gage expanded or contracted from the standard temperature of 68 deg. F. to the temperature at which it was measured. In the case of the steel gage being measured with the invar standard, the gage should and the invar standard does not expand. If, however, the standard is of steel it expands the same amount as the steel gage being measured and the measurement can be made at any temperature.

STEEL RECOMMENDED BY METALLURGICAL DIVISION

	Johansson	Bureau of Standards	Material Used
Carbon	1.19%	1.00% to 1.25%	0.99%
Chromium	1.23%	1.00% to 1.50%	1.47%
Manganese	0.11%	Not more than 0.20%	0.35%
Silicon	0.24%	0.15% to 0.25%	0.24%
Nickel	0.39%	0.25% to 0.50%	None
Phosphorus	0.026%	As low as possible and less than 0.03%	0.012%
Sulphur	0.012%	As low as possible and less than 0.03%	0.026%



FIG. 4. AT THE RIGHT THE OPERATOR IS GRINDING THE EDGE RADIUS. THE PRECISION LATHE AT THE LEFT IS RIGGED FOR LAPPING THE COUNTERSINK

Recommendations of Metallurgical Division

The use of packhardened machine steel as a material for precision gages, was eliminated, owing to the fact that it was believed that after manufacture the soft core would tend to change differently than the hard shell. This has been verified by experiment to some extent, but is still under further investigation. The problem then being restricted to the use of tool steel, it remained to determine which grade and composition of tool steel would best suit the purpose. After making chemical analyses of Swedish gages, and after giving careful consideration to the qualities desired, a steel was suggested by one metallurgical division of the Bureau of Standards, having a chemical composition as indicated in the following table. The steel used corresponded as closely as possible to the recommendations of the metallurgical division with the exception of the nickel content which, as specified, was non-essential.

It will be noted that the carbon content of from 1.00 to 1.25 per cent. corresponds to the regular tool-steel carbon content. The chromium content of from 1.00 to 1.50 per cent. is essential for its qualities in preventing corrosion; for its beneficial effect on the wearing qualities and, also, on the reduction of warping or change during hardness. The percentage of nickel from 0.25 to 0.50 per cent. is not enough to be of material benefit in preventing corrosion and the absence of nickel in the material used makes but little difference. The content of the other elements specified corresponds closely to a good grade of tool steel.

Schedule of Operations

The various operations required for producing finished gages are listed in the following table:

Number of Operation	Description of Operation	Machine Used
1	Stock	
2	Turn, drill, ream, countersink one side, cut off	Cleveland automatic
3	Rough grind the cut-off side	Blanchard vertical surface grinding machine
4	Countersink the cut-off side	Drill press
5	Mark size	Dwight-Slate marking machine
6	Heat-treat	Hardening room
7	Rough grind faces	Blanchard vertical surface grinding machine
8	Season	Hardening room
9	Finish grind radius on edges	Sloan & Chase lathe
10	Rough lap	Hoke lapping machine
11	Inspect	
12	Lap countersink, both sides	Sloan & Chase bench lathe
13	Finish outside diameter	No. 10 Brown & Sharpe cylindrical grinding machine and on walrus hide buff
14	Finish lap faces	Hoke lapping machine
15	Final inspection and measurement	Optical laboratory
16	Assemble in sets	
17	Pack and ship	

Machining Rough Blanks.—The rough blanks are machined from 1-in. annealed bar stock with a Cleveland automatic screw machine. In this operation the blanks

are turned to ¾ in. diameter; $\frac{3}{16}$-in. hole is drilled and reamed through the center of the blank; a 90-deg. countersink, having a diameter of ½ in. on the finished face, is put in one face of the gage; it is chamfered on both edges with a pronounced radius; it is then cut off to the required thickness. The machining is complete in this operation with the exception of putting a countersink in the cutoff face.

In the next operation, the cutoff face of the gage is rough-ground on the Blanchard surface grinding machine, and the gage is brought down in thickness to within about 0.010 in. above the finished size. This operation facilitates the next operation, No. 4; namely, countersinking the cutoff side, which is done with an ordinary drill press.

In operation No. 5, the dimension of the gage and other identification marks are rolled in the edge with the use of a Dwight-Slate marking machine, as shown in Fig. 3.

In the hardening operation, No. 6, the gages are preheated slowly to a temperature of from 800 to 1000 deg. F. They are then placed in a lead pot and heated to a temperature of from 1550 to 1569 deg. F. In quenching the gages from this temperature, it has been found desirable to quench into water through oil as this treatment results in gages which are of sufficient hardness (the resulting hardness ranging from 90 to 95 deg. scleroscope scale) and the number of cracked gages is reduced to a minimum. It has been found best to use different depth of oil on top of the water tank, using a greater depth of oil for long gages than for short gages.

Rough-Grinding Faces

In operation No. 7, rough-grinding the faces, which is done on the Blanchard surface grinder, the gages are brought down to within about 0.005 in. of the finished size, care being taken to grind each face an approximately equal amount in order to have the countersinks of equal depth at each face of the gage. In the rough-grinding with the Blanchard Surface Grinder, a soft wheel and an excess of water is used in order to eliminate as far as possible surface cracks which might develop in the grinding operation.

In operation No. 8, the gages are given a seasoning treatment, which consists of dipping them alternately in boiling water and ice water about 30 times. The gages are held in the boiling water and in the ice water only for a sufficient period to insure that the pieces have reached the temperature of the boiling water or ice-water bath. In connection with the seasoning treatment, it will be mentioned that experiments carried out in which the gages were dipped alternately in boiling water and liquid air, show that the gage undergoes a very pronounced change in size and shape during the first two or three cycles but that after seven or eight cycles they remain practically constant. In the seasoning treatment with boiling water and ice water the same changes occur but a larger number of cycles are required for the seasoning process.

In operation No. 9, the radius on the edges is finished by grinding. This is accomplished on a Sloan & Chase bench lathe, as shown at the right in Fig. 4. In this operation, any burrs on the edges of the blanks which might scratch the laps used in subsequent operations, are removed.

In operation No. 10, the gage blanks are rough-lapped on the Hoke lapping machine. In the rough-lapping, a coarse abradant is used and the lapping proceeds quite rapidly. Only about 60 minutes' lapping is required to reduce a batch of 50 gages from about 0.002 in. oversize to 0.0005 in. oversize.

In operation No. 11, after the rough-lapping operation, the gages are inspected for any fine surface cracks which may have developed during the hardening or grinding. For this inspection a very sensitive test was discovered, which is of particular interest on account of its simplicity. In this test for cracks the gages are immersed in coal oil which has in suspension fine steel particles resulting from the lapping process. The gages are then removed and the steel or iron particles arrange themselves in the magnetic field, emanating from the cracks, with the result that a very pronounced streak of black iron particles indicates the fine crack which would not be discovered with the naked eye or even with the use of a magnifying glass or microscope.

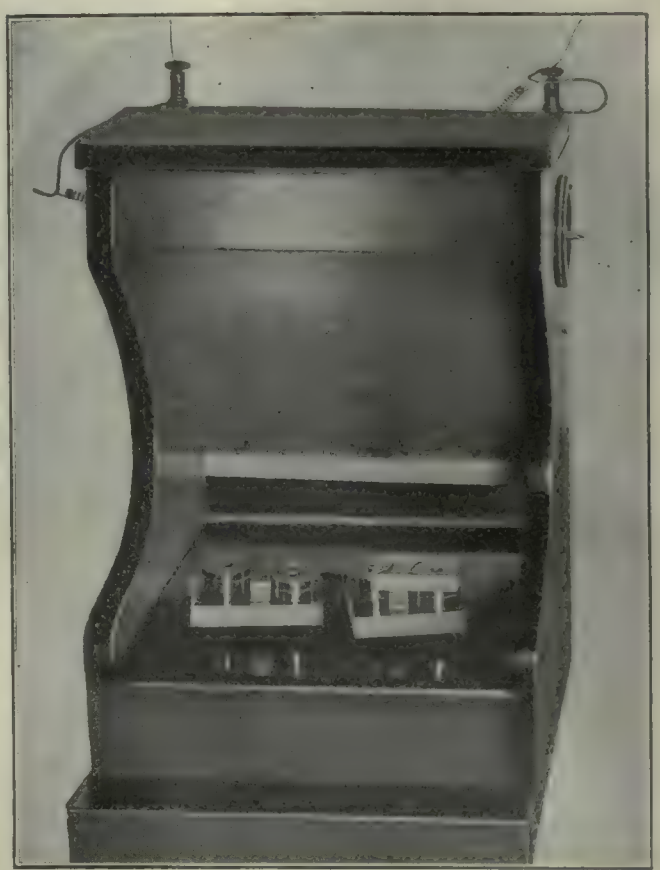


FIG. 5. APPARATUS USED IN TESTING FLATNESS AND PARALLELISM TO ONE MILLIONTH OF AN INCH

In operation No. 12, the gages which pass inspection are prepared for final lapping, in that the countersink is finished by lapping. This is performed on a Sloan & Chase bench-lathe outfit, as shown at the left in Fig. 4. In this rig the gage is held in a split chuck and the countersink is lapped by a copper lap charged with emery, the copper lap having the form of the countersink and being given a movement back and forth from the center line of the work at an angle of 45 deg. with the face of the gage. This movement produces a 90-deg. countersink and tends to hold the shape of the lap at its proper form.

In operation No. 13, the outside diameter of the gage is finished by buffing, or by grinding and buffing; the

shorter gages are finished by buffing only, while the longer ones are ground to true them up prior to buffing. When the gages are ground on the outside diameter, a Brown & Sharpe No. 10 cylindrical grinding machine as shown in Fig. 3 is used.

The finish-lapping of the gages (operation No. 14) is done on the Hoke lapping machine. While it requires no particular skill, it must be executed under careful supervision and a definite procedure must be followed, in order to insure that the gages are lapped to proper size, and of a suitable finish. In this operation about 50 gages are lapped in an operating time of about two hours. In the reduction of the gages to the proper size, it is necessary to keep the supply of abradant constant, the speed of the machine constant, and as far as possible all conditions uniform, in order that the lapping may proceed at a uniform rate. The gages are measured from time to time, the rate determined, and are gradually brought down to the required size within 0.000005 in. In many instances

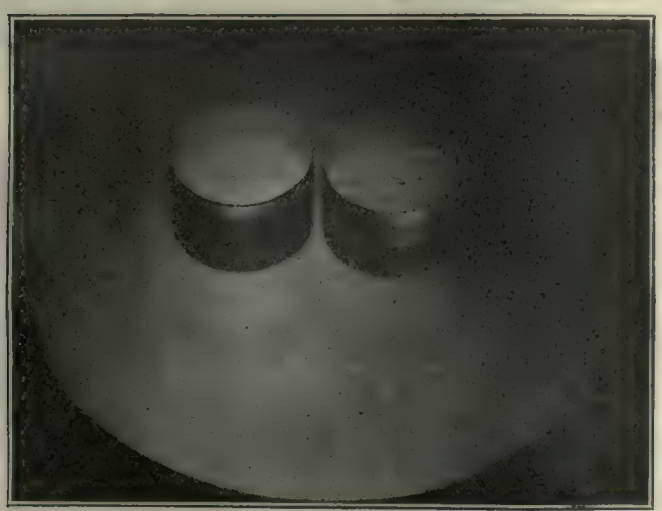


FIG. 6. PHOTOGRAPHIC ILLUSTRATION OF THE INTERFERENCE METHOD, SHOWING LIGHT WAVE LINES

gages are produced in which nearly all the gage pieces are correct in length within 0.000001 in. or 0.000002 in. For instance of a batch of 53 gages of nominal dimension 0.1005 in., 31 were absolutely correct to the sixth decimal place (measured 0.100500 in.) and the others were within 0.000001 in. or 0.000002 in. of the correct size.

The final inspection listed under operation No. 15 is made in the optical laboratory with the use of the light wave interference method. Fig. 5 shows the only apparatus required for making direct comparisons of length for testing the flatness and parallelism of the end surfaces to within 0.000001 in. This apparatus includes only two optical glass flats and a source of light of one color. In Fig. 5 the gages mounted between the glass flats are ready for comparison by examining the interference waves resulting from light reflected from the ground glass placed above the gages at an angle of 45 deg. and reflecting the rays of light emitted from a vacuum tube containing helium gas. Instead of a light from a helium tube, there could be substituted a light from a mercury-vapor lamp, such as known commercially as the Cooper-Hewitt lamp. The use of a source of light of one color, such as a helium tube or a mercury-vapor lamp, is not necessary in the light wave interference method. Either daylight or artificial light may be used, but in this case the interference bands resulting are made up of several colors merging into one another, while with the use of a light of one color, the interference bands take the form of more definite light and dark spaces or bands, which facilitate the inspection.

In the complete determination of the accuracy of the gages by the light wave interference method, the following procedure has been adopted:

1. Select from a batch of gages to be measured, one nearly perfect in flatness and parallelism of end faces.
2. Determine its absolute length by the light wave interference method.
3. Compare the remainder of the batch of gages with length of standard previously determined.

The determination of the absolute length of a block by the light wave interference method while not difficult or tedious, is not explained here in detail for the reason that it involves rather a complicated computation. Briefly, the process consists of wringing two glass plates on each end of the gage and with suitable apparatus determine the number of light waves between the gage planes. Inasmuch as the exact number of light waves in a length represented by the international standard meter has been determined to within an accuracy of about one part in 15 million, the length of a light wave is very definitely known and is constant. Therefore, the determination of a number of light waves between the two glass planes on each end of the gage is equivalent to determining its exact length to a high degree of accuracy. The comparison of the length of a gage with a standard and the determination of the flatness and parallelism of the end faces is very easily accomplished with the apparatus as shown in Fig. 5.

Light Wave Interference Method

The principle utilized in the light wave interference method will be explained with reference to Fig. 6. Here, two circular glass flats are shown in contact with a larger glass flat, and the interference bands resulting from interference of the light reflected from the bottom surface of the upper flat and from the top surface of the lower flat, are in the form of straight lines. The fact that the interference bands are straight indicate that the two reflecting surfaces are flat. If the one surface was flat and the other surface convex or concave, the bands would assume the form of concentric circles.

It will be noted that the reflection of the interference bands resulting from one of the glass flats are at right angles to the interference bands resulting from the other glass flat. This is due to the fact that the air between the upper glass flats and the lower glass flat is in the form of a wedge, the point of the wedge on the other case. The bands resulting from the wedge of air between the two surfaces indicate both the position of the wedge and the magnitude of the taper. In the glass flat at the left, the bands are relatively close together. This flat indicates that the taper of the wedge of air is relatively steep. The fact is that each interference band shows that the surface of the upper glass flat at this point is approximately 0.00001 in. higher than the point on the surface corresponding to the preceding band. Thus on the small flat at the left, 13 interference bands may be counted, which indicates that the edge of the top flat shown at the left, near the center of the figure, is approximately 0.00013 in. higher or lower than the edge at the left of the figure. In a similar manner, the four bands shown in

the flat at the right indicates that the edge of this flat near the observer is 0.00004 in. higher or lower than the edge away from the observer. Were one of the small upper flats to be brought into absolute contact with the lower flat the interference bands would disappear.

Thus, it will be seen that from the shape of the bands, the character of the surface as to whether it is flat, spherical, concave, convex or of other complicated form, can be determined, and furthermore, that from the distance between the interference bands, the amount that the surface deviates from a plane can be determined. In reality the interference bands may be likened to a contour map where irregular lines show elevations at intervals of 10 or 100 ft. as may be the scale of the map. In the comparison of a number of gages of the same nominal size with a standard, generally two gages are compared at once with a known standard as shown in Fig. 5. The latter illustrates the use of a previously standardized Swedish gage as a standard for comparing two gages which are placed at each side of the Swedish gage. All three gages are wrung on the lower optical flat using a drop of alcohol which results in bringing the gages in practically absolute contact with the glass flat eliminating all air. Another glass plate optically flat is laid on top of the gages and by noting the character and direction of the interference bands on all three gages, it can be ascertained at a glance whether the gages are longer or shorter than the standard and the amount of such difference; whether the surfaces of the gages are flat, and in addition, whether or not they are parallel to the bottom surface of the gages. The entire process of comparing gages with a standard by the light wave interference method is extremely simple and the cost of the measurement and inspection including the determination of the standard for each size gage is in the neighborhood of about seven cents per gage. Considering the commercial value of these gages and the accuracy with which they are measured, this cost of inspection is indeed very slight.

Application of Gages

The gages are used to advantage for surface plate work. The cylinders, being provided with a hole and countersink in the center, after being run together, can be securely fastened by a rod and turnbuckle through the center hole, the flat head screws of the rod and turnbuckle being below the measuring surface. This results in a standard which is in the shape of a rod and is very convenient for general use. If in wringing the gages together they are slightly out of line, they can be aligned very readily by simply rolling them on a flat surface. Spherical end pieces are provided which can be securely fastened by means of a turnbuckle, and with these end pieces the gages are applicable for the measurement of depths of holes or for such work as measuring the rifling lands and the grooves of cannon. In reality, the cylindrical shape is applicable for the measurements for which the rectangular-shaped gages are used and in addition has other advantages.

While the development of the process of manufacturing Hoke precision gages was undertaken and accomplished at the Bureau of Standards in collaboration with the engineering division, Ordnance Department, as a war activity, the advantages to be gained by American manufacturers is of equal and perhaps of more importance than the advantages which would perhaps have accrued had the program for procuring war material continued. The program for the manufacture of these gages called for a production of 50 sets for the use of the Ordnance Department, and it is of interest to know that 10 sets were available Mar. 1, 1919, and that the program is to be complete and the 50 sets available in the near future. The government has secured shop rights for manufacturing these gages, using the machine and process invented by Major Hoke. Since the manufacturing equipment is available at the Bureau of Standards, there should be no difficulty in having available sufficient gages of this character which might be required by government departments for future military preparations.

The outcome of this work of the gage section, Bureau of Standards, has thoroughly demonstrated and proven that precision gages of the utmost accuracy can be produced in this country.

NO illustration of the Hoke lapping machine is reproduced at this time because of the fact that Mr. Hoke's patents have not yet been issued. The general construction and operation of this device is as follows:

The work is done on a lapping fixture driven by a vertical drilling machine. The fixture consists of three plates. The lower and upper plates are lapping plates and are approximately 18 in. in diameter and 4 in. thick. The intermediate plate is the gage block carrier. This is of somewhat less thickness than the gage blocks which are to be produced and has holes near its circumference which carry the gage blocks and which allows both surfaces of the gage blocks to come in contact with the lapping surfaces. The upper and lower lapping plates are secured against rotation, the sole rotary movement being that of the gage-block carrier plate which rotates and oscillates at the same time. The upper lapping plate, however, is free to descend and approach the lower plate as lapping of the gages proceeds.

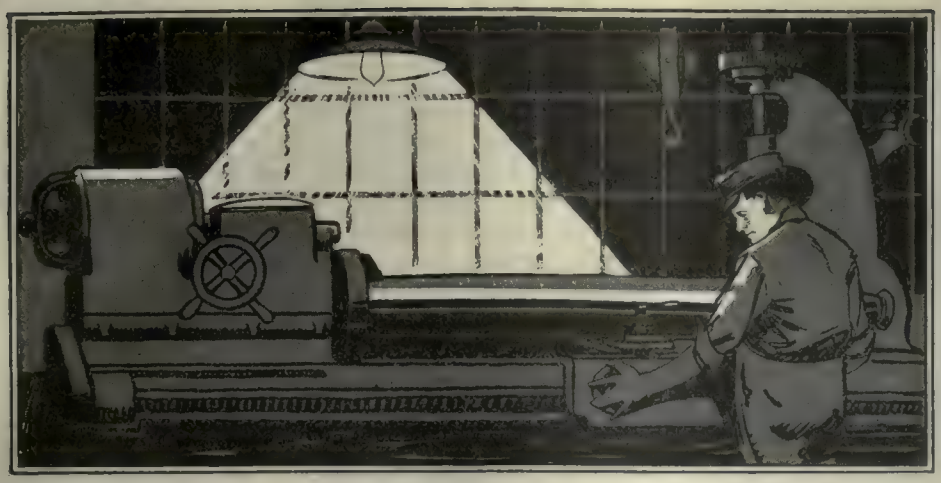
A method of equalizing the thickness of the gage blocks has been worked out. It consists of transposing these blocks diametrically and at 90° at various times during the process of lapping each batch. The rate of removal of metal has been carefully timed by experience, and a clock operating on the stop watch principle is used to indicate the progress of lapping. When the clock indicates the approach of completion, the gages are measured and, if necessary, placed back for further lapping for a time period determined upon, according to the amount of metal still to be removed.—EDITOR.

Knurling With a File

By A. W. Garrett

Having occasion at one time to knurl the head of a very small screw, and fearing that to use a knurling tool in the toolpost in the regular way would bend or break the piece, I sought another means of doing the work.

Running the lathe at a moderate speed and standing behind it, I pressed a new mill file on the part to be knurled, letting the file drift along with the work so that no cutting took place. By this method the sharp teeth of the new file sank into the soft metal sufficiently to leave a very good knurled appearance.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Motor Capacity for Shop Machinery

In this article the heating effect of the electric current in its relation to the limit of motor capacity is discussed. The single value of current equivalent to the varying demands of a machine tool on its driving motor is explained. A number of methods are described whereby such a single value of current may be found by experiment under actual operating conditions. These methods include the use of the watt-hour meter, oil calorimeter and the graphic ammeter. A comparatively recent development on the oil-calorimeter principle in the form of a so-called "root-mean-square" meter is described and its method of use treated.

IN ORDER to point out practical schemes for checking up the sizes of motors in terms of the loads to which they may be connected or for a determination of the size of a motor for a new machine certain fundamental principles of motor operation and of the heating effect of a varying current should be known. The purpose, therefore, is to include in the preliminary part of this article a brief discussion of these principles and then show how they may be applied under practical operating conditions.

The satisfactory operation of a motor involves a number of points, chief of which are that it shall comply in operation with approved limitations in the following respects: Operating temperature, mechanical strength, commutation, dielectric strength, insulation resistance, efficiency, power factor and regulation[1]. Practically all of these points except the first are fixed by the design of the machine, so that under shop conditions the primary attention is often given to the temperature at which the motor operates as an indication of how nearly it is suited to the load with which it is connected.

The rules referred to above state, in effect, that the capacity of a motor, so far as it relates to temperature, is usually limited by the maximum temperature at which the materials in the machine, and especially those used for insulating purposes, may be operated for long periods without deterioration. When this safe limit is exceeded deterioration is rapid and increases

[1]This statement and a portion of the notes immediately following are based on the standardization rules of the American Institute of Electrical Engineers.



FIG. 1. A LABORATORY METHOD FOR TESTING MOTORS

with the length of time that the excess temperature is maintained, as well as with the degree of this excess, and in the end the insulation may break down and thus disable the motor completely.

On the other hand there does not seem to be any gain in the operation of a motor at temperatures below the safe limits so far as the insulation life is concerned. Hence we may conclude that while care should be exercised to keep the load on a motor from rising to values which will make it operate too hot, it is good practice to operate it at such loads as will keep its temperature within the limits set by good practice. To illustrate the values of these temperature limits it may be stated that the standardization rules of the A. I. E. E. assign a maximum temperature to which the material may be subjected of 105 deg. C. for cotton, silk, paper and similar materials when so treated or impregnated as to increase the thermal limit, or when permanently immersed in oil; this also applies to enameled wire. A figure of 125 deg. C. is given for mica, asbestos and certain other materials under given conditions.

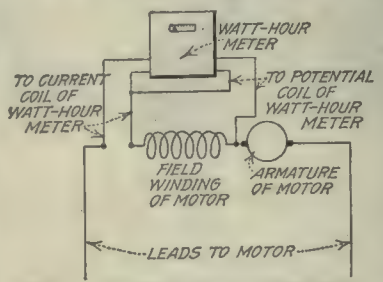


FIG. 2. ELECTRICAL CONNECTIONS FOR A WATT-HOUR METER

From what has been stated the rating of a motor as given on the name plate of the machine has or should have taken into account the temperature limits given above, and it is customary in handling shop motors to use the name-plate rating as the guide for the permissible output which may safely be placed on the unit. The difficulty of assigning such motors to machine tools is usually due to variation of the power required by the machine throughout some particular cycle of duty. Thus the current may have one value for several minutes, quite another value for a succeeding period, may be at rest for still another period, and so on. Some of these current values may be above the limits set by the name plate of the motor; others may be below. Our purpose is, therefore, to ascertain what single value of current is equivalent in its heating effect to a succession of different values.

The heating effect of the electric current is proportional to the square of its value at each instant and depends on the resistance of the circuit through which it is flowing. This may be expressed by saying that the rate at which heat is produced in a circuit of resistance R by a current I is equal to the product of R and of I^2; that is, to RI^2. Now if a steady current of 10 amp. is flowing through a circuit of 2 ohms resistance, the rate at which heat is developed is simply $2 \times 10^2 = 200$ watts.

Suppose, however, that the current has one value for a few minutes, another value for a succeeding period, and so on. The problem is to find the single value of current equivalent to these changing conditions so that this single value may be compared with the name-plate rating of the motor to see if the motor is overloaded on the average or not. To make the point more definite let us assume that the circuit under consideration has a resistance of 2 ohms and that the current flowing through this circuit has a value of 10 amp. for 2 min., 5 amp. for 4 min. and zero amp. for 4 min., after which it passes through the original series of values successively for an indefinite time.

The heating effect for the first period of 2 min. is proportional to 10^2 or to 100; of the second period, to 5^2 or 25, and of the third period, to zero. Weighting each of these in terms of the length of the period over which it is effective, we have the following figures: $100 \times 2 = 200$; $25 \times 4 = 100$; $0 \times 4 = 0$; total, 300. Now, dividing 300 by the total time of the cycle, that is, 10 min., we obtain directly the average square of the current for the 10 min. and this is equal to 300/10 or 30. The square root of this average is equal to $\sqrt{30}$ or closely to 5.5 amp. Put into simple language it may be stated that the heating effect through the circuit of 2 ohms is essentially the same if a steady current of 5.5 amp. flows for 10 min. as if 10 amp. flows for 2 min., 5 amp. for 4 min. and no current flows for 4 min.

This simple principle forms the basis for overcoming the difficulty in selecting motor sizes for machine tools in which the demands for power vary widely throughout the duty cycle, and with a clear understanding of the numerical example given above and the principle it illustrates the reader should find no difficulty in understanding the notes to follow in relation to practical shop methods for the experimental determination of the so-called root-mean-square current and its use when judging of the proper size of motor to use for any given machine tool.

It may be stated in advance of the notes on practical shop motor tests that it is always possible, when the necessary test equipment is available to test out a motor as a check on its name-plate rating. For example, in Fig. 1, a laboratory method of testing small motors is shown. Each of the two motors in the foreground is equipped with a brake and a balance for loading the motor up to any desired value. The motor may be operated at what is supposed to be its full normal capacity and observations of the temperatures of the different parts of the machine made until such time as the motor ceases to show any further rise in temperature. A comparison of these values with the standards assigned in the aforementioned rules is then an indication of whether or not the given load has exceeded the safe limits prescribed in the operation of such machinery.

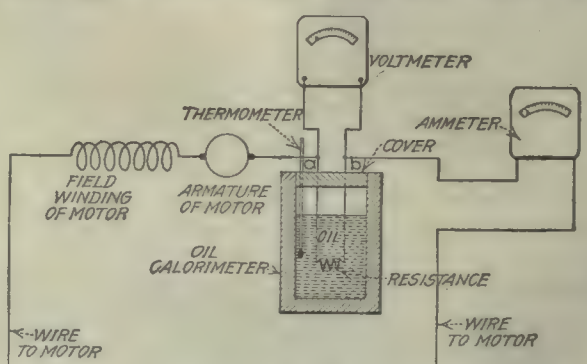


FIG. 3. DIAGRAM SHOWING ELECTRICAL CONNECTIONS FOR THE USE OF AN OIL CALORIMETER IN MOTOR-TEST WORK

However, as it is believed that the average shop will more often be concerned with a determination of the size of a motor to use for a given machine tool than with capacity tests on a motor itself as a check on its own rating, attention will chiefly be directed in what follows to practical tests under shop conditions.

Using the Motor to Measure Power

As an illustration of the use of the motor as a means for measuring the power required to drive a machine tool let us suppose there are half a dozen machines of the same size and kind in a shop to each of which a motor is to be attached for driving purposes. The problem is to determine the size of the motor to employ. In such a case any convenient motor of approximately the right size may be connected up to one of the machine tools and electrical measurements may be made of the power put into the motor during the operation of the given machine tool so as to find the root of the mean square current as explained above.

Several methods for finding the root of the mean-square current are available. One of these is shown in diagram form in Fig. 2, this diagram being drawn up to apply to a series direct-current motor, the field winding and the armature being indicated. A similar arrangement might be employed with a direct-current shunt motor by connecting a known resistance in series with the motor and making the connections of Fig. 2 with respect to the known resistance instead of the series field.

An ordinary watt-hour meter is shown connected so that its current coil is in series with the motor and its potential or voltage coil is placed across the terminals of the series field winding. The motor is now allowed to operate the machine tool to which it is connected over a sufficient length of time so as to get the

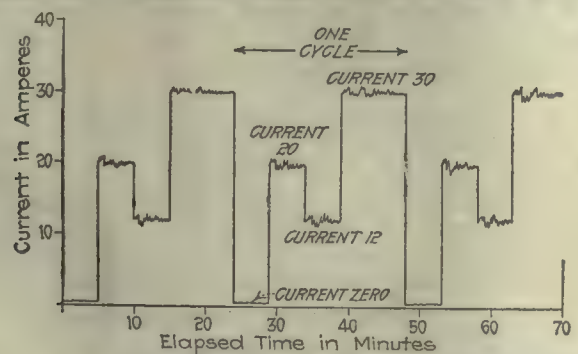


FIG. 6. GRAPHIC CURRENT RECORD (ASSUMED) USED AS THE BASIS FOR FINDING THE ROOT-MEAN-SQUARE CURRENT

full benefit of the ranges of load met with in the ordinary operations of the machine. A reading of the watt-hour meter is taken before and at the end of the run and the time of the run is recorded in hours or fraction of an hour. The difference between the two watt-hour meter readings indicates the energy consumed by the motor field winding during the run and is equal to the product of the resistance R of the field winding, the average square of the various current values I^2 passing through the motor and the time T of the run expressed in hours; that is, watt-hours equal RI^2T.

The resistance R of the field winding may readily be found by connecting an ammeter in series with the motor and taking a simultaneous reading of the current and of the voltage drop across the winding by a voltmeter. R then equals V/I where V is the volts drop across the winding and I is the simultaneous reading of the current. As the resistance of the field winding is likely to change during the run, due to changes in its temperature, a number of readings of V and of I should be taken throughout the run and the resulting values of R averaged. If we let W represent the total watt hours as recorded on the watt-hour meter, then $W = RI^2T$ and hence $I^2 = W/RT$ from which I may be determined by taking the square root of I^2. This value of current I is the single value of current equivalent in its heating effect to all the changing values which were due to the varying load conditions in the operation of the machine tool, and its use in determining the rated input or output of the motor to employ is explained below.

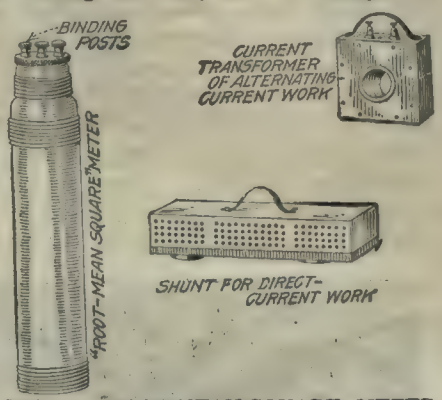


FIG. 4. ROOT-MEAN-SQUARE METER FOR CURRENT MEASUREMENTS, SHOWING SHUNT AND CURRENT TRANSFORMER TO THE RIGHT

Another simple way of measuring the root-mean-square current is outlined in Fig. 3, which shows an ordinary oil calorimeter connected in the motor circuit. A resistance is immersed in a pail of oil, and the value of this resistance R is determined by taking simultaneous readings of the ammeter and voltmeter connected at a and b, the value of R will represent the total resistance between a and b, including that of the wires leading to the resistance in the oil from a and b. Several readings of V and I should be taken as the run progresses to secure an average value of R.

Principle of the Device

The principle of this device is based on the fact that the amount of heat given off by the resistance due to the electric-current flow expressed in electrical units is equal to the amount of heat received by the oil expressed in heat units, neglecting radiation for which due account may be taken by calibrating the device in advance by means of a steady current.

The heat given off by the resistance R in a run of t seconds is equal to RI^2t joules or $\frac{1}{4.2}RI^2t$ gram calories. The heat absorbed by the oil (neglecting radiation) is equal to the weight of oil in grams W, times the specific heat of the oil s, times the rise in temperature T, in deg. C.. as observed by the thermometer from reading before and at the end of the run. Equating these two quantities we have:

$$RI^2t = 4.2\,WsT \qquad \text{from which } I^2$$

may be found, since everything except I is readily determinable, i.e.,

$$I^2 = \frac{4.2\,WsT}{Rt}$$ and I, the root-mean-square current, is equal to the square root of I^2.

A simple device based on the principle of Fig. 3 con-

sists of a vacuum bottle containing water, as in Fig. 4, where the resistance is placed in the vacuum bottle[2] To the right a shunt is shown for use with the root-mean-square meter and also a current transformer for reducing when desirable the current actually passed through the meter when measuring direct currents and alternating currents respectively. Its use is quite similar to that of the oil calorimeter.

A very convenient method, and in some respects a more satisfactory scheme than either of the two preceding methods is by using the graphic ammeter or wattmeter. In Fig. 5, for example, there is shown an ordinary graphic meter adjacent to a lathe ready for use in making an analysis of the lathe operation. Sup-

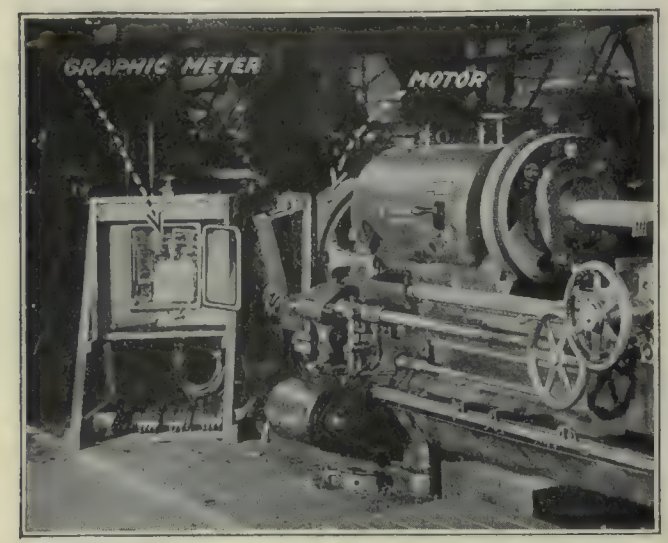


FIG. 5. GRAPHIC METER IN POSITION FOR ANALYSIS OF LATHE OPERATION

pose the graphic record in such a case takes some such form as shown in Fig. 6. Here the successive values of current during one of the duty cycles of the machine tool operated by the motor have fairly well-defined values for their respective time intervals. Thus in the duty cycle marked in the diagram the current is practically zero for 5 min., 20 amp. for 5 min., 12 amp. for 5 min. and 30 amp. for 9 min., this cycle being repeated indefinitely.

The root-mean-square current as indicated from this chart is found as follows: 0×5 min. $= 0$; $20^2 \times 5$ min. $= 2000$; $12^2 \times 5$ min. $= 720$; $30^2 \times 9$ min. $= 8100$; (total time $= 24$ min.) 10,820.

The average square of the current is then $10{,}820/24 = 421$ and the root-mean-square current is found by taking the square root of 421 or $I = 21$ amp.

Using these figures to determine the horsepower of the motor necessary for the work corresponding to the chart we find that if the pressure of the supply circuit is 220 volts and the efficiency of motors of this class is on the order of 85 per cent., the horsepower required is:

$$\frac{220 \times 21}{746 \times 0.85} = 7 \text{ as the nearest whole number.}$$

This value of horsepower may be termed the root-mean-square horsepower, inasmuch as it has been based on the root-mean-square current. The actual horsepower rating to select depends partly on the standard ratings available and partly on the periods of rest during which the motor has a chance to cool and on the amount by which the higher current values exceed the root-mean-square value.

In the particular case just cited a current of 30 amp. lasts for 9 min. out of the 24, or roughly for one-third of the time, and 30 amp. is about 50 per cent. above the root-mean-square current value. If the actual horsepower rating selected for such a case is lower than the root-mean-square value, or even the same, and the overload capacity is depended upon for the high currents, informtion should be secured from the motor manufacturers as to whether the overloads indicated by the graphic records can safely be expected from a motor of the rating chosen.

In addition to the horsepower determination due regard should be taken to obtain a motor with suitable operating characteristics in such matters as range of speed adjustment and starting torque to accommodate the load to be driven.

Graphic Meter More Satisfactory

From what has been said above it will be apparent that the graphic meter is more satisfactory than the other measurements of root-mean-square current described in that such a graphic record furnishes not only the data for giving this current, but it shows overload conditions and the duration of such overloads as well as of rest periods.

These methods for determining horsepower are applicable either to machines where motor drive is contemplated or for a study of machines which are already motor driven. In the latter case they furnish a convenient means for ascertaining whether or not the motor is operating at its full rated capacity or the extent of the under or overloading as the case may be. It is obviously to the interests of the shop to make use of some such scheme in changing motors from one machine to another rather than to depend entirely on guesswork or even merely on judgment.

Incorrect Lead of a Die

By O. F. Kuhlman

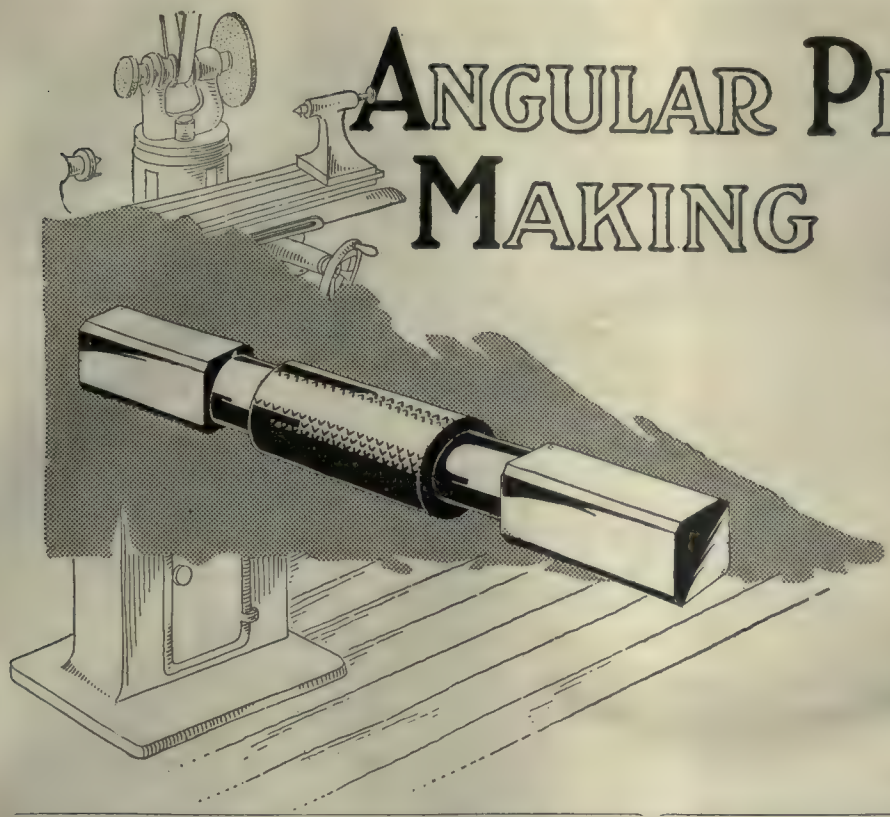
Recently there came to our shop the job of threading some ⅞-in. rods, for about 15 in. of their length and fitting to each a cylindrical nut about 5 in. long. The nuts were of such shape as to permit chucking and they were first chased nearly to size and then finished with a new tap.

There were 40 of the pieces to be fitted, and as this would constitute a somewhat tedious job if the threads were cut in the lathe an attempt was made to cut them with a die.

The first piece had been cut nearly to size in the lathe and then finished by running the die over it. This fitted the nut all right so the man cut the next eight or ten, using the die alone before trying any more in the nut. When he did try one he found to his surprise that it would go only about halfway through the nut.

Readjusting the die to cut smaller he ran it over the piece again with no better results. Successive adjustments and recuts until the threaded piece was perceptibly loose on entering the nut failed to get it through, and finally one of the nuts was sawed open lengthwise when it was found that the male thread was one whole turn short in the five inches.

[2] A description of this instrument is given in detail in the "Electrical Journal," Vol. XIV, No. 2, 1917, page 59.



Angular Plug-Gage Making

By Hugo Pusep

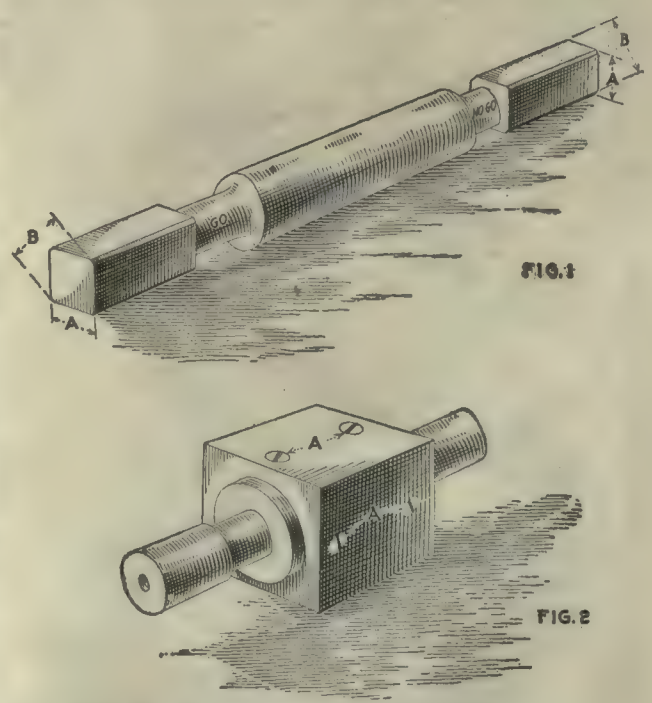
The gagemaker's skill and ingenuity are nowhere demonstrated to better advantage than in planning and performing the operations necessary for grinding and lapping angular plug gages to conform to the specified limits of accuracy. In this branch of gage making it is equally true that the errors in preliminary operations, if not taken into account at the proper time, will accumulate and cause serious defects in the gages, which will be difficult if not impossible to eliminate in later operations.

A COMMON type of gage used to gage rectangular holes is reproduced in Fig. 1. The distances *A* across the flats and over the rounded corners *B* vary in go and no-go end to the degree of accuracy necessary in the gaged product. To anyone familiar with the use of these gages it is apparent that they will not function properly unless all the flats are perfectly square and equidistant from the center and the four rounded corners concentric. When machining the gages the measuring ends are left cylindrical to facilitate the finishing of the rounded corners, and after hardening, these ends are ground and lapped to size, similar to any ordinary cylindrical plug gage. It is not out of place to say that the grinding of both ends must be done on perfectly true centers; the reason for this will appear later.

Preparing the Master Block

In order to have perfect control of measuring and checking the gage while grinding and lapping the flats the master-block method is the most accurate and simple one for this class of work. A square block of cast iron is bored about $\frac{1}{32}$ in. larger than the knurled part of the gage, Fig. 2, and is drilled and tapped for eight setscrews, two on each side, as at *A*, Fig. 2. This master block, as it is commonly called, should be made as small as practicable and still accommodate the setscrews, and the gage should protrude far enough from both ends to allow the grinding wheel sufficient working room.

With both ends ground and lapped to a true cylinder and to the finish dimensions the gage is placed in the cast-iron block, Fig. 2, and is adjusted by the eight setscrews till there is no variation on the indicator when being tested on the surface plate as shown by the diagram, Fig. 3. While testing this setup the block *A* is laid on its four sides in rotation, and the indicator *B*, held in the surface gage *C*, is passed over the finished cylindrical end of the gage. If the block has been carefully ground by the aid of a good angle plate it is possible to set the gage central to the block by adjusting the eight setscrews. As a general rule, however, where great accuracy is required the master block must be scraped to finish on all four sides. This is done with the gage in position and setscrews tightened, and is continued till a most sensitive indicator shows no variation on the gage in any of the four positions. A knife-edge square is used at all times while scraping, and when no light appears between the block and the square



FIGS. 1 AND 2. GAGE AND MASTER BLOCK

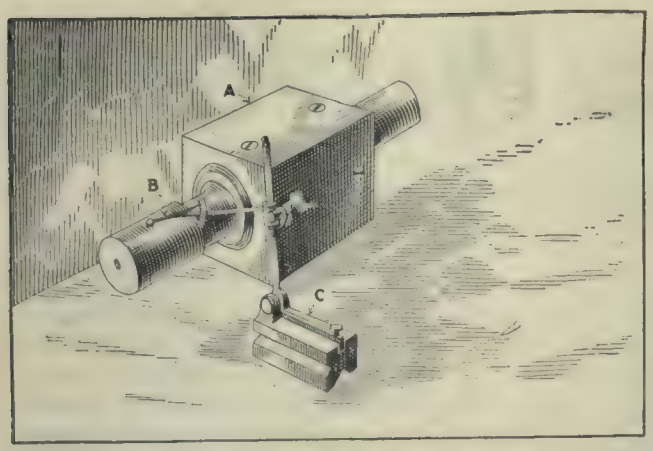


FIG. 3. METHOD OF USING INDICATOR

blade in four positions of the former the gage is ready to have the flats ground on it.

In order to do good work a surface plate, which is known to be a true plane, is a most important adjunct, as is also a knife-edge square that is absolutely accurate and a very sensitive indicator. The master block should be stamped from 1 to 4 in rotation, on its four sides, which will save confusion in grinding and lapping. When ready to begin scraping the block a side which is nearest the center of the gage is found, which is then scraped to a plane. Now when the indicator is set to read zero over the go end of the gage it should read over the no-go end exactly one-half more than the difference in their sizes. For instance, if the no-go end measures 0.001 in. larger the indicator reading should be 0.0005 in. over zero on that end. Let us assume that the side of block just finished is stamped 1. Now a block is laid on the side marked 3. A second surface gage with an indicator is now necessary to finish-scrape that side, because the block must be tested at its four corners for parallelism as well as the gage itself. Indicating is a quicker and surer method than using micrometer for this purpose. A gagemaker must use judgment in finishing the second side. If there are two or three thousandths of an inch of metal to remove, the bulk of it should be taken off on the surface grinding machine, then the scraper used for the final tenth or so. The third side, which is marked either 2 or 4, is now scraped. Only one indicator is now required, but the knife-edge square is constantly employed in testing the two finished sides for squareness as the scraping proceeds. The remaining side of the block is scraped similar to the one marked 3, two indicators being used in conjunction with the square to detect any accumulated errors.

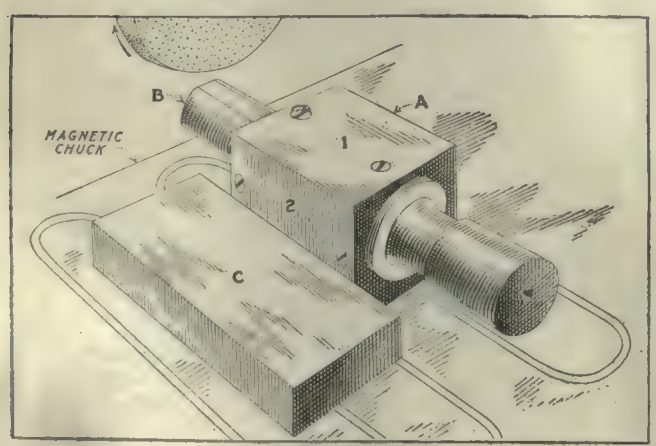


FIG. 4. ROUGH-SIZING ON GRINDING MACHINE

The reason for grinding both cylindrical ends of the gage on true centers, as previously stated, will be clear to anyone after the description of preparing the master block. If the ends of the gage had been ground on centers which did not run true the method of setting the gage in the master block would be much complicated; in fact the block would have to be scraped separately for each end of the gage, thus doubling the time for this operation. In case the design of the gage should be such that the knurled central part is smaller in diameter than the distance over the rounded corners a split sleeve is made, the outside diameter of which is slightly greater than that of the rounded corners, thus allowing it to be inserted easily into the master block, the diameter of the hole in the sleeve being $\frac{1}{32}$ in. larger than the knurled handle of the gage.

Grinding the Gages

The gage is now ready to have the four flats ground, which is accomplished on a magnetic chuck in the surface grinding machine. The face of the magnetic chuck must be tested for parallelism with the grinding wheel, and if found to be out of true, a facing cut should be taken over it. It is not a very simple matter to true a magnetic chuck properly, and the tendency of the magnetic poles to charge the grinding wheel must be taken into consideration. A good way of accomplishing this is to use a medium wheel for the operation, employing a very coarse feed and a slight cut; grade M, Norton or Carborundum Co. gives satisfaction. Under no circumstances should a hard wheel be used, because it glazes and consequently burns the face of the chuck, resulting in a rough surface. Soft wheels are also undesirable because of their quick-wearing qualities.

The flats on both ends of the gage should be roughed out to within 0.005-in. or so of size. This is accomplished as illustrated in Fig. 4. The master block *A* with gage *B* is laid on the magnetic chuck with the side numbered 1 uppermost. A parallel *C* is placed against the block, as shown, to prevent shifting under pressure of the cut. A soft wheel should be used for this operation; a Norton grade *H* or its equivalent will do the work. The reason for always using a soft wheel for roughing is that it cuts fast and does not burn the gage; a cut 0.0005 in. or even deeper can easily be taken. Once the wheel is set for the first side its position should not be altered till all eight flats have been ground with the same setting, because it prevents mistakes, and the fact that the four flats on the master block are numbered will remind the gagemaker when the cycle of operations on either end of the gage has been completed. If the above described procedure is followed there is little chance of grinding off too much by mistake, as every time a cycle of operations is completed, it will suggest the measurement as a matter of course.

Success at this stage depends on a few time-worn kinks, but which cannot be too strongly emphasized. The grinding wheel should be re-dressed immediately it shows signs of beginning to charge. Whenever changing the position of block *A*, Fig. 4, in relation to its sides, the parallel *C* is also removed and the surface of

the magnetic chuck wiped clean with a piece of waste; but before replacing the block the palm of the hand should be passed over the chuck and the contacting side of the master block in order to remove the last traces of dirt, it being a well-known fact that the human hand acts similarly to the finest chamois leather.

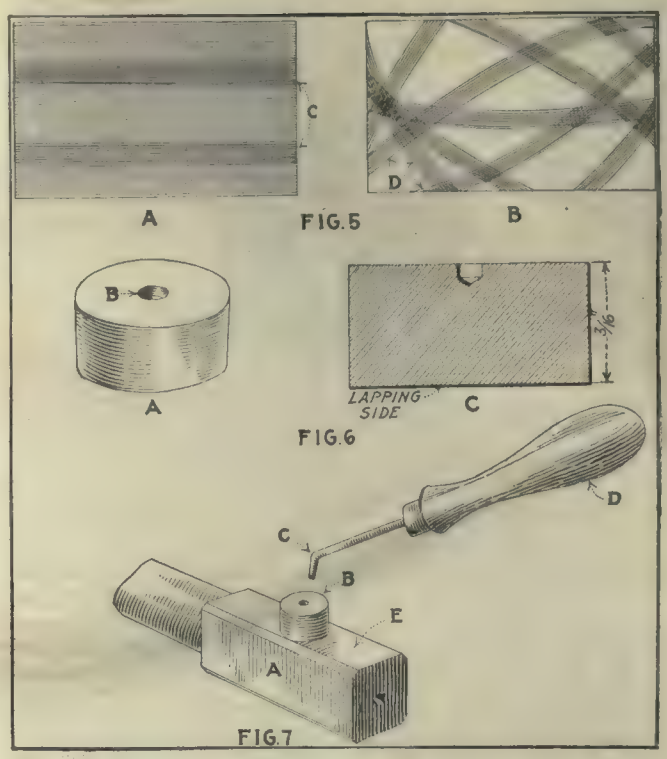
The last few thousandths is taken off with an elastic wheel of about grain 60 in order to obtain as fine a finish as possible, thereby leaving only a small fraction of a thousandth for the lapping operation. With a smooth-grinding finish there need not be more than 0.0001-in. left on for lapping, and to obtain this, free from chatter marks, all play in the grinding-machine spindle must be taken up and the finishing wheel nicely balanced. While finish-grinding only hand feed should be used. This is because the adjustable dogs on the grinding-machine table on engaging the reversing lever set up a vibration that will show on the ground surface as chatter marks. Taking the last few tenths off by hand feed will eliminate this to a large extent, resulting in a very smooth finish.

Lapping

This operation should be looked on as a smoothing or polishing of the gage flats, and when an extra-good grinding job has been performed the removing of grinding-wheel marks should bring the gages to size. However, as a precautionary measure, slightly more metal is left on for lapping than is absolutely necessary to eliminate the wheel marks. The old saw, "It is easier to take off than to put on," holds good here as elsewhere.

Preparatory to lapping, the gage, which is still held in the master block, is placed on the surface plate and tested with an indicator in the surface gage. Taking the end that it is intended to lap first, the indicator is passed over all the flats in rotation, noting the difference in reading, if there are any, and commencing the lapping on the highest side. Copper has proved to be the best material for laps in this class of gage work. For larger sized gages the best form of lap is a small rectangular block of copper, the lapping side of which has been worked to a true-plane surface. This result is acquired either by milling, shaping or grinding, but before beginning to use it the copper block is rubbed over a good true cast-iron lapping plate. This puts it into condition of a true plane.

For first-class results the copper lap should not be as large as the surface which it is to lap. Experience has taught that the lap should not be larger than about half of the length and two-thirds of the width of the flat surface on the gage. A fine grade of Turkish emery is used for the lapping compound, as this cuts quite fast but leaves a good, smooth surface. The copper lap is charged on a hardened and ground steel plate. Loose emery is sprinkled over the charging plate, the surface of which has been previously wetted with benzine or kerosene. This helps to spread the emery evenly over the surface. A circular motion should be imparted to the lap while pressing it to the charging plate, to embed the emery properly. Although the method of charging a surface lap may seem to be a simple operation there is quite a difference in the performance of a lap that has been properly charged. The diagram *A* in Fig. 5 shows in exaggerated form a lap, the surface of which has been charged by moving it only back and forth over



FIGS. 5, 6 AND 7. SMALL LAPS FOR LOCAL LAPPING

the charging plate. At *C* are shown streaks of emery particles embedded in the lap. This condition is hard to prevent in moving the lap in a straight path over the charging plate. The result of this condition of the lap being that the heavier charged portions *C* wear correspondingly minute grooves in the gage surface. As there is only a limited surface on the gage to work on, the lap cannot be so readily turned to counteract these grooves, thus resulting in a more or less faulty surface. The diagram at *B*, Fig. 5 shows the surface of a lap that has been given a somewhat circular motion in

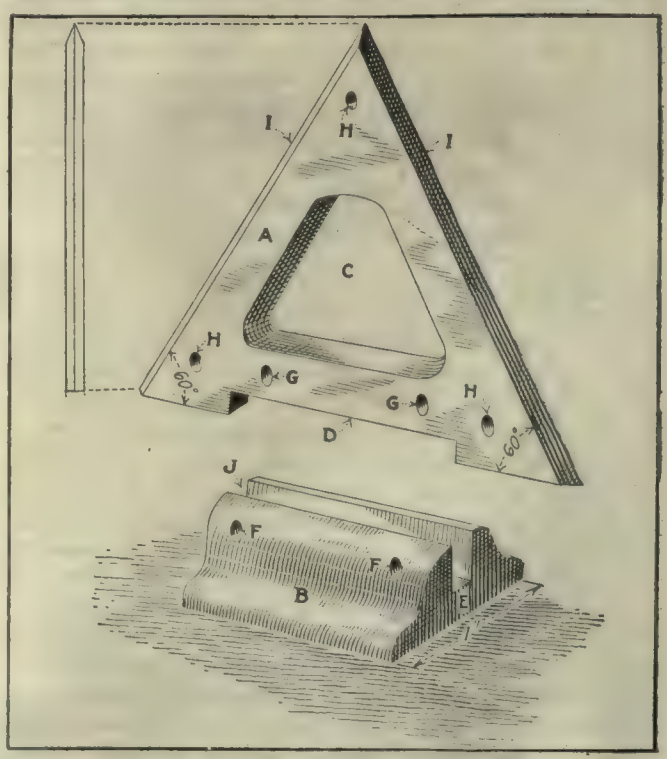


FIG. 8. SIXTY-DEGREE MASTER ANGLE

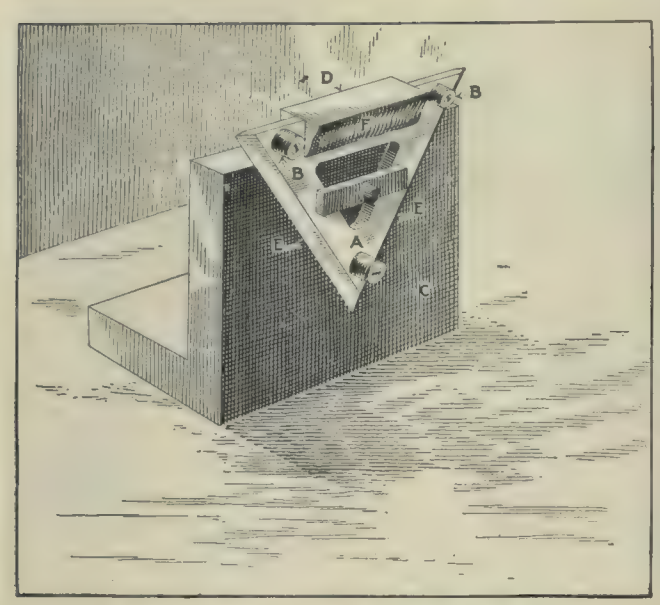


FIG. 9. SET UP OF MASTER ANGLE

charging. Heavily charged portions of the lap are shown by lines *D*. It becomes clear now that no matter whether the lap is moved lengthwise or sidewise over the gage surface it will cut evenly, because all heavily charged positions of the lap will act at all points over the surface lapped and at each pass of the lap.

The Disk Lap

For lapping the flats on very small gages where the rectangular lap just described could not be conveniently held a form of lap shown at *A*, Fig. 6, is used. As can be seen from the sketch it is in a form of a disk.

These disks are parted off in the lathe from a copper rod of suitable diameter and are about $\frac{3}{16}$-in. thick, the diameter being slightly less than the width of the flat surface to be lapped. Only one side of the disk is used for lapping, the opposite having a small, shallow hole *B* drilled at the center for the purpose of working the lap, as will be explained presently. The cross-section *C*, Fig. 6, shows plainly the form of this kind of lap. Grinding or scraping is the easiest way of bringing the lapping side of these disks to a perfectly plane surface, after which they are charged with emery in a manner already described in the case of rectangular laps. Fig. 7 shows the working of the disk lap. *A* is the gage, *E* the surface lapped, *B* the disk lap, while the bent wire *C* in the file handle *D* forms a convenient means of holding and working the lap. The bent end of the wire *C* seats itself in the small drilled hole as already explained in the construction of the lap, and transmits the pressure from the file handle to the lap. This form of lap is very effective and convenient to use, not only in angular plug gage work but in all work where the surface to be lapped is very small or not easy of access.

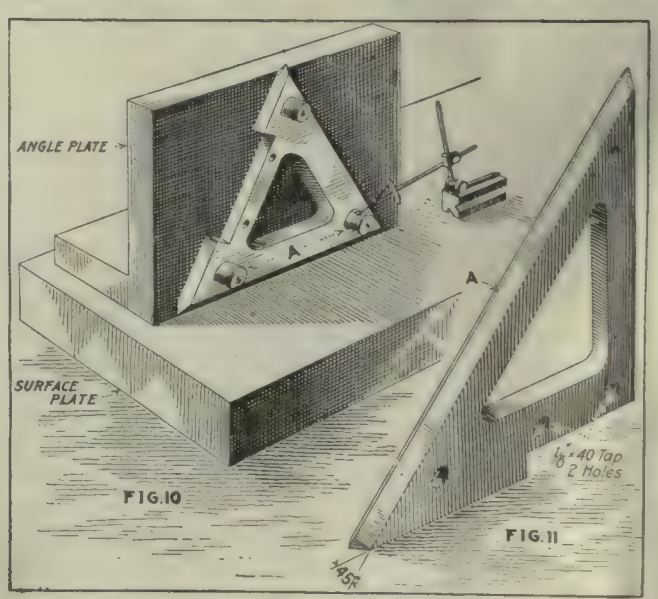
Lapping of gaging flats on angular plug gages is performed with the gage still in the master block in which it was set up and ground. It is not removed from the surface plate while lapping, because frequent measuring with the indicator, square and micrometers is necessary. When getting close to finish size the measuring micrometer is set to Johansson blocks and the spindle locked. In this way a gagemaker can work to extremely close limits by feeling alternately over the gage flats and the Johansson blocks. A slight variation in size over the gage flats can thus easily be detected and corrected by lapping. When a tight place has been found the indicator is passed over the flats concerned and the high spots noted, which are then reduced with the disk lap till the opposite flats show a parallelism within the limits specified.

Hexagon and Octagon Gages

After square plug gages the hexagon and octagon gages are the ones often met with in practice. The grinding and lapping of these are identical to square gages, namely, in scraped master blocks. As the commercial bevel protractor is not considered accurate enough for preparing these blocks special master angles are necessary. In making these master angles the aim should be to produce a theoretically perfect angle, and although this entails quite an expense in the first place it will be found a good investment later on, not only on angular gage work but in a large variety of tool work. The different uses of the master angles will naturally suggest themselves where such angles are available, as reference gages, means of accurately setting up jigs for boring holes at an angle, setting the planer head for dovetail work, etc.

Developing a 60-Deg. Master Angle

The sketch in Fig. 8 shows a completed 60-deg. master angle. For the sake of clearness the blade *A* and the base *B* are shown separately. The blade is made of good quality tool steel about $\frac{1}{8}$ in. thick and machined as shown. The opening *C* is for lightening the blade. The recess *D* corresponds in depth to the thickness of part *E* in the base. The base *B* can be made either of tool steel or machine steel carbonized and hardened. The dowel holes *F* in the base are transferred to the blade, as at *G*. For this reason that part of the blade is protected by sheet asbestos during hardening, so as to leave the locations of the holes soft enough for drilling and reaming. The three equally spaced button screw holes *H* are drilled and tapped with a $\frac{1}{8}$ x 40-thousandths tap, and the knife edges *I* are milled to 60-deg. bevel, after which the blade is ready for hardening. After hardening, both faces of the blade are ground parallel on the



FIGS. 10 AND 11. INDICATING THE BUTTONS AND MASTER ANGLE FOR AN OCTAGON

surface grinding machine. Buttons are affixed in three positions *H* and are located equidistant by the aid of Johansson blocks. No care should be spared here, because the accuracy of the master angle will depend entirely on correct location of the buttons. The base *B*, Fig. 8, is now fitted to the blade and secured by two dowel pins as already explained. The assembled master angle *A*, Fig. 9, is secured to an angle plate *C* in the manner shown, with the buttons *B* leveled accurately to an indicator on the surface plate.

The bottom edge *D* of the master angle and its assembled base is now ground perfectly flat on the surface grinding machine, after which the base *F* is detached from the blade and the measuring edges *E* are set up and ground in the same manner as the bottom edge. The grinding of the 60-deg. beveled edges is accomplished either by the aid of an adjustable angle plate or in a tilting vise. About 0.003-in. has proved to be the correct flat to leave on the knife edges. After completing the grinding of the blade it is lapped on its two knife edges, while the progress of the lapping is closely watched as illustrated in diagram Fig. 10 by indicating on the surface plate over the two buttons *A* nearest the edge being lapped. A ground and lapped test plate of convenient length and size, which is true to a straight edge, is used for testing the knife edge on the master angle blade for straightness. The master-angle blade and its base are now reassembled, and lapping the bottom edge of blade and the base completes the job.

Developing Master Angle for Octagon Plug Gages

In developing the master angle for octagon gages a somewhat similar yet distinctive method is employed. Fig. 11 shows the blade, which from the similarity to the 60-deg. angle blade needs no further explanation. It might be said, however, that the knife edge *A* is ground and finish-lapped before the base is attached, which in all respects resembles the hexagon angle base. Before assembling the base with the blade two buttons are affixed by the tapped holes shown. These buttons need

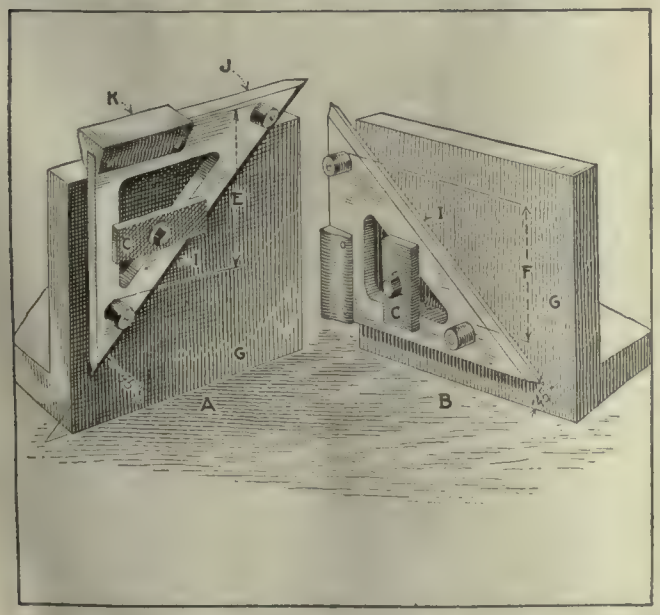
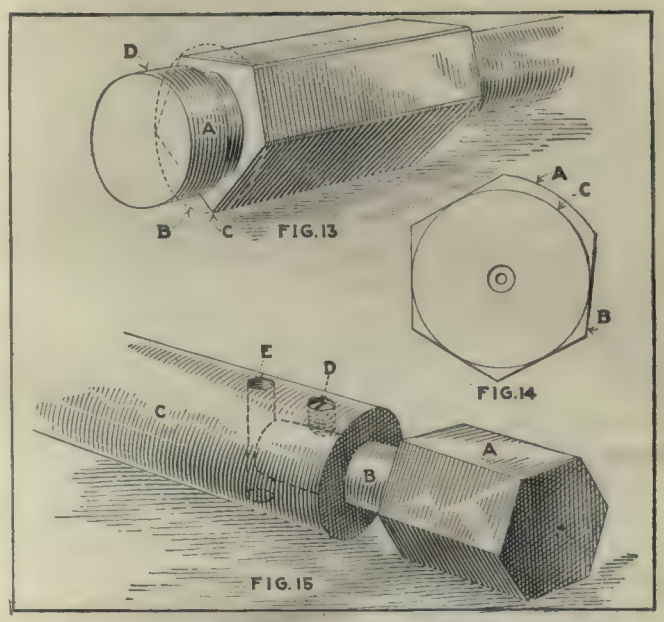


FIG. 12. METHOD OF SETTING MASTER ANGLE FOR GRINDING



FIGS. 13, 14 AND 15. OTHER ANGULAR PLUG GAGES

not be any certain distance apart, but they must both measure the same distance from the knife edge *A*.

For grinding the bottom edge and the assembled base of the 45-deg. master angle a practically square angle plate is necessary. The two views in Fig. 12 show diagrammatically the method of setting the master angle preparatory to grinding the base, reference letters in both views being the same. As shown the master angle is held by the clamp plate *C* and capscrew *D* to the face of the angle plate *G*. The distance *E* in view *A* is now measured with indicator and Johansson blocks, then the angle plate is turned over to rest on its sides as at *B* and the distance *F* is measured similarly to distance *E*. When, after due adjustment, no difference in the two measurements is found, the knife edge *I* is at an angle of 45 deg. to the surface plate. Now the bottom edge *J* of the master angle and the base *K* is ground and a few passes over a lapping plate will complete the master angle.

Master measuring angles of other than 60 or 45 deg. can be developed successfully by the bottom method, as already described in the two previous examples. The sine bar is also used to advantage in this class of work.

Odd-Sized Angular Plug Gages

Angular plug gages having an odd number of sides, although not frequent, do occur in practice. Of these the triangular and pentagonal gages are the ones most commonly used. These gages, as in the case of ones previously described, are ground and lapped in master blocks, the finishing of which to correct angles is accomplished by special master angles, the construction of which needs no further explanation in view of the data already given. There are, however, some special features about measurement of odd-sided gages that must be dwelt upon. Fig. 13 shows a pentagonal plug gage. The cylindrical end *A* is ground to diameter that is tangent to the flats on the gage in its finished condition. This cylindrical end *A* and the diameter *B*, which will afterward form the rounded corners *C*, are ground and lapped first. Then the five flats are ground, setting the measuring indicator to the highest point *D* on the

cylindrical end. Thus with an indicator reading to ten thousandths of an inch it is easy to determine the progress of grinding and lapping the flats. This method of accurately measuring the distance of flats from the center by indicating over an extra cylindrical end applies to all other odd sided gages. Should there be occasion to make a gage that has one or more flats of varying distance from the center then those furthest from the center are finished first and the cylindrical end reduced in diameter till it comes tangent to the next flat closer to the center of the gage.

There is another type of angular plug gage having a large circular part besides the flats. An end view of such a gage appears in Fig. 14. The circular part *A* should be looked on as merely an enlargement of the cylindrical or rounded corner, and if treated as such it should cause little worry to the gagemaker as to the method of finishing the gage. The flats *B*, if odd in number, are finished to the cylindrical measuring end left for that purpose on the gage and represented in this instance by line *C*. This cylindrical measuring end in odd-sided gages is ground off after the gage has been completed and passed by the inspector.

Designing Gages for Rapid Production

It might be fitting in this article on angular plug gages to suggest improvements in design of these gages that would result in a great saving of time where quantity production is desired. American machine shops are sure to be called upon in the near future to contribute the larger part of their capacity to reconstruction work. This means that quantities of gages will be needed to produce machine products of every kind on the basis of interchangeability.

In Fig. 15 is shown a type of an angular plug gage which has detachable gaging ends. These gaging ends *A* have short taper shanks *B* fitting into a reamed hole at each end of the knurled handle *C*. The setscrew *D* bears against a flat on the taper shank, thus furnishing added security against the possibility of pulling the gaging ends off the handle should the gage be jammed tightly into the hole being gaged. The hole *E* provides means for driving the gage off the handle when required. Any standard taper is suitable for the shanks.

The advantages of this detachable design for angular plug gages are numerous, the more prominent being the reduction in cost of producing the gages in the first place and much lower upkeep expense, as in the case of making renewals, etc. Where solid double-ended gages are used, as described at the beginning of this article, the master blocks in which they are ground and lapped must be adjusted for each individual gage and sometimes ground or scraped all over in order to be within the limits of accuracy necessary. The taper shank of the detachable gage is ground concentric with the body of the gage, so when a master block is once finished for the first gage it will need no adjustment or rescraping, the tapered hole at each end of the master block centering each subsequent gage properly. A drift hole of course must be provided for each hole in the master block to remove the finished gaging ends.

Angular plug gages are made of tool steel, machine steel carbonized not being practicable on account of the stock that has to be removed by grinding the flats after hardening. In the solid type of gages therefore the large amount of expensive tool steel in the knurled handle is wasted. The handle *C* in Fig. 15, being of machine steel, eliminates this waste of expensive material. Further the same handles can be used for different gages or when changing the design of the gaged hole and also in renewing worn gaging ends. If, for instance, the product of any shop calls for three sizes of square hole gages, the sizes being 1 in., 1¼ in. and 2 in. across the flats respectively, the shanks of all these sizes could be of the same taper. Then only one master block, just large enough for the 2-in. gage, could be used for grinding and lapping all the square hole gages in the shop.

This last item alone should convince any gage user as to the practicability of the detachable design. Even on small quantities this design is a wonderful time saver. With the return of the country to peace basis and the resumption of keen competition among the machinery producing establishments not only of America, but of the entire world, advantage should be taken of all improvements whether in the processes of manufacture or improvement of design.

A Successful Apprentice Toolmakers' School

By C. R. Dooley
Committee on Education and Special Training,
War Plans Division, General Staff

I read with much interest the article entitled, "A Successful Apprentice Toolmakers' School," in the *American Machinist* of Feb. 20. The experience cited coincides exactly with that of the Committee on Education and Special Training with its vocational schools. During the past summer and fall we operated 167 schools, training 140,000 soldiers in 67 different trades.

I would take exception to the last statement of the article which reads as follows: "The secret probably lies in their rule of admitting only high-grade machinists of long experience to the course, and those only who have served long with the company and themselves ask for the opportunity." Undoubtedly this had a great deal to do with their success, but our experience this summer proved almost equally successful with men who had had practically no experience in the trade they were learning. Garment makers were trained as very good blacksmiths, bank clerks as pattern makers, salesmen as tinsmiths, etc. The length of our training was the same as the one cited in this article, namely; two months.

As a result of the war there is surely evidence in favor of the training of men following their lines of native ability rather than their trades and experiences. Thousands of men are today employed in work not at all suited to them and which they do not like. A great upheaval like a war throws them into their proper environment and they surprise us with the character of their work. Nowhere is this more apparent than in the training of the thousands of officers required by the army. As you know the training was largely done in a period of three months in the face of the fact that the regular army officers, and all of us for that matter, said that two years would be necessary at least. Given the proper method of instruction and the line of work suited to the individual, according to his native ability and temperament, the speed with which excellent results can be accomplished is simply marvelous.



VII. Thermit Welding of Cast Iron and Other Parts

The welding work described in the first part of this article is closely allied to the repair of machine tools in general, while the latter part describes some special small-tool applications.

THE Thermit process, while adapted to the welding of cast iron, cannot be used on all cast-iron welds owing to the difficulty in many cases of allowing properly for the shrinkage of the metal in the weld when cooling. The Thermit steel contracts twice as much as the cast iron, so that in certain constructions shrinkage strains will be set up in the weld causing cracks. This difference in shrinkage often makes it impractical to weld long cracks in thin sections. As a general rule we should say that if the length of crack is more than eight times the thickness of the material a Thermit weld should not be attempted, because on account of the difference in shrinkage along the line of the fracture small hair-line cracks will appear perpendicular to the line of the fracture. These cracks however being perpendicular to the line of the weld are often therefore of little consequence and do not interfere with the strength of the weld.

It is also not usually feasible to weld cracks in cast-iron cylinders, pots, kettles and similar castings. Where there is a clean break between two sections or where the section to be welded can be completely cut through and can be separated a sufficient amount to allow for the contraction in the weld, and also where the length of the weld is not more than eight times the thickness of the material, a Thermit weld would be entirely practical and can be made in exactly the same way as outlined for the welding of wrought-iron and steel sections.

In cases where the crack can be opened up mechanically or by heating a parallel part to a dull red a weld may be made, but it must be remembered that expansion gained in this way must be a little more than the expansion of the parts next to the weld during the preheating.

Care should be taken in preheating for cast-iron welds not to heat the sections too hot; a dull red is sufficient. One should be careful to keep the heat going until the mold is thoroughly dried out.

The mixture of Thermit for the weld should be different than for wrought iron and steel, and for this purpose the special mixture known as cast-iron Thermit is recommended. This consists of plain Thermit with which is mixed 3 per cent. ferrosilicon 50/50 and 20 per cent mild-steel punchings, i.e., to every 100 lb. of plain Thermit is added 3 lb. of ferrosilicon and 20 lb. of punchings. This gives the best results on cast iron and produces a homogeneous metal in the weld.

Welds on cast iron are a little more difficult to machine than welds on wrought iron and steel, as the metal along the line of junction of the Thermit metal and the cast iron is apt to be a trifle hard due to the absorption of carbon from the cast iron. This objection is not a serious one, however, and hundreds of welds have been completed with the most satisfactory results.

Examples of Cast-Iron Welds

In order to show the possibilities of welding various cast-iron pieces with Thermit a few examples taken from actual practice are given.

Fig. 75 shows how a new jaw was burned onto the frame of a heavy shear, in the shops of the Raleigh Iron Works Co., Raleigh, N. C. The job was done in 1906 and the machine is still in service. This machine was designed for shearing 1½ x 6-in. bars, producing an enormous strain on the jaws. A large part of the corner of the lower jaw, weighing about 75 lb., broke

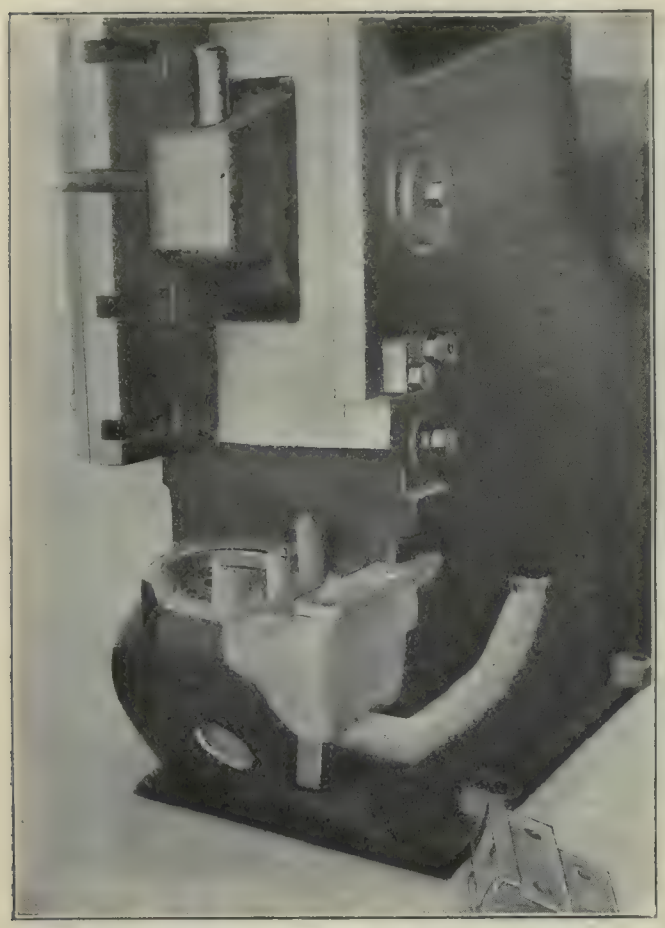


FIG. 75. NEW JAW BURNED TO FRAME CASTING OF HEAVY SHEAR

off. It then became a question of getting a new frame or burning on a new jaw corner, which would require the fusing of a surface about 1 sq.ft. in area in order to obtain a thorough union. It was finally decided to try Thermit. The surface of the break was chiseled off for the reason that a cast-iron break is usually glazed with graphitic carbon. The mold was then put in place and well luted with fire clay where there was any danger of leakage. Moist sand was also rammed around the mold and other parts as a further precaution. The surface of the fracture and the stock around the jaw was then heated through the gates and risers by means of gas jets, in order that the casting might be thoroughly heated and all moisture driven out. The gas torches were kept in action several hours. A crucible containing 175 lb. of Thermit was then put in position for tapping into the mold. After the reaction the Thermit steel was run into the mold and at once fused the entire surface of the fracture. In the meantime a ladle of molten cast iron containing about 600 lb. of metal was held in readiness and was superheated by means of a Thermit semisteel can. As soon as possible after pouring the Thermit, this cast iron was poured into the second gate, shown at the front of the jaw, and this forced the Thermit steel out of the mold after it had served its purpose in bringing the surface of the jaw to a welding or fusing heat. The result was a new corner of cast iron burned onto the old jaw. The illustration shows the two gates and four risers before they were trimmed off. In *Reactions* for the fourth quarter of 1917 W. J. Musick, blacksmith foreman of the St. Louis shops of the Missouri Pacific R.R. wrote:

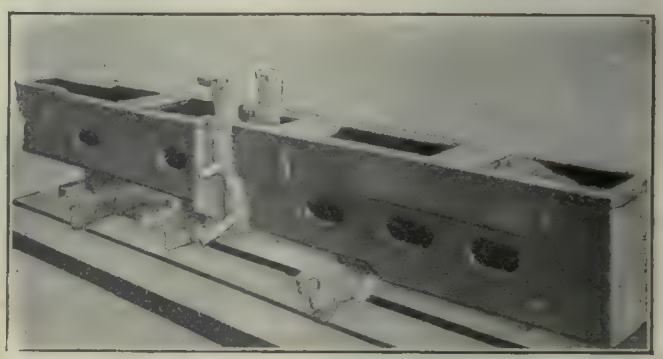


FIG. 77. CAST-IRON ROLLING MILL BASE REPAIRED FOR THE WACLARK WIRE CO., ELIZABETH, N. J.

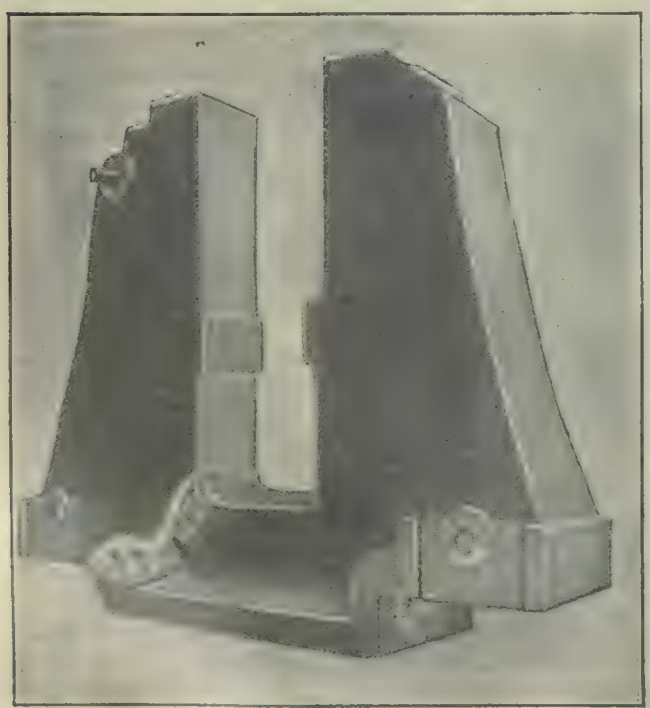


FIG. 76. WELD ON 48-IN., 68,000-LB., CAST-IRON BLOOMING-MILL HOUSING. ABOUT 3500-LB. OF RAILROAD THERMIT USED

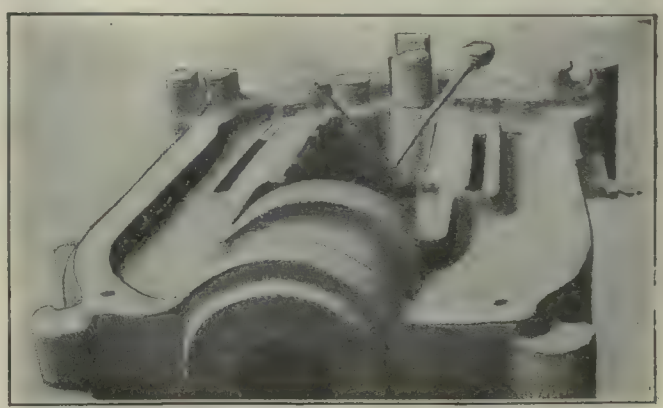


FIG. 78. REPAIR ON A 25-TON NAIL-MACHINE HOUSING

> We recently had one of our steam hammers break through both sides of the frame and through the throat, the fracture being 61 in. long. This hammer was so badly broken that it seemed as though it were doomed for the scrap pile.
>
> A new steam hammer was ordered, but in the meantime it was decided to try to repair the old one with Thermit. The weld was made and a successful repair was accomplished, resulting in saving a considerable amount of money.

We have also welded a cast-iron engine bed for the Helmbacher Rolling Mill Co. The bed of this engine is 32 in. high and 12 in. across the top. The mill was only shut down 24 hours while the repair was being made.

Master Mechanic George M. Stone, writing in the same publication, says:

I think your readers will be interested in the accompanying illustrations of Thermit welds which have been made by me in the shops of the Chicago, Rock Island and Pacific Railroad, Chickasha, Okla., and I would like to call par-

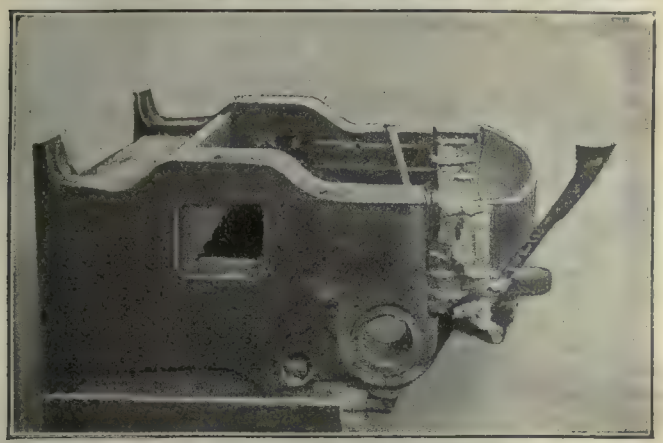


FIG. 79. CAST-IRON HOUSING OF KNUCKLE MACHINE, WELDED BY THE STANDARD PARTS CO., CLEVELAND, OHIO

ticular attention to the welding of valve seats on locomotive cylinders, which I consider an exceptionally good piece of work in view of the fact that these are cast-iron cylinders. The manner in which we handled the work was as follows:

The ports of the cylinders were cracked through from the steam port to the exhaust port. A Thermit weld was made on these cylinders, and in order to do this the entire cylinder was cut loose from the frame and smoke arch of the locomotive. The pistons were removed from the cylinders, as well as the cylinder heads both front and back. The cylinder was then preheated with a slow wood fire and welded with Thermit.

We have also had very good success with the welding of

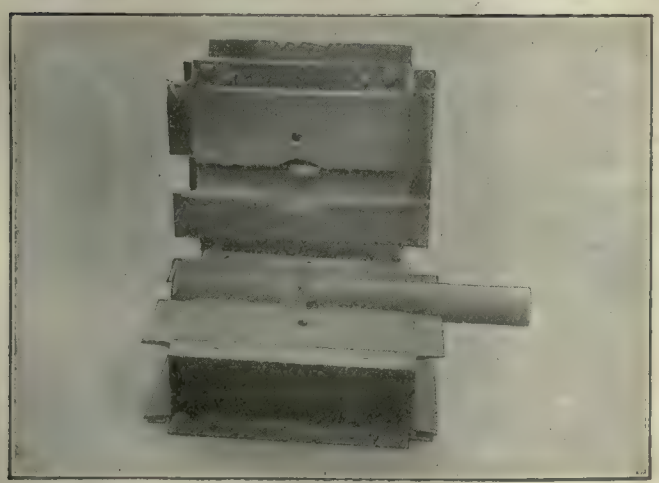


FIG. 80. MACHINERY STEEL AND HIGH-SPEED STEEL READY TO CLAMP MOLD

spokes in driving-wheel centers and the welding of main frames on one of our heaviest classes of engines in freight service.

These instances show that in many cases the success or failure of a cast-iron welding job is merely a matter of good judgment. As in other kinds of welds, expansion and contraction must be allowed for, and in many cases where a purely Thermit weld would be out

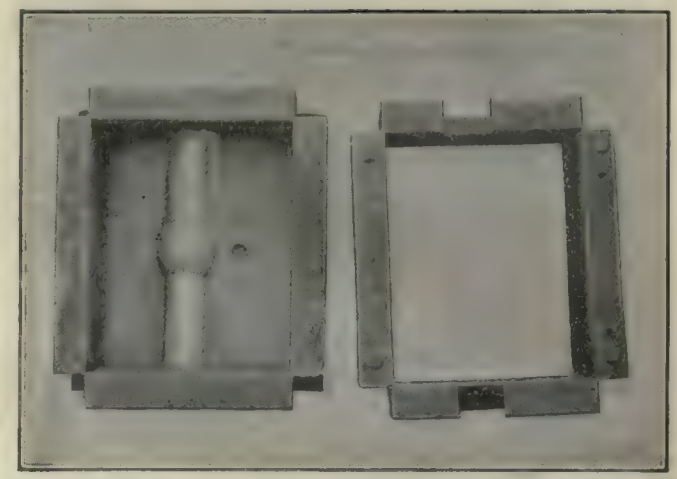


FIG. 81. SHEET-IRON MOLD BOX AND WOODEN PATTERN

of the question, owing to the difference in contraction of cast iron and Thermit steel, the Thermit may be used merely to bring the broken surface up to a fusing heat and then molten cast iron may be burned on, as was done with the shear jaw previously mentioned.

The illustrations here given show how Thermit welding may be applied to various cast-iron machine parts. Fig. 76 shows a weld on a 48-in. blooming mill housing, which weighed 68,000 lb. Approximately 3500 lb. of railroad Thermit was used. Fig. 77 shows a weld on a rolling-mill bed made for the Waclark Wire Co., Elizabeth, N. J. The weld shown in Fig. 78 was on a 25-ton nail-machine housing, and 650 lb. of Thermit was used. Another housing weld on a knuckle machine made by the Standard Parts Co., Cleveland, is shown in Fig. 79. Many times breaks on machine-tool parts could be repaired in the same way.

Welding High-Speed Steel to Machinery Steel

The largest weld ever made, up to January, 1919, was a cast-iron weld on a blooming-mill shear at the plant of the Pittsburgh Steel Co. The broken piece was of irregular shape approximately 37 in. wide by 5 ft. 6 in. long and weighed about 3000 lb. Five No. 10 crucibles were used for the job.

Sometimes it is advisable to weld tool or high-speed steel to a mild-steel bar or shank. This is perfectly feasible for special drills, reamers, boring bars or

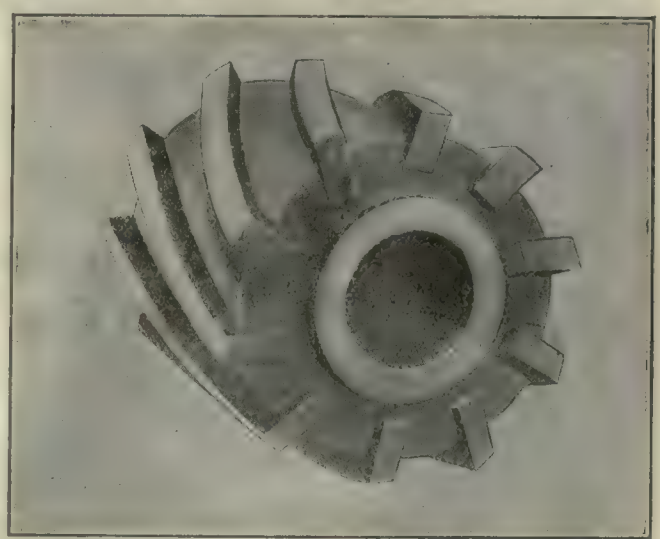


FIG. 82. HIGH-SPEED STEEL CUTTERS HELD IN WAX PATTERN WITH HOLLOW STEEL CORE

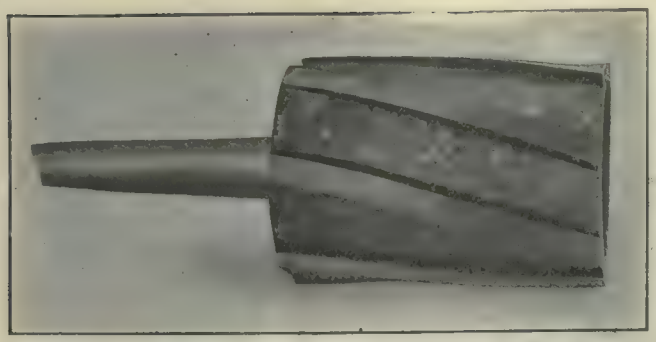


FIG. 83. HELICAL INSERTED-BLADE REAMER MADE BY THE THERMIT PROCESS

special tools of various kinds. Where only one or two jobs are to be done ordinary welding by the wax-core method may be employed, but where many pieces are to be welded it will pay to make molds. A mold for

TABLE V. COST OF THERMIT AND APPARATUS FOR GENERAL WELDING

	Gross Lb. Shipping Weight	Cost
Railroad Thermit (50-lb. boxes only)	67½	$17.50
Plain Thermit (50-lb. boxes only)	59	17.00
Cast-iron Thermit (50-lb. boxes only)	70½	17.50
Ignition powder (½-lb. cans)	..	.45
Yellow wax, per pound	..	.35
Punchings, per pound	..	.025
Special molding material (300 lb.)	340	4.00
Fire clay (300 lb. net)	340	3.50
Fire brick, per barrel (300 lb. net)	340	4.00
Kiln-dried silica sand (300 lb. net)	340	3.50
Single-burner preheater	200	50.00
Double-burner preheater	225	75.00
Flaming-burner attachment	...	3.00
Magnesia stones, No. 1	...	.15
Magnesia stones, No. 3	...	.20
Magnesia thimbles, No. 1	...	.10
Magnesia thimbles, No. 3	...	.15
Magnesia tar, about 400 lb. net	450	.06
Plugging material, No. 2 package	...	.10
Automatic crucibles (with caps and rings)	40	4.00
Automatic crucible, No. 2	60	5.50
Automatic crucible, No. 5	150	11.00
Automatic crucible, No. 10	775	60.00
Cast-iron relining cone, No. 1	50	5.00
Cast-iron relining cone, No. 5	150	12.00
Cast-iron relining cone, No. 10	600	40.00
Tripods, Nos. 1 to 7, weights 11 to 65 lb.	...	$2.50 to 9.00

welding round bars together is shown in Fig. 80. The pattern and mold box for this are shown in Fig. 81.

High-speed steel blades may also be welded into large or emergency job reamers in a comparatively short time. For this purpose a cylinder is bored out slightly larger than the hole to be reamed. The blades for the reamer are placed inside this cylinder and wedged

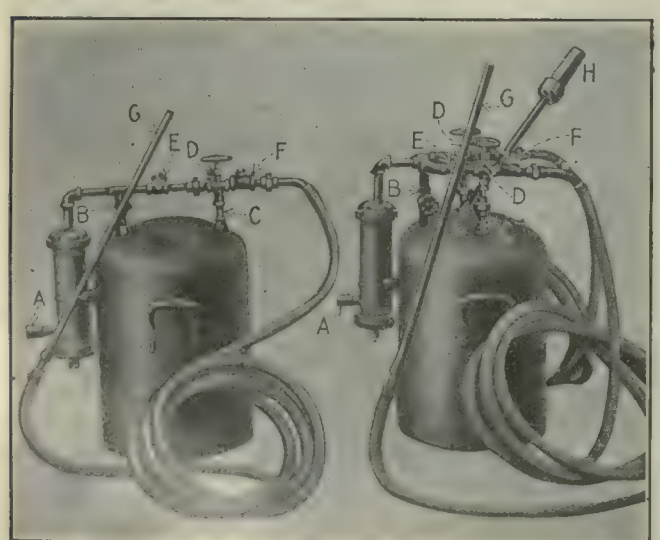


FIG. 84. SINGLE-BURNER AND DOUBLE-BURNER PREHEATERS, USING EITHER GASOLINE OR KEROSENE

into their proper places. Tin or wooden spacing pieces may be used for this if they are so placed as to be removed after the wax hardens. After the blades are fixed in position another cylinder or piece of pipe is centered inside the blades, allowing space between the blades and this cylinder according to the size of the reamer being made. Wax is next poured into the spaces between the blades and the inner cylinder. After it is removed from the outer cylinder and the wax hardens, enough of it is trimmed away between the blades to allow for chip space. The wax matrix with the blades in place is then rammed up in a mold. The inner cylinder is then warmed slightly and removed. A steel shank is next inserted and centered correctly. The wax is now melted out and the Thermit steel run in, welding the blades securely to the steel shank. A wax matrix, with blades and inner cylinder

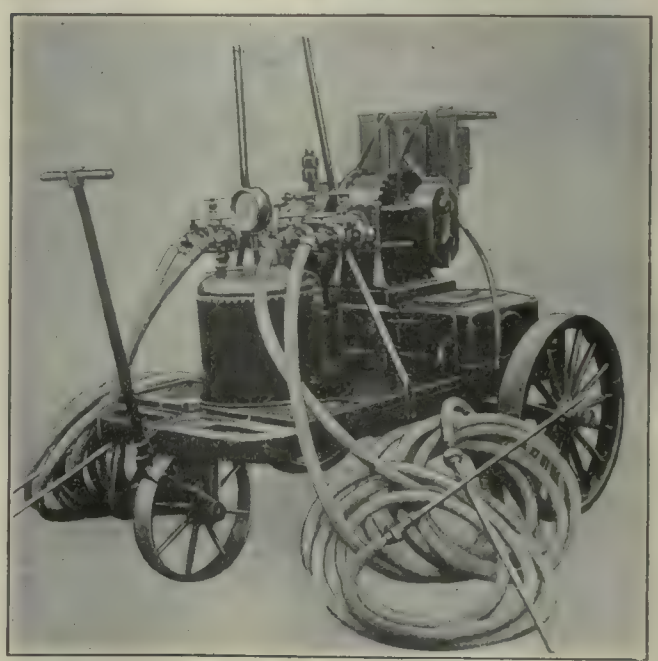


FIG. 85. RAIL PREHEATER THAT WILL HEAT FOUR JOINTS AT ONCE

in place, is shown in Fig. 82. In this illustration the wax has been cut away between the blades and the assembly is ready to be put into the mold box and be rammed up. When the work is cool it is centered and the blades ground for size and clearance.

A helical reamer with inserted high-speed steel blades is shown in Fig. 83. This reamer was made by T. O. Martin, blacksmith foreman of the Illinois Central R.R. shops at Jackson, Tenn.

Preheaters for Thermit Work

As practically all welds in ordinary practice, except those on pipe, require preheating it is well to use heaters made for the purpose wherever possible. In some shops gas-burning torches supplied with compressed air may be used. Many shops, however, have neither gas torches nor compressed air. This method is not practicable on outdoor welds. Crude-oil heaters should not be used at all, on account of their tendency to deposit carbon or other matter on the surfaces to be welded, thereby causing inperfect welds. In order to make the preheating work as easy and convenient as possible the Metal and Thermit Corporation makes the preheaters here shown. Fig. 84 shows two kinds,

a single and a double burner. For infrequent or small jobs the single burner, which may be fitted with a flaming burner also, will probably answer the purpose. Where a number of welds are to be made, however, the double-burner apparatus should be selected. In these illustrations *A* is the place to attach the hose from the compressed-air supply; *B* is the valve for regulating the pressure on the surface of the fuel; *C* is a tube which runs within a few inches of the bottom of the tank; *D* is the needle valve which controls the fuel to the burner; *E* is the air pressure control to the burner; *F* is a check valve which prevents back fire; *G* are torches or burner pipes; *H* is a flaming burner. The small tank on the left side is a water separator for the compressed-air supply.

Fig. 85 shows a four-burner portable apparatus used largely for rail-welding work. It carries its own air compressor, which may be run by attaching to a trolley wire or to some other electric-current supply. All of these burners use either gasoline or kerosene.

Cost of Thermit Welds and Apparatus

There are many factors which enter into the calculation of the cost of Thermit welding and the apparatus. Where a single weld is to be made and the shop man has to buy the apparatus, materials and do the work himself, the cost will naturally be higher than where several welds are to be made or where he can hire it done. There are so many places now making a specialty of Thermit welding that in ordinary circumstances it is usually better to have them do the work on large jobs than for inexperienced men to undertake the work. One big factor in favor of Thermit welding, on large jobs especially, is that of time saving, and many times this process would be preferable to any other plan on this account alone, even if the cost were ten times what it really is.

TABLE VI. COST OF MATERIALS AND APPLIANCES FOR PIPE WELDING

STANDARD WEIGHT PIPE

Inside Diameter, Inches	Price of Welding Portions: 100 or Less	Over 100 and Less than 500	Over 500 and Less than 1000	1000 or More	Price of Mold	Price and Size of Crucibles	Price and Size of Tongs	Price and Size of Clamps	Price and Size of Pipe Facing Machines
½	$0.36	$0.32	$0.27	$0.19	$0.75	No. 2	No. 2	No. 1	No. 1
¾	.44	.40	.36	.26	.75	2	2	1	1
1	.60	.56	.55	.39	1.00	2 $1.75	2 $2.00	1	1
1¼	.78	.74	.69	.60	1.25	2	2	1 $20.00	1 $35.00
1½	.90	.86	.84	.75	1.50	2	2	1	1
2	1.03	.99	.97	.90	1.75	2	2	1	1
2½	1.50	1.46	1.43	1.35	2.00	3 3.00	3 2.50	1	1
3	2.16	2.12	2.09	2.06	2.25	3	3	1	1
3½	3.06	3.02	2.99	2.96	2.50	4 4.75	4 3 25	2 25.00	2 60.00
4	4.63	4.59	4.56	4.50	2.75	4	4	2	2

EXTRA HEAVY PIPE

½	$0.45	$0.42	$0.37	$0.29	$0.75	2	2	1	1
¾	.54	.48	.42	.34	.75	2	2	1	1
1	.72	.67	.62	.56	1.00	2 $1.75	2 $2.00	1	1
1¼	.90	.86	.84	.75	1.25	2	2	1 $20.00	1 $35 00
1½	1.14	1.10	1.05	.98	1.50	2	2	1	1
2	1.78	1.75	1.71	1.65	1.75	3 3.00	3 2.50	1	1
2½	2.94	2.90	2.86	2.80	2.00	4	4	1	1
3	4.23	4.20	4.16	4.10	2.25	4 4 75	4 3.25	1	1
3½	5.43	5.40	5.36	5.10	2.50	4	4	2 25.00	2 60.00
4	6.22	6.18	6.14	6.08	2.75	5 7.50	5 4.50	2	2

DOUBLE EXTRA HEAVY PIPE

½	$0.93	$0.90	$0.86	$0.81	$1.50	No. 2 $1.75	No. 2 $2.00	No. 1	No. 1
¾	1.08	1.04	1.02	.96	1.75	2	2	1	1
1	1.20	1.16	1.14	1.08	2.00	3 3.00	2	1	1
1¼	1.49	1.43	1.41	1.36	2.25	3	3 2.50	1 $20.00	1 $35 00
1½	2.14	2.08	2.03	1.94	2.50	4 4.75	3	1	1
2	3.82	3.73	3.71	3.68	2.75	4	4 3.25	1	1
2½	7.30	7.27	7.24	7.20	3.00	5 7.50	5 4.50	1	1
3	10.60	10.57	10.54	10.50	3.50	5	5	1	1

Data for the approximate cost of various jobs has been given in tables and specifications throughout the article, but in order to give those responsible for repair or other welding work, as exact information as possible on which to base their calculations, the accompanying tables are included. These are taken from the price list of the Metal and Thermit Corporation, published June 15, 1918, and of course are subject to changes. These quotations are f.o.b. Jersey City, N. J. Table V gives prices for general welding materials, and Table VI for pipe work. It will be noted that some of the quotations in this last table do not exactly agree with figures given in the table of comparative costs of Thermit welded and mechanically-joined pipe, but it should be borne in mind that the comparative table gives averages only, and is also subject to variations in cost of labor and materials.

What Is the Matter With the Machine-Tool Business?

By Entropy

Just *why* anyone stays in the machine-tool business is almost as great a mystery as *how* they can stay in it. It is an absolutely essential business, and yet it is among the first to go down under pressure and the last to come up. What is the matter? Why cannot it be equalized?

Possibly the trouble is that a machine tool built just after the Civil War was almost usable at the beginning of the late war. In hardly any other line of machinery are the builders so lacking in inventive ability that they cannot change designs radically in less time than it takes to wear out the product. In the machine-tool business the changes in design over a period of 10 years are only noticeable to an expert. There may be a change in the style of oil-hole covers or there may be a handwheel on the tailstock instead of a crank, but the fundamentals remain imperceptibly changed. The size of the head spindle for a 16-in. lathe has advanced timidly by sixteenths of an inch. The change gears have hardly been glanced at, the belt power has mounted only by eighths. Our designers seem to be tied hand and foot; conservatism has held the fort, and timidity is the only recognized virtue. Once in a blue moon some designer from the back-hill country comes out, shines with meteoric splendor, makes a killing, grows rich and shuts up in his shell again. Such circumstances only accentuate the gloom; they do not light the way for others. Users of machine tools are apt to look on them as permanent investments, not as articles of consumption. Not long ago I sold a lathe to a shop where they were considering taking out an oldish machine with a stone bed. On reconsideration, however, it was decided that the old machine was pretty good for certain purposes and might as well stay. Can such a thing be imagined of any other kind of a machine? Very few new general-purpose machine tools have been

changed since the memory of the present generation enough to alter their identity. Very few special-purpose machines have developed a general demand.

One reason is that so few builders are willing to make changes from the standard article, and the product is so standardized that it is very expensive to make those changes. An entirely special machine not far different from the standard may easily cost four or five times the asking price for the standard machine. When built, used and sold again it will bring no more and possibly not as much as a standard machine that has been used as long. The purchasing public is not educated up to a sense of values. It is apt to figure back to a price per pound basis, whereas the basis should be earning capacity per dollar.

A machine that requires a $1500 man to operate it may only cost $1000 all set up and equipped. The overhead charges may be 200 per cent., which will make the total cost of operation $4500. Against this the original cost of the machine is a pretty small item. A new machine at the same price which will add 25 per cent. to the product will pay for itself in a year. It is pretty difficult to look into a machine shop and not imagine a 25 per cent. improvement in its equipment. It is more difficult to work in one and not imagine a 100 per cent.

Handiness Sought by Makers

Handiness is sought after by a few makers, but seldom referred to by the makers in their advertisements. Quickness of adjustment, of setting up, so that idle time is cut, is not always thought of. Someone proposed several years ago that there might be false planing-machine tables so that work could be set up on one, as on a bench, and the planing machine be cutting away on the other. It has even been tried out successfully, but never adopted. Gear boxes for quick change of thread cutting are popular, and yet lathes are used less than 5 per cent. of the time on thread cutting. They are a talking point, but not much more. It is such a job to get a vise off that most small shaping jobs not specially fitted to be held in a vise are done on a planing machine costing twice as much and taking twice as long. And so we might multiply instances of ways in which one who stands off at a little distance from the problem might add to the efficiency of the use of the machine without adding greatly to its cost.

All this will be of no value so long as the stereotyped phrases are in circulation, such as "If you are interested in obtaining only the best tools, etc.," "Insures accurate alignment and efficiency," "All bearing accurately scraped or ground to exact standards" and so on for ever. Something new will have to be used; something that indicates what percentage of the time a machine has to stand idle because of lack of adequate equipment of which the purchaser does not realize the need. If a dealer gets an order for a lathe and equipment he will send the customer a chuck and a set of 10 or a dozen lathe tools of carbon steel, and he stops right there instead of asking what the machine is to be used for and supplying a set of equipment suited to the job.

Salesmen will also have to quit using these same stock phrases, and will have to learn that a demonstration is the only convincing thing to a purchaser of a lathe or a milling machine just as it is with the purchaser of a grinding machine. The weakest built lathe in the country with proper equipment will beat out the best lathe with improper equipment on some classes of work. The improper equipment is almost sure to be the home-made type. Again, if the salesman could find out what type of work the machine was wanted for, he might often direct the attention of the purchaser to these accessories or to some special changes that could be made to make the machine more effective.

Unless some such timid advances are made by builders it seems likely they will continue in the feast-or-famine way in which they have gone for the past 50 years. The public must see visible signs of profit before it will swap horses and pay anything to boot. If there is a profit there never is a time so dull that there is not a group of firms which has always made its money by buying its straw hats in the winter and which has the cash hidden away for just such opportunities to buy before the other fellow does and beat him to it for the profits.

Spanish Equivalents for English Names of Metals in Common Use

By J. J. McIntyre

In view of the probable expansion of export trade, particularly in the direction of the Spanish-speaking countries of South America, a knowledge of Spanish nomenclature as applied to things intimately associated with the machine shop will not come amiss. As a step in this direction the following partial list is appended:

English	Spanish
High-speed steel	Acero para alta velocidad.
Oil-hardening steel	Acero templado con aceite.
Chrome and nickel steels	Acero al cromo y niquel.
Tool and drill steels	Acero para herramientas y taladros.
Pick, wedge and hammer steels	Aceros para picos, cuñas y martillos.
Music wire for springs	Alambre para resortes.
Cold-rolled steels	Aceros laminados en frio.
Forgings, specialties	Piezas forjadas especialidades.
Toolholder steel	Acero de porta-herramientas.
Vanadium steel	Acero vanadio.
Annealed punch and die steels	Acero recocido para punzones y matrices.
Spring steels	Acero para resortes.
Machinery steels	Acero para maquinaria.
Drill rods	Varillas de taladro.
Tempered spring wire	Alambre de resorte templado.
Drawn steels	Aceros estirados.
Iron	Hierro.
Steel	Acero.
Forged steel	Acero forjado.
Tool steel	Acero de herramientas.
Angle iron	Hierro de angular.
Forged iron	Hierro forjado.
Cast iron	Hierro fundido.
Wrought iron	Hierro dulce.
Brass	Latón.
Bronze	Bronce.
Copper	Cobre.
Gold	Oro.
Lead	Plomo.
Silver	Plata.
Tin	Estaño.
Tungsten	Tungsteno.
Crucible steel	Acero de crisol.
Openhearth steel	Acero siemens-martin.
Steel castings	Piezas fundidas de acero.
Pig-iron billets	Hierro en lingotes.
Steel plates	Chapasde acero.
Steel bars	Barras de acero.
Strip steel	Acero en tiras.
Seamless tubing	Tubería inconsútil.

Government Inspection of Machines and Small Tools

EDITORIAL CORRESPONDENCE

Some of the requirements of the War Department in the matter of inspecting machine tools, micrometers and similar products are of interest to those who desire to know what standards of accuracy are demanded by the War Department.

THE various machines and small tools purchased by the government must pass rigid inspection requirements, for which definite rules have been formulated. For lathes, after the usual visual inspection, the following tests are prescribed:

For Alignment of Live Spindle.—The lathe shall be levelled by means of a sensitive graduated spirit level laid on the tops of the ways. This must read the same when laid in any position across the ways at the two ends, or lengthwise at any point.

A test bar will be furnished the inspector by the Government. It will have a standard taper at one end and a cylindrical portion, one in. in diameter and about 12 in. long, extending therefrom. The tapered portion of this test bar will be used to gage the correctness of size and angle of the tapered hole in the end of the live spindle.

With the test bar inserted in the spindle, and an indicator mounted on the toolpost and set against the top of the bar, move the carriage and indicator out to the end of the test bar. The difference in readings between the two ends of the bar will give the error in alignment in the vertical plane. Without moving the carriage, rotate the spindle one half turn, or 180 degrees.

Move the carriage and indicator back to the head end of the bar. Rotate the spindle for a second half turn, or 180 deg. Note the difference in readings between the beginning and end of the latter movement. The indicator and spindle are now at their original positions.

Set the indicator on the side of the test bar, and without rotating the spindle, move the carriage and indicator out to the end of the bar. The difference in readings between the two ends of the bar will give the error in alignment in the horizontal plane.

Rotate the spindle through one half turn, or 180 deg. Note the difference in reading.

Move the carriage and indicator back to the head end of the bar. Rotate the spindle for a half turn, or 180 deg. Note the difference in readings between beginning and end of latter movement.

For Alignment of Tail Spindle.—With the indicator at the side of the end of the bar, and with the tail spindle flush with the front face of the tailstock, adjust the tailstock by a side movement so that it centers with the test bar in a vertical plane. Read the indicator.

Run the tail spindle out 75 per cent. of its length, and again center it in the test bar. Note the difference between these two readings.

The tail spindle must be clamped tight to the ways when each of these readings is being taken.

Move the indicator to the top of the test bar. Determine the difference in readings when the tail center is flush and when it is 75 per cent. extended.

For Truth of Cross Feed and Faceplate.—Note diameter of the largest faceplate.

Clean the threads on the large spindle, and screw on the largest faceplate covered by the order. Adjust the indicator on the toolpost so that readings may be taken across the horizontal diameter of this faceplate. By means of the cross feed and without rotating the plate determine the difference in readings between the front edge and the center of the plate.

Continue the motion, and determine the difference in readings between the center and rear edge of the plate.

Rotate the spindle and faceplate one quarter turn, or 90 deg. By means of the cross feed determine the difference in readings between the rear edge and center of the plate.

Continue the motion and determine the difference in readings between the center and front edge of the plate.

Obtain the signed statement called for by the specifications to the effect that the threads on the lead screw are within the limits of accuracy called for by the specifications.

TESTS FOR SHAPING MACHINES

In addition to the visual and operating inspection, the following tests are made for the accuracy of the machines:

1. Every machine shall be tested by the inspector after it has been tested and passed by the manufacturer. The manufacturer may observe all Government tests.

2. Adjust the machine so that the ways on the column are vertical, using a sensitive, graduated spirit level and square. See that the table top and the top of the vise body are level.

3. *Alignment of the table top with the line of motion of the ram.*—Clamp an indicator in the toolpost with its point against the top surface of the table near the outer edge. Move the ram back till the indicator makes contact near the inner edge of the table. The difference of these two readings gives the error in alignment of the table top with the line of motion of the ram. This must not exceed 0.003 in. in 12 in. of movement.

4. *Alignment of the table top with the line of transverse motion of the table.*—With the indicator still clamped in the toolpost, move the table till the indicator makes contact with the top surface first near one edge then near the other. The difference in the indicator readings gives the error in alignment between the table top and the line of transverse table motion. This must not exceed 0.003 in. in 12 in. This test is unnecessary if the table swivels.

5. *Alignment of the side of the table with the line of motion of the ram.*—With the indicator clamped in the toolpost, adjust its point to bear on the side of the table and make a test similar to 3. The error in alignment must not exceed 0.003 in. in 12 in. of movement.

6. *Alignment of the table when swiveled.*—If the machine has a swiveling type table, turn the table through 90 deg. and test the surface now on top for alignment as in 3. The error in alignment must not exceed 0.003 in. in 12 in. of movement.

7. *Alignment of the table side with the vertical motion of the table.*—Clamp the indicator on the table support or some part which does not move with the table and bring its point into contact with the side of the table. The difference in the indicator readings as the table is run up and down will show the error in alignment of the side of the table with the line of vertical motion of the table. This must not exceed 0.003 in. in 12 in. This test is unnecessary if the table swivels.

HORIZONTAL-SPINDLE MILLING MACHINES

In addition to the usual inspection, the machines are operated to see that they function properly, that gears run quietly, that friction clutches and releasing clamps act properly, that limits and safety stops perform their various functions, and that the machines generally are in good condition. The following tests for accuracy are then prescribed:

1. Every machine shall be tested by the inspector after it has satisfactorily passed the manufacturer's test. The manufacturer may observe all Government tests.

2. *Relation of the table top to the vertical motion of the table.*—Set the machine so that the ways on the column are vertical. Use a sensitive, graduated spirit level with a square to determine when this condition has been obtained. With the machine set so that the column ways are vertical, test the table to see that it is level in all directions.

3. *Size of the taper hole in the spindle.*—Test the taper hole in the spindle. See that the diameter, length and taper of the hole are correct.

4. *Alignment of the taper hole in the spindle with the spindle bearings.*—Insert a test bar in the spindle. Clamp an indicator on the table so that it may be brought into contact with the test bar near its end. Turn the spindle and note the maximum and minimum readings of the indicator. Their difference must not exceed 0.002 in. Repeat the test with the indicator in contact with the test bar about 1 in. from the spindle nose. A tolerance of 0.001 in. is permitted.

5. *Vertical alignment of the spindle with the transverse motion of the table.*—With the indicator clamped on the table, bring it in contact with the bottom of the test bar about 1 in. from the spindle nose. Without turning the spindle, move the saddle so that the indicator moves over the length of the test bar. In order to eliminate errors due to non-alignment of the spindle hole with the spindle bearings, turn the spindle through 180 deg. and return the saddle and indicator to the spindle end of the test bar. The movement of the indicator needle must not exceed 0.002 in. in 12 in. of movement.

6. *Horizontal alignment of the spindle with the transverse motion of the table.*—Set the indicator against the side of the test bar instead of the bottom and test for alignment in a horizontal plane in a similar manner to that described in 5. The limits of error in alignment are the same as those in 5, 0.002 in. in 12 in. of movement.

7. *Alignment of the table top with the tranverse motion of the table.*—Clamp the indicator on the spindle or some part which does not move with the saddle or table and bring it into contact with the top surface of the table. Move the saddle so that the indicator traverses the table top. The indicator readings at the opposite edges of the table will show the error in alignment between the table top and the transverse motion of the table. This must not exceed 0.002 in. in 12 in. of movement.

8. *Alignment of the table top with the longitudinal motion of the table.*—With the indicator clamped as in 7, bring it into contact with the top surface of the table near one end. Move the table so that the indicator travels the full length of the table. The indicator readings at opposite ends of the table will show the error in alignment of the table top with the longitudinal motion of the table. This must not be more than 0.002 in. in 12 in. of movement.

9. *Alignment of the table swiveling motion with the table top (on universal millers only).*—On universal millers, swivel the table as far as possible and repeat the alignment tests for longitudinal and transverse table motions, 7 and 8. The tolerance are the same, 0.002 in. in 12 in. of movement.

See that the swivel table clamps hold the table firmly.

10. *Size of the taper holes in the spiral head and tailstock.*—Test the taper hole in the spiral head and tailstock with the test bar furnished for that purpose to see that the holes are of correct diameter and taper.

11. *Alignment of the taper hole in the spiral-head spindle with the spindle bearings.*—Make a test on the spiral-head spindle similar to the test for the main spindle described in 4. The tolerances are 0.002 in. at 12 in. from the spindle nose, 0.001 in. at 1 in. from the spindle nose.

Cylinder Grinding Machines

The visual and operation tests are very similar to those of the milling machines, with regard to gears meshing properly and speed stops acting positively. The accuracy tests are as follows:

Mount an angle plate with a true, flat face on the table facing the end of the wheel spindle. Mount an indicator on the wheel spindle with its point in contact with the face of the angle plate. Set the angle plate so that rotating the head without turning the spindle will show the plate aligned with the plane of rotation of the end of the wheel spindle within 0.002 in. in 12 in. The spindle should be set for boring the maximum hole, that is, at its greatest eccentricity. If the plate is not accurately aligned, allowance should be made in the following tests for the error in setting up the angle plate.

Horizontal Alignment of the Table Motion with Spindle Rotation.—Clamp a square on the face of the angle plate with its blade parallel to and in the same horizontal plane with the wheel spindle. Adjust the indicator to read the alignment of the edge of the square when the table is moved parallel to the spindle. The error in alignment must not exceed 0.003 in. in 12 in. of movement.

Vertical Alignment of Table Motion with Spindle Rotation.—Repeat this test, but with the square in the same vertical plane as the spindle. The tolerance is 0.003 in. in 12 in. of movement.

Inspection of Micrometers

The inspection of micrometers involves the placing of the instrument in a stand so that it will not be necessary for the hand to come in contact with the frame while making the tests. The smoothness of the screw action should be noted and the adjustments made from zero. The measuring spaces are tested for accuracy by using hardened steel balls of different sizes, mounted in sheet aluminum handles. These should be used in order starting with the smallest ball. The judgment of the inspector must be used in rejecting micrometers which show high spots of lack of parallelism between the faces. The tests are as follows:

Make a light setting on the ball and then explore the surfaces of the measuring faces.

1. For micrometers reading from 0 to 1.0 in., test the following readings by means of Johannsen blocks—

Series A:—0.000 in., 0.200 in., 0.400 in., 0.600 in., 0.800 in., 1.000 in.

Series B:—0.000 in., 0.205 in., 0.410 in., 0.615 in., 0.820 in., 1.000 in.

Series A will check the screw and the zero on the sleeve at six points in the working range. *Series B*, when compared with the corresponding ones in *Series A*, will test the accuracy of the graduations on the sleeve.

2. Micrometers reading through another range, as from 2.0 in. to 3.0 in., from 3.0 in. to 4.0 in., etc., shall be tested through the working range in the same way, special attention being paid to the even inch measurements.

Check carefully the standards furnished with the micrometer.

3. *Tolerances.*—For micrometers reading to 0.001 in., the graduations, as tested in paragraphs 1 and 2, shall be correct within 0.0003 in. Micrometers reading to 0.0001 in. shall be submitted to the Bureau of Standards for test when so directed by the Supplies Inspection, Signal Equipment, Washington.

Turning Versus Grinding

By E. H. Fish

A cylindrical grinding machine to handle work of a certain size will cost from two to three times as much as a lathe of the same capacity. The cost of power is larger; the cost for oil and coolant is greater; the labor cost per hour may be a shade less.

Why not stick to the lathe? There are a number of jobs where accuracy cannot well be attained except by grinding, but the greater number of lathe jobs can be finished by a man of medium attainments on a lathe within the limits prescribed. Yet despite some of its well known limitations the grinding machine is gradually pushing its way in and growing more and more established as a standard and expected machine tool.

One very good reason for this is something which is peculiar to the grinding machine, but need not be, and that is the automatic-measuring feature. A grinding

machine operator micrometers his work, finds it is still 0.008 in. over size, sets his automatic-feed stop and quits worrying. It will not go under size anyway. It is this matter of measuring which is the fundamental difference between a skilled and an unskilled workman. A man who cannot measure at all must be a laborer; a man who can make fine measurements can have any job he likes in the mechanical field. When he makes fine measurements by aid of artificial means, by means of micrometers, automatic stops, or even unit pieces as a printer does, he is not really making the fine measurements himself, and he is not entitled to pay.

Another thing which makes the grinding machine profitable is that its cutting tool is self-sharpening; that is, each particle of abrasive cuts until it is dull and then it is pushed out of its matrix to make way for another sharp one. This is what should always happen and does happen if the wheel, its speed, the speed of the work and the material, are all suited to each other. If the operator is on day rates he welcomes a hard wheel which holds its shape and requires but little truing. It may need frequent dressing, but he does not do it. His production is low, but he claims that the time saved from truing makes up for the slow production. His machine is running a large portion of the time anyway, and unfortunately a great many foremen judge their men by the appearance of being busy rather than by production.

Put this same man on piece work and he soon calls for a softer wheel, one that cuts freely and wears down rapidly. Such a wheel is a source of profit to the makers, for two will be used where but one of the harder wheels would be required. To be sure the man with the soft wheel will get out double the product and more, so the superintendent has to figure very carefully to know just which wheel is the cheapest in proportion to production. A hard wheel lasts longer and stops less for truing the machine. A soft wheel produces more work, but requires more time for truing, less for dressing. It wears itself out quicker, but takes less power to run it. The superintendent needs a formula of this sort:

Cost of work = Cost of labor + cost of power + cost of wheel per unit + cost of truing + cost of dressing + general overhead.

Truing and dressing should be carefully distinguished. Truing is done to keep the wheel round and to preserve the shape of the face. Dressing is breaking up the face to knock out the dull particles of abrasive; in other words, dressing is sharpening.

Dressing is automatic if the wheel is of the correct grade. If the wheel is too hard, the cutting points dull and are rounded over, but do not fall out on contact with the work. It requires a dresser to knock them out. The dresser also knocks out a great many more sharp particles than it does dull ones. It is expensive medicine, but it must be used if a penurious purchasing agent persists in buying grinding wheels for their lasting qualities.

If the wheel is too soft the cutting particles will fall out before they have done their full duty. A too soft wheel is apt to wear out of true and require frequent truing. Efficient grinding can only be attained by scientific investigation. A man who claims to be able to tell by the looks of a wheel whether it is the best for a given job is taking advantage of the extreme ignorance of his customer. He may be able to improve the output by reason of the wheel formerly used being altogether unsuited for the job, but he cannot get the best conditions except by patient trial of different grades, grains and speeds.

Every test shows the direction in which to go. There is nothing blind about it. If the wheel is too hard the amount of work it will do will show a rapid decrease after the first few minutes, and its efficiency will be restored by dressing. If the grain is too fine there is no room for the chips and the wheel will clog and scratch the work. If the wheel speed is too slow there are not enough cutting particles presented to the work. If the work speed is too slow, production will be correspondingly slow. Speeding up a wheel that is too soft has the same effect as using a harder wheel, but the grade of wheel which most nearly approximates the requirements should be selected first and the work speed used to bridge the gap between the grade of one wheel and another of the same nominal grade.

The purchaser should realize that wheels of a given grade are not always uniform in hardness. Grade M means a range of grades that run into L and N on the hard and soft sides. Two M wheels may be quite a bit different in grade and still be graded correctly. The one which is nearly hard enough to be called L might be graded L by another grader. The same is true on the side toward the soft wheels. So there is need of means for varying the work speed so that all kinds of wheels of a given grade can be used to their greatest advantage.

Cutting Stub-Tooth Gears With a Standard Involute Cutter

By Joel Sundell

On account of the delay in obtaining replacements for gears and the consequent slowing up of production it was decided to take a chance and attempt to cut 20-deg. angle stub-tooth gears with a 14½-deg. angle standard involute cutter. That the chance was worth taking is shown by the fact that the gears so cut have operated for several months in just as satisfactory a manner as the original ones.

In attacking the problem a 10-pitch standard involute cutter was selected for an 8-10-pitch stub-tooth gear. On account of the differences in the two kinds of teeth it was decided to try either a No. 1 or a No. 2 cutter regardless of the number of teeth. Both gave satisfactory results in service.

To find the amount to set the cutter off center to give a 20-deg. angle we deducted 14½ deg. from 20 deg., which gave 5½ deg., and multiplied the sine of 5½ deg. by the radius of the work.

The job was done by setting the cutter on center and milling the teeth to the required depth all the way round the blank. Then the cross-slide was moved the determined amount to get the cutter off center and a shaving cut off one side of each tooth. The gear must be revolved in the opposite direction to that in which the cross-slide was moved, i.e., if the cross-slide was moved toward the column the top of the gear must be revolved away from it. Then the cross-slide was moved to the other side of the center and a shaving cut off the other side of each tooth, taking care to keep the thickness of the tooth at the pitch line correct. This may be tested with a solid gage or by a tooth caliper.

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

Suggestions for Conserving Coal and Assisting Manufacturing

By GEORGE N. COLE

This shows what was accomplished in coal conservation through instruction in burning fuel. It also suggests ways and means of spreading knowledge of the mechanical industries in the same way as agricultural pursuits are benefited by the present Government organizations.

THE Bureau of Conservation of the United States Fuel Administration did much effective work in saving fuel that should not be lost to the community, and it is the purpose of this article to indicate how this work may be advanced for the benefit of all concerned. In an address before the American Society of Mechanical Engineers at its recent annual meeting Davis Moffat Myers, representing the Fuel Administration, outlined that part of the work of the Bureau of Conservation which had to do with maintaining production at its highest rate with the minimum consumption of fuel.

He drew particular attention to the fact that the bureau strove for economical production rather than curtailment, and the slogan was "maximum of production with minimum of waste"; he also pointed to an accomplishment of saving coal that amounted annually to 7,000,000 tons and which it was expected to better greatly.

For an initial performance it was most striking and is worthy of perpetuation. It was accomplished in a prompt and simple manner. Avoiding the delays of survey with its inspections and reports the bureau went direct to the core of the matter by issuing a questionnaire which indicated what should be performed along eight divergent lines of factory economy. It asked owners what their operating conditions had been and suggested that they make all possible improvement in order to conform to the rules for conservation laid down by the bureau.

Substantial Fuel Savings

The response was prompt and the improvement began immediately and quickly mounted to a saving, as Mr. Myers states, of 10 to 25 per cent. in fuel. This is almost revolutionary and was accomplished not only in small plants but in the large ones. Factory interests were instructed to help themselves, and they have so appreciated the advantages that letters have been received in Washington from individual plants all over the country which say in effect, "We have installed your recommendations. Our records for the three months during which these have been in effect, compared with last year's three months, show a saving of 25 per cent. in fuel."

Results like these must be recognized for the general good and should not be abandoned. Little wonder that Mr. Myers reports that the closing of the activities of the Fuel Administration is met with the earnest question, "You are not going to let the fuel-conservation movement stop, are you? It has done us so much good you have got to go ahead with it."

At present the Bureau of Mines and the United States Geological Survey are taking over the work of improving the quality and the processes of mining. They are also considering the engineering problem of generating electric power near the sources of coal supply. Increasing the productivity of the individual plant on the same or reduced coal allowance is most important, but seems still in abeyance.

Utilizing the State Colleges

This calls to my mind a project I instituted in the winter of 1911 in one of our big manufacturing states. Moved possibly by envy of the facility with which the farmer can obtain detailed instruction in his various activities, whether they be of the soil or seed, animals or machinery, and that the investigating resources of the whole country are placed at his disposal by a postal card, attention was called to the fact that practically no aid was vouchsafed the manufacturing industries in any of the technical difficulties that arise from time to time. It was pointed out that this work might be done by the mechanical and other departments of the large state universities and the Government land-grant colleges, and that it would have the advantage of giving the student, under the supervision of the professor, a taste of the practical questions of manufacturing. After some trade-paper publicity and the energetic action of a state senator the State University of his commonwealth was put in possession of the ability and an appropriation to carry out work of this kind. Numerous land-grant colleges in the other states are doing various phases of this work to the great benefit of their manufacturing communities and inestimable advantage of the students participating.

This action was but the prewar manifestation of what could be slowly accomplished for the good of any manufacturing commonwealth. It was coming gradually into favor. As experience and publicity brought it to the aid of one plant competition and progress demanded its use by others. For some installations it had accomplished wonders—it had become a necessity.

Experiment Stations

With the urge and bustle and yet deficiencies of war production, patriotism demanded larger outputs with smaller supplies of power, men and material, and the country was obliged to develop its brains that its means might reach farther. One of these progressive organizations was the Fuel Conservation Bureau, and with keen, quick action it made our fuels cover their necessary obligations of doing more work per ton mined and at the same time vindicated the theory that the state benefits amply by leading and instructing its manufacturers.

Experiment stations have been tried before. More than a third of a century has vindicated the vision of

those who established the system of agricultural experiment stations throughout the country. These experiment stations had brought immeasurable recompense for the expenditure involved and no element in the community, not counting the directly interested farming industries, would see the activities of these stations impeded. They are in close relation to the agricultural departments of the land-grant colleges and have sprouted and branched into all the remotest parts of our country's earth, air and water plant products.

The Land-Grant Colleges

The land-grant colleges were founded for "the propagation of the agricultural and mechanic arts, not excepting military science." The last few years have proved that, as in military science, by their output of aviators, radio men and auto divisions, the people are in thorough touch with these universities, which are among the largest in the land, as to agriculture and military science mentioned above. Yet, with few exceptions, the mechanical departments of these schools still hold themselves apart from the communities they might serve so admirably.

The land-grant colleges and the agricultural experiment stations are today receiving large appropriation and support from the United States Government in addition to the goodly sums that the states find most profitable to bestow for the education of their sons and daughters, and they are most completely in touch with the agricultural interests and are bending their energies most seriously to their help. People and college would regard any curtailment as a catastrophe.

Helping the Mechanical Industries

The mechanical side of a state's industries should have equal benefit of a similar installation of experiment stations. As a Government enterprise it may be an innovation, but its benefits in a limited way under state supervision have already been proved, and it has the magnificent precedent of the before-mentioned chain of Government agricultural experiment stations, which extent from Maine and Florida to Alaska and the Philippines. State industrial extension stations, in connection with the mechanical departments of the various state schools now supported in part by the Government, could answer the questions and point progress, advise economies and teach administration to the industrial commonwealth similar to that the agricultural commonwealth now receives.

These mechanical stations could be coördinated, prevented from costly duplication and directed to new endeavor by a national bureau. This would provide a rational residuary legatee of the fuel-conservation work, a thing which Mr. Myers, the advisory engineer of the bureau, seconds, pledging in a letter that we may be sure of his "support of this excellent plan."

It is a movement that must be started promptly, that the impetus given to the work already under way may not be allowed to lag and because any delay is so much waste of real money to the industries. These industries are ready and anxious for guidance, and the opening should not be neglected. It is a proposition that is live today and 10 years from now it could no more be taken from the mechanical industries than its agricultural counterpart could be abolished today.

Fuse Sizes for Industrial Motors

Special Correspondence

The proper size of fuse for a motor is too often obtained by the chief electrician or one of his repairmen by haphazard methods. The motor's normal operating current is given by the maker on the name-plate, but fuses are properly selected of a larger capacity to allow for starting and for momentary overloads. Hence it is rather more usual for the maintenance man to select his fuses "be guess and be gosh," with a view to their permanence in service rather than the safety of the motor they are supposed to protect.

In order to give a practical working idea of what sizes to use, the Westinghouse Electric and Manufacturing Co. has prepared and issued the following tables. These are based on the following assumptions as to size of fuse required to stand starting current without blowing:

Type	Times Fuse Load Current at Starting
Polyphase wound rotor	1½
Squirrel cage (thrown on line)	3
Single-phase repulsion induction with rheostat	2
Single-phase repulsion induction, without rheostat	4
Direct current	1¼

Since the fuses for squirrel-cage and repulsion motors without rheostats are respectively rated at three and four times full load current, they give practically no overload protection. Hence it is recommended that double-throw switches be installed connecting the motor through fuses of one and a quarter times full-load rating (as under wound rotor sizes) for running and through the regular heavier fuses or direct to the line for starting.

FUSE RATING IN AMPERES

Direct Current Motors

Hp.	Voltage 115	230	550
1	10	5	3
1½	15	8	3
2	20	10	5
2½	25	12	6
3	30	15	6
3½	35	15	6
5	50	25	10
6½	65	35	15
7½	70	35	15
8½	85	45	20
10	90	45	20
11	100	55	25
12½	110	60	25
15	125	70	30
20	175	90	35
25	225	110	45
30	275	125	55
35	325	150	65
40	350	175	75
50	450	225	95
60	550	...	110
75	...	...	150
100	...	...	200

2-Phase Wound Rotor Induction Motors

Hp.	Voltage 220	440
5	20	8
7½	25	15
10	35	20
15	45	25
20	60	30
25	70	35
30	90	45
35	110	55
40	120	60
50	150	70

3-Phase Wound Rotor Induction Motors

Hp.	Voltage 220	440	550
5	20	10	8
7½	30	15	12
10	40	20	15
15	50	25	20
20	70	35	30
25	85	40	35
30	100	50	40
35	125	60	50
40	150	70	60
50	175	80	65

3-Phase Squirrel Cage Motors

Hp.	Voltage 110	220	440	550
½	12	6	3	2
1	20	10	5	4
2	35	20	10	8
3	50	30	15	12
5	90	45	25	20

2-Phase Squirrel Cage Motors

Hp.	Voltage 110	220	440
½	10	6	3
1	20	10	5
2	35	15	10
3	45	25	15
5	80	40	20

TYPE AR SINGLE-PHASE MOTORS

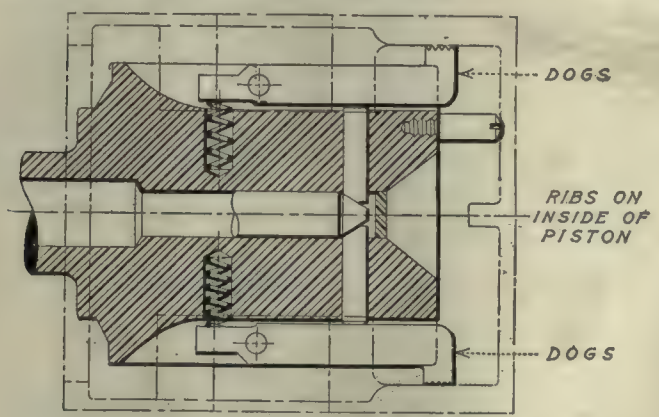
Hp.	Without Rheostat Voltage 110	220	With Rheostat Voltage 110	220
2	80	40	40	20
3	120	60	60	30
5	200	100	100	55
7½	325	175	175	■
10	400	200	200	100
½	20	10	10	6
¾	30	15	15	8
1	40	20	20	10



Air-Operated Chuck for Pistons

By Robert Belmont

In machining a piston which had ribs on the inside of the head running part way down in a parabola shape, we had considerable trouble due to the fact that we could not get up near enough to the head with the regular design of expanding chuck to prevent chattering. After several attempts we developed the design shown in the sketch, which consists of a machine-steel body carrying expanding pins in the front end operating on four dogs which go up against the piston, forming a stiff and rigid method of holding. The chuck is used on a Bardons & Oliver lathe and is operated by air pressure.



CHUCK FOR GAS-ENGINE PISTONS

An Automatic Blueprint Washer

By M. H. Potter

A unique device for washing blueprints is shown in Figs. 1 and 2. It consists of a stationary box or tray *A* having pivoted on it a smaller tray *B*, the bottom of which is composed of light slats. On this second tray, so attached as to be removable, is a smaller box *C* with a perforated bottom and divided longitudinally through the center by a partition.

The operation of this device is as follows: The top box being removed by turning the buttons securing it, the blueprints are laid on the slats of the second box, as many as six or eight at one time, and the top box replaced. The water is turned on at the faucet and one side of the pivoted box is depressed to either of the positions shown by dotted lines in Fig. 2, which will allow the water to flow into the compartment at the higher side of the smallest box. A considerable portion of the water will trickle through the small holes in the bottom of this box and onto the prints, while the opposite edges of the prints will be immersed in the water in the lower box, which is maintained at a constant level by the overflow. The perforations in the bottom of the top box not being sufficient to carry off all the water, it gradually fills up that compartment, and the pivoted box, thus overweighted, changes to the second position.

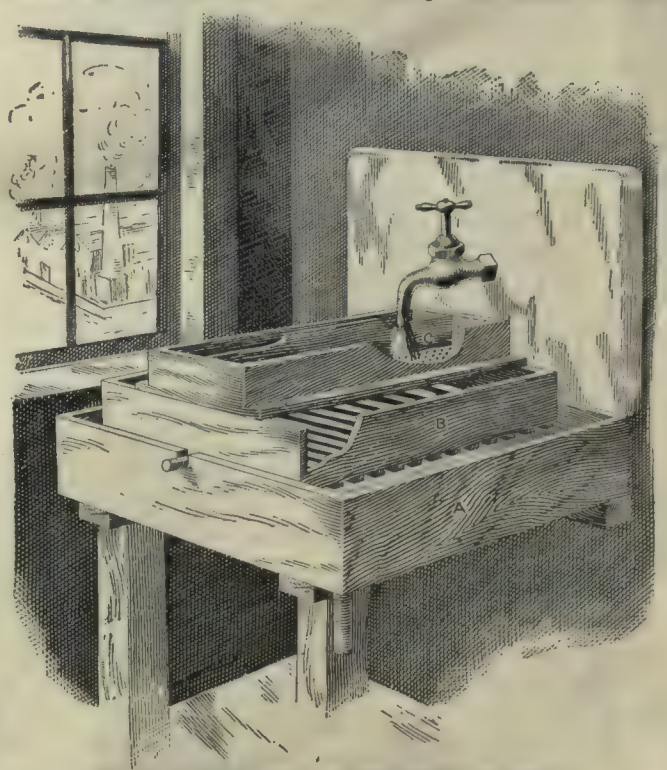


FIG. 1. AUTOMATIC BLUEPRINT WASHER

The water from the faucet now flows into the other compartment of the top box until this fills up and the operation is repeated. The frequency of the alternating movement may be regulated by the amount of water allowed to flow from the faucet. The washing is very thorough as the prints lying on each other are separated and the upper ones float whenever that side is depressed

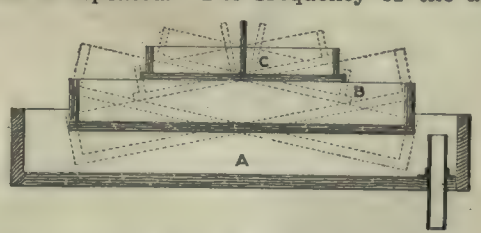


FIG. 2. HOW THE WASHER OPERATES

into the water. The water constantly flowing in and out of the lower box quickly eliminates the chemicals. Galvanized iron or zinc boxes protected by paint are preferable, although wooden boxes may be used if they are kept well painted.

Record of Chain and Sling Tests

By A. T. Miller

In the factory of the R. & V. Wagner Ordnance Co., East Moline, Ill., all chains and slings used for handling material are subjected to a monthly test to insure

TEST OF HOISTING CHAINS AND CABLES			DATE 10-1-18	DATE 11-5-18	DATE 12-17-18	DATE 1-8-18	DATE	DATE	DATE	DATE
SKETCH	NO.	TYPE	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST
	1	BUFFALO SCALE	6000	7530	8040	11,060				
	2	SPREADER	7860	"	"	"				
	3	CABLE FOR SPREADER	"	"	"	"				
	4	CABLE FOR SPREADER	"	"	"	"				
	5	SPREADER	"	"	"	"				
	6	CABLE FOR SPREADER	"	"	"	"				
	7	CABLE FOR SPREADER	"	"	"	"				
	8	SPREADER	"	"	"	"				
	9	TWO CHAIN LIFT	5360	4680	4020	"				
	10	TWO CHAIN LIFT	"	"	"	"				
	11	FOUR CHAIN LIFT	7890	7530	8040	"				
	12	STEELCHAIN	"	"	"	"				
	13	STEEL CHAIN	"	"	"	"				
	14	CABLE SPREADER	"	"	"	"				
	15	HOOK SPREADER	"	"	"	"				

CHART OF CHAIN TESTS

safety to operatives and work when handling heavy pieces.

The results of these tests are noted on the chart, which is at all times available for inspection so that there is no excuse for imposing on any such part a burden greater than what is positively known to be a safe load.

A Timekeeper's Time Saver

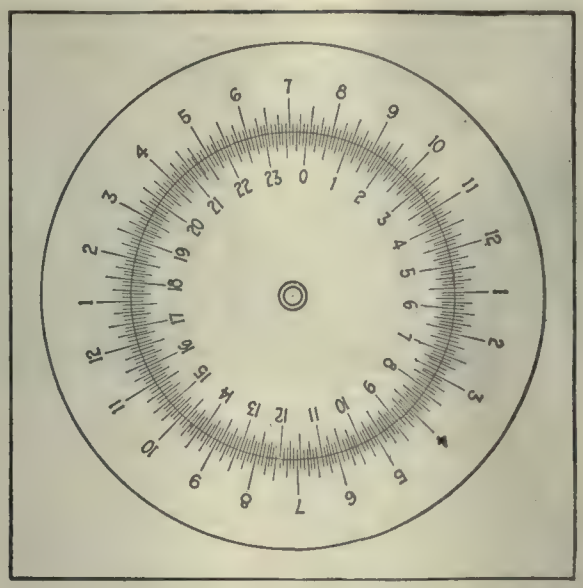
By Franklin H. Decker

The figure illustrates an easily constructed device for the rapid solution of problems in time calculation. The size depends upon the convenience of the user. The one shown was made of celluloid backed with heavy cardboard to stiffen it enough to make it durable.

Each circle has 288 small divisions, each representing 5 min., with every third dividing line made slightly longer to indicate a quarter hour. The longer lines are hour lines and are numbered from 0 to 23 in the inner circle and from 1 to 12 twice on the outer one.

The disk is shown set for the solution of a typical time problem. If a man comes to work at 7:25 and quits at 3:10, how many hours has he worked? The zero of the inner circle is set opposite 7:25 on the outer; then opposite 3:10 on the outer we read 7 hours 45 min. on the inner. If the man had had 20 min. for his lunch the first setting would have been at 7:45 and the total tim would have been 20 min. less, or 7 hours 25 minutes.

The disks may be divided in any other way suited to



TIME-COMPUTING DISK

the timekeeper's system. For finding the number of days between two dates the disks should be divided into 365 parts each and each fifth dividing line on the larger from 0 to 30 made longer. Leave a space for 31, mark this month January, begin over again at one for February and continue for the other months. Should Feb. 29 of a leap year come in between the given dates a day must be added to the indicated total.

Using Rimless Cartridges in New Service Revolvers

By E. A. Dixie

There is an interesting little story behind the article under the above caption on page 859, Vol. 49.

Several years ago the superintendent of one of the small-arms factories conceived the idea of making a clip to hold six cartridges to be used in the regulation revolver. My recollection of the clip is shown in Fig. 1. It is practically the same as the one shown on page 860, but holds six cartridges instead of three, and besides is provided with slots *A* in the members between the cartridges to provide a spring hold on the cartridges. The idea occurred to the inventor previous to the war. He made several of the clips, altered a revolver so as to use them and found that after a little practice he could fire more shots a minute with it than with the automatic pistol.

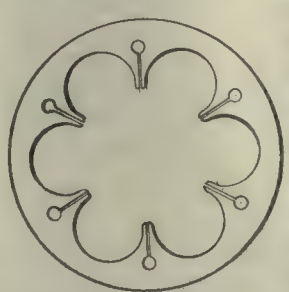


FIG. 1. THE ORIGINAL CLIP

However, there was apparently no demand for the device, and not finding a purchaser he swapped it for a second-hand automobile.

I do not know how many shops have been making the new-type clips, but I do know that they have been made by the million.

The stock used is a hard, cold-rolled steel strip 0.038 in. thick. The dies are made as shown in Fig. 2. Each die is made of two pieces of steel *A* and *B* to facilitate manufacture. The punches are made of a single piece of steel. Two dies are mounted as shown at *C* and *D*

and after the first stroke of the press two clips are made at each stroke.

The presses are run at about 160 strokes per minute. Owing to the very hard stock used the noise made by the presses is deafening. It was thought that the dies did not stand up as long between grindings as they

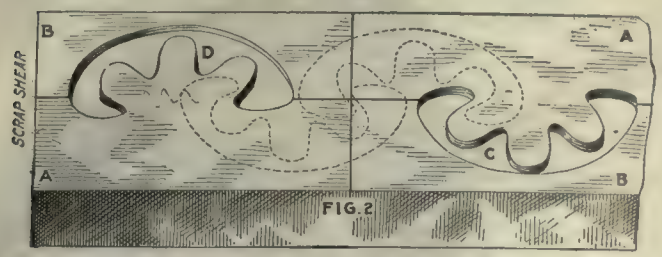


FIG. 2. THE DIE FOR THE NEW CLIP

should, so the speed of the presses was reduced, but as the noise was not lessened, nor the output increased, they were again put back to the original speed.

The feed is by hand, and at 160 strokes per minute the feeder keeps a steady pressure on the stock. Die breakage was caused usually by failure to feed the stock clear through to the stop, thus causing the punch to tilt.

The dies are about 4 in. wide, and the noise was somewhat abated by crowning the die about $\frac{1}{8}$ in. in the center; the punch face was of course kept flat, as the work must be flat. At the rear end and in front of the stop a scrap shear was provided. The short-sheared scrap falls into one receptacle and the clips into another. The clips are tumbled to remove all burrs and then blued.

Results of Tests on Torsion Springs

By Cleveland C. Soper

The torsion spring shown in Fig. 1 is used on a device I recently redesigned, and was tested with the results shown in Fig. 2 and Fig. 3. The function of this spring was to take a light load, it being used (two in parallel) in tandem with a heavy leaf spring in such

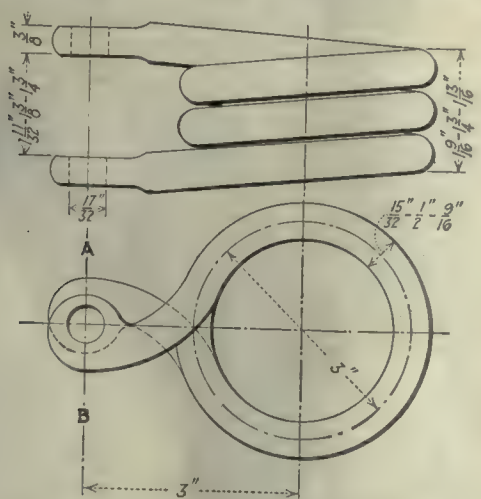
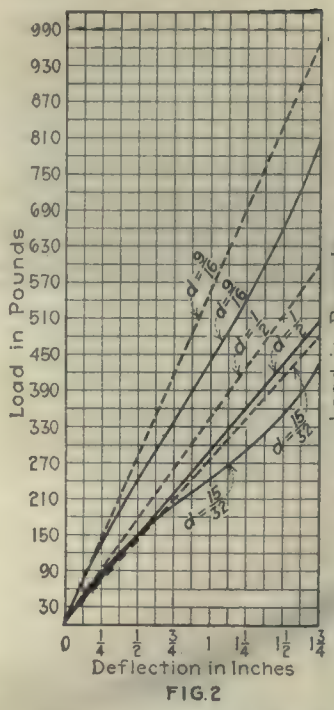
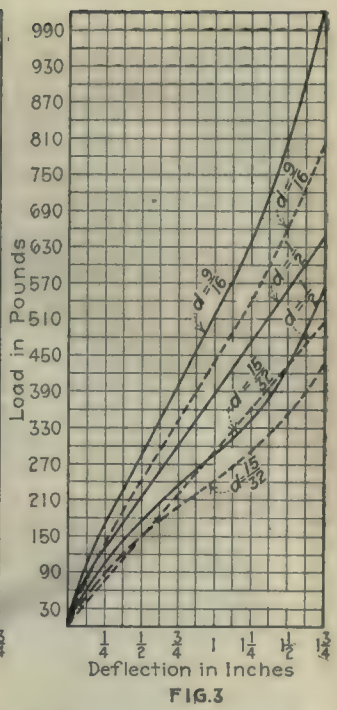


FIG. 1. AUXILIARY COIL SPRING

a manner that when the load became sufficient to compress the spring $1\frac{1}{2}$ in. on the axis *A-B* its guide brought up against a solid stop, thus throwing any additional load into the heavier spring.

The spring was used in three sizes, $\frac{15}{32}$, $\frac{1}{2}$ and $\frac{9}{16}$ in.,





FIGS. 2 AND 3. LOAD DEFLECTION DIAGRAMS COMPARED TO CALCULATED AND LOAD DEFLECTION, FREE COMPARED TO FIXED ENDS

and was made of tempered cast steel. Fig. 2 gives in full lines the load-deflection curves of the three springs (average of eight results) with the ends free to move on the fulcrum pins. In dotted lines are given the anticipated results, according to Prof. J. B. Peddle (*American Machinist*, June 19, 1913), where $a = \frac{3667\,M\,D\,N}{Ed^4}$

in which

M = Twisting moment, in. lb.
D = Mean diameter of coil, in.
N = Number of coils
E = Tension mod. of elasticity
d = Dia. of wire
a = The angle of twist, deg.

These results have been plotted for load on *A-B*, Fig. 1, on the assumption that the center of the spring moves up and down midway between the two spring fulcrums. The vertical force will then be the tangential force times $\cos \frac{a}{2}$ and the vertical distance = $6 \sin \frac{a}{2}$.

It is noteworthy in this set of curves to observe the difference between the calculated performance and the actual results. It is apparent from the difference being in the same direction in each case that the more flexible action is due to the projecting ends, which function somewhat in the capacity of an additional part of a coil. (My opinion is that the lower range of the $\frac{15}{32}$-in. spring is distorted due to an upsetting in flattening the ends.) This fact is brought out in Fig. 3, which has plotted in dotted lines the values shown in full lines in Fig. 2 (tested load with free ends) and in full lines the load with the ends fixed. The fixed end had a nut screwed down, securely binding the end in place. The additional load for a given deflection shows a shortening of the effective length of the spring by creating a point of contraflexure.

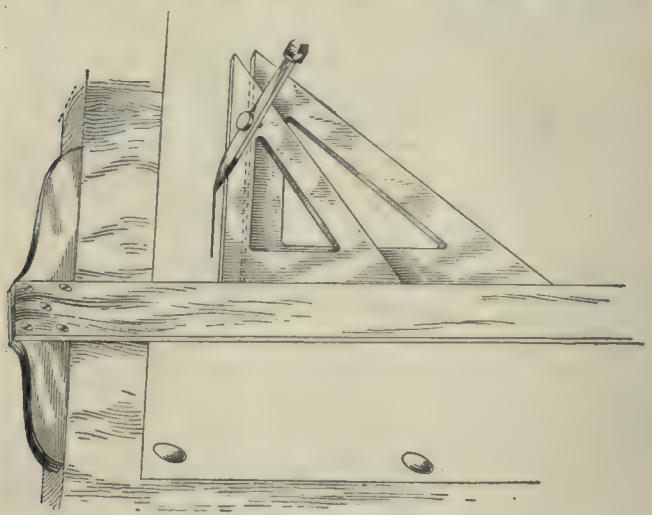
This feature was brought out first by failure in road

tests, and was objectionable from the standpoint of this particular design, as it caused this spring to take loads which were intended only for the larger one. This effect would not have been so pronounced in a larger number of coils. It is an interesting fact that so close to a straight line result can be obtained with three coils of this design.

Using Two Triangles to Avoid Blotting

By Wilfred Dickson

When making a tracing it is often necessary to make some very heavy lines, and in using the ruling pen along the edge of the triangle little pieces of lint or dust catch in the pen and the ink runs under the angle,



KINK FOR DRAFTSMEN

sometimes spoiling the tracing. To overcome this it is only necessary to use two triangles, one on top of the other as shown in sketch. You will find this to be a very handy way of finishing up lines that were left out, by sliding the upper triangle over the wet surface with no danger of blurring.

A Stringing Machine for Fence Barbs

By M. E. Duggan

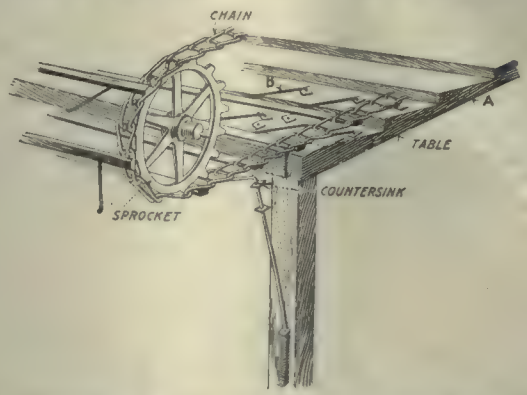
The barb used in the old-fashioned barbed-wire fence was a diamond-shaped steel punching having in its center a hole through which the wire was passed in the making of the barbed wire.

These steel barbs were gathered somewhat after the manner described in Mr. Hunter's article, page 1077, Vol. 49 of the *American Machinist*, excepting that instead of a four-pronged fork for gathering the barbs, a single wire was used for stringing as this operation was called.

Here are a few of the details of the machine construction. *A* is a table 6 ft. wide and 10 ft. long, the top face of which is corrugated and covered with sheet steel. It is elevated about 6 ft. from the floor and loosely fastened to a frame made of wood.

On this frame just above and flush with the sides of the table is mounted a pair of link belt chains, every third link of which is special, and to these links are fastened crossbars of wood. On each of the wooden bars are securely fastened 05 needles, as shown at *B*, and at the front of the machine are 50 wires (stringers) fastened at the lower end and free at the upper end, resting in V-grooves made in the front end of the table.

The table is made to oscillate by means of a mechanical contrivance at the back end of the machine. The steel barbs are scattered over the corrugated surface of the table and the "gathering" needles *B*, traveling in the direction indicated by the arrow, fall into the hole in the barbs and draw them to the end of the table



A GATHERING MACHINE FOR WIRE FENCE BARBS

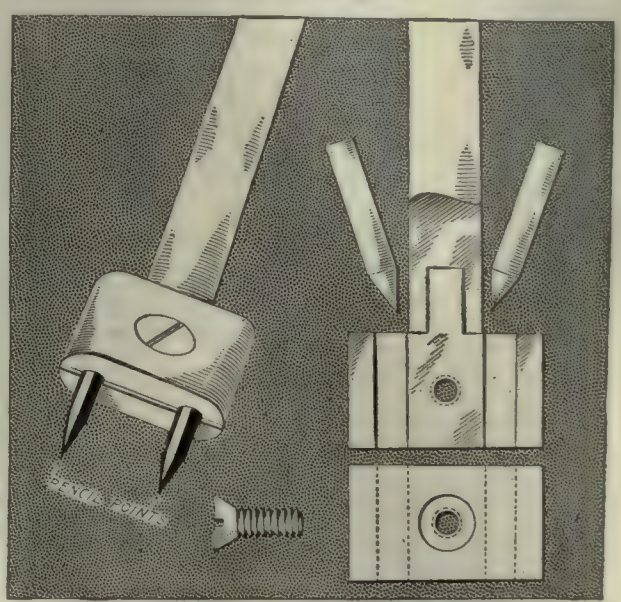
where the points of the needles are guided by grooves sunk in the steel plate, into the counter-sinks at the top of the string wires. With the points of the needles in the countersinks the pressure was sufficient to draw the stringing wires away from the table and thus allow the gathered barbs to fall until the wires were filled. The overflow barbs fell into a hopper at the front of the machine.

Two Pointed Ruling Pencil

By John H. Moore

A novel and useful drawing tool containing two pencil points in place of one is shown in the illustration.

The handle is made of ¼-in. cold-rolled steel, and the part containing the leads is of any size convenient to the user. The leads are held in position by tightening the small screw. This pencil is especially valuable in section lining of drawings or when ruling lines as guides for lettering purposes. There are many other uses to which it may be adapted.



TWO POINTED RULING PENCIL

US
ARMY ORDNANCE NEWS

Finding the Cost of Ordnance

By LIEUT. L. S. GATTER

The wise manufacturer studies his "indirect expense" as closely as he does his direct labor. Cost methods should be applied to such matters as inspection, machine and equipment maintenance, etc., as well as to items of direct expense. This article illustrates and describes how the Ordnance Department watched its inspection costs.

IT is said that the cost of the war is to be borne by future generations. This will mean increased taxation for a period of years, which, coupled with the entry of the United States into strenuous competition for world trade, will make it necessary for our manufacturers to be more and more accurately advised as to the costs and efficiency of their organizations.

A committee of engineers recently defined an engineer to be, "one who economically directs man-power and by scientific design utilizes the forces and materials of nature for the profit of mankind." It is seen that the very essence of the definition involves an appreciation of relative values and costs, and so for those who have made efforts in the past to equip themselves with a cost system, it may not be amiss to outline the system which was finally adopted in the Ordnance Department of the United States Army for determining the costs of inspecting ordnance material.

To those who are maintaining a cost system, the following questions may be apropos:

(a) How much does it cost to obtain your costs?

(b) Do the results obtained lend themselves to a sufficiently quick analysis so that corrective measures may be adopted?

Methods for determining the answers to these and other questions are in some measure to be found by the following analysis, but more especially is this true for manufacturers who are facing problems relating to inspection.

The Type of System for This Work

The purpose of any inspection is to insure that the materials being produced meet certain requirements. The essential factors of successful inspection are that it is accurate, prompt and economical both in man-power and in money. Particularly during the government emergency the essential man power had to be conserved.

Inspection is inherently an incidental charge and for this reason the importance of economy in connection with it is often overlooked in view of the great sums necessary for a direct charge in actually producing the material. This fact, taken with the proposition that inefficiency and waste are said to be condoned by victory would seem to mitigate against the importance of establishing a careful analysis of the costs of inspection, but when it is considered that billions of dollars were involved in the production of ordnance material and that even a small percentage of this sum would still run into the millions, it immediately becomes apparent that a careful check was necessary. Moreover, it was felt that it would offer a method of comparison of the inspection systems installed in the various manufacturing plants producing ordnance material. A tentative selection having been made from various types of familiar cost-accounting methods, equipment was set up for a short trial period.

The entire costs in dollars and cents of carrying on the work of inspection was determined by adding the total wages and salaries in the Home Office together with the operating expenses of the Home Office, depreciating furniture and equipment according to commercial practice, and including the total of the traveling expenses necessary for supervisors, etc., who were stationed in the Home Office. This total overhead expense was distributed to the various plants manufacturing ordnance material on the basis of the relation which the total wages and salaries of inspection personnel at an individual plant bore to the total wages and salaries of inspection personnel at all the plants. By expense of inspection at the plants is meant the total wages and salaries at the plant together with the operating expenses and the travel occasioned by the personnel assigned to the plant going to and from the plant. The Home Office expense is occasioned by the field personnel, and therefore the wages and salaries of that personnel are a proper basis for distribution without including travel.

In connection with this question of the expense of travel, it is interesting to note that in the case of an inspector who was assigned to inspect material being manufactured at plants A, B and C, and to travel between those plants, it was impossible equitably to distribute this charge except by charging the expense of travel to the plant at destination. Wherever there were several contracts at one plant, the total plant expense including the pro-rated portion of the main office overhead was distributed to those several contracts on the basis of the cost of the direct labor spent on each contract to the total of the wages paid to direct labor on all the contracts. Indirect labor at the plant was also distributed in this manner. In other words, at the end of each semi-monthly period the total expenses of in-

ARMY ORDNANCE NEWS

spection were distributed to all of the contracts involved, and having determined the number of contract units inspected and accepted for the government in the corresponding period of time by means of semi-monthly reports containing this information, it was possible to arrive at the cost of inspecting each contract unit in dollars and cents for that particular period. It was soon apparent that in view of the rapidity with which the volume of work increased that the necessary personnel to accomplish the system outlined above was prohibitive in cost, and would far offset any value which might attach to the determination of the results as expressed in the unit cost of inspection in dollars and cents for any contract unit. Moreover it was impossible to analyze the results obtained; that is, the unit costs in dollars and cents, for the reason that the various factors entering into the composition of a unit cost could not be segregated, and therefore, although wide fluctuations might occur, it was impossible to indicate the cause of them. The results proved to be very cumbersome and reports were of such a lengthy nature that they could not be properly analyzed, and so ramified as to prohibit active corrective measures. For these reasons it was apparent that the disadvantages of applying accounting methods to this problem would make it necessary either to give up an attempt to analyze the cost or else to introduce a system without these disadvantages.

N-333
PLANT Smith Jones & Co. LOCATION East Orange, N.J.
CONTRACT NO. C A 1003 COMPLETION DATE 4/19/19
CONTRACT FOR: 5,000,000 3" Cartridge Cases
U. S. TO FURNISH Brass Discs OPERATION Finish
REMARKS

FROM	TO	A UNITS ACCEPTED	B TOTAL HOURS DIRECT LABOR	C UNITS ACCEPTED PER HOUR PER MAN	D COST OF DIRECT LABOR PER HOUR	E COST DIRECT LABOR	F COST INDIRECT LABOR	G F E	H J NUMBER DIRECT EMPLOYED M	F	REMARKS:
1/15/18	1/31	5,000	100	50	.40	40.00	10.00	25%	5	4	Hypothetical case

FIG. 1. OPERATION CARD USED IN DETERMINING INSPECTION COSTS

Agreement Reached After Careful Review of the Situation

After a careful review of the situation it was agreed that the purpose of any cost analysis of inspection must be to obtain data and set standards to aid in securing the speed and economy consistent with accuracy, also to permit comparisons between plants as well as to furnish a basis for predicting the necessary personnel for inspection on new contracts.

Another consideration affecting the type of system to be chosen for this work was that results should be obtained in time to make it possible to take corrective action where necessary. It was also felt that the reports and results obtained might be accomplished in a routine manner, but that the practical application of these results should by all means be left to trained personnel.

A system was established by which an analysis could be obtained of the amount of direct and indirect labor utilized and the results obtained with it. Certain definitions were essential; chief of these were the definitions of direct and indirect labor.

Direct labor was considered to be the labor of all operatives expended in *the actual examination for acceptance* of units or in the direct supervision thereof. Indirect labor was defined to be all executive, administrative, clerical or stenographic labor in the plants applied to inspection. In order to accomplish this analysis it was necessary to adopt a method which involved a consideration of three factors:

(a) The number of units on any operation, forging, machining, finishing, etc., which could be inspected and accepted by one inspector in one hour.

(b) The average cost of direct labor per hour for inspecting various operations.

(c) The percentage relation between the indirect and the direct labor.

These factors could readily be found without the use of additional personnel since certain people were always required in connection with the preparation of the payrolls and worked under peak load conditions in payroll periods. These individuals and between times were assigned necessary duties pertaining to the cost analysis.

Reporting the Progress of the Work

The inspectors in the various plants were required to make periodical reports as to the progress of the work, showing the number of contract units which had been accepted during that period. These reports were primarily for the use of other organizations but were placed at the disposal of the personnel operating the cost system. The time cards from the plants, upon which the inspection personnel at plants were paid, were also in their possession and the backs of these time cards were provided with space to indicate the exact number of hours spent on the inspection of material under the several contracts which might be in process

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at any particular plant. This determined the hours of direct labor spent on any operation at that plant. By referring to Fig. 1, it will be seen that this amount was entered in column B, the units accepted having been entered in column A. Care was observed that the contract numbers and operations described in the progress reports agreed with the contract numbers and operations indicated on the time cards. The number of units accepted in a given period appearing in column A, divided by the total number of hours of direct labor spent in accepting those units in that period appearing in column B gave the units accepted in one hour. From the time cards was obtained the average cost of direct labor per hour appearing in column D. If there were four employees at $4 per day and two at $2 per day and one enlisted man at approximately $2.50 per day, the average daily rate is $3.21 and the average cost per hour would be 40c. In column E appears the cost of direct labor which is obtained by multiplying the entry in column D or the cost of direct labor per hour, by the entry in column B, which is the total number of hours. In column F appears the cost of indirect labor which is taken directly from the time cards for clerks, stenographers, administratives and executives, or from pay vouchers in the case of officers. If there is more than one operation in process at the plant, the amount chargeable to each operation is determined by pro-rating the entire amount of indirect labor at the plant to each operation on the basis of the relation between the direct labor on that operation to the total amount of direct labor at the plant.

N-166 ANALYSIS OF COST OF INSPECTION 6"Howitzer Shell (Class VI Sec.3)

Operation	Unit Cost Of Inspection a	Estimated Unit Price a	%	Remarks
Steel	.0277 per U	$5.32 per U	.0052	
Forging	.07	2.75	.025	
Machining	.268	9.25	.029	No copper bands, base covers, caulking wire, fuze hole plugs
Loading	.146	8.00	.018	
Assembling	.040	2.00	.020	
Cart.Case	.029	4.25	.0068	9.93" long 271 cu.in.cap.wt.8.1] with primers
M.C.B.D. fuze	.027	2.67	.010	5,000 in a lot
110 gr. primer	.0053	.14	.0375	
Smokeless Pdr.	.004	1.88	.0212	Nitro cellulose base(7 perforated cyl.gr.) 3 zones 3 bags.
T. N. T.	.00695	6.94	.001	13.87#
Copper Bands	.000272	.64	.0004	
Base Covers	.00244	.25	.0098	
Miscellaneous	.00240	.27	.0091	
(caulking wire,fuzehole, plugs & cart.cloth)	.6368	44.36	.0144	600 in 1 lot (120# each)

FIG. 2. ANALYSIS OF THE INSPECTION COST OF A 6-IN. HOWITZER SHELL

Relation Between Indirect Labor and Direct Labor

In column G appears the relation between the indirect labor and the direct labor obtained by dividing the entry in column F by the entry in column E. This should decrease as peak load production on that operation is approached, since the numerator of the fraction should remain almost constant with a marked increase in the denominator until peak load production is reached. In column H and J appears the number of male and female operatives respectively as a ready reference in making an analysis without reference to the original records.

These operation cards were filed alphabetically by plants and at semi-monthly intervals averages were taken of three factors mentioned above in order to erect a standard for comparative purposes and to make other analyses.

A formula used in determining the estimated unit cost of inspection was the cost of direct labor per hour appearing in column D divided by the units accepted per man-hour, appearing in column C, giving the unit cost for that operation on the basis of direct labor. Then having determined the total cost of inspection from all sources readily accessible from the disbursement books, and comparing the total cost with the cost of direct labor obtainable from the payrolls, a percentage relation was immediately obtained, which could be used for "loading" the estimated figure based on direct labor only. In other words, if the total cost of direct labor was 50% of the grand total cost, the estimated unit cost based on direct labor only would be "loaded" by 50% of itself in order to give the estimated unit cost based on the entire inspection expense and including all overhead charges. These latter estimated unit costs were subsequently compared with unit costs obtained by the original system of obtaining unit cost of inspection in dollars and cents previously described and no differences were obtainable up to the third decimal place.

Some Results Obtained with This System

As an example of the possibilities of predicting personnel requirements for future work, assume that work has been started on a contract for 500,000 three-inch cartridge cases to be completed in eight months. A theoretically perfect production schedule would enable this plant (assuming that it started work at a maximum capacity and was a plant which had had a previous contract for the same class of material) to complete 62,500 per month or 31,250 in each 15-day period. In other words there would be offered for inspection 31,250 completed units per period. If it was found by referring to the averages of column C that the standard for inspection of this material indicated that 15 of these units could be accepted in one man-hour, it is estimated that in a 15-day period of eight hours each including two Sundays and assuming the employees worked full time, or 104 hours, there would be accepted in one man-period 15×104 or 1560 units, but since there were to be offered 31,250 units, it is apparent that it will take 31,250 divided by 1560, or 20 men to do the work. If the units accepted per man-hour are below the average indicated by the standard

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or criterion for that operation, it indicates over-organization, unless for some reason the contractor was unable to offer for inspection during that period the customary number of completed units. (The work done by inspecting units subsequently rejected was found to be negligible but would, if sufficiently large, occasion this result.)

If the average hourly rate is in excess of the standard for that operation, it may indicate the use of unnecessarily expensive labor. One instance of this was found in the case of two steel mills in the same city where the average price of direct labor varied by 10c. an hour. Another case was discovered where the inspection force was composed of 100% male operatives when all other plants doing the same kind of work were using from 70% to 80% female operatives.

If there is an excessive relation between the indirect and direct labor it may indicate over-organization in the clerical force in a plant office. Instances were found where one inspection force for some reason could not measure up to the standard for units accepted per man-hour and the conditions which affect this are very numerous and varied. Considerable time and effort can be saved for example by depressing the pits in which inspectors stand in examining weighty material (since the material does not leave the floor level during the inspection). Raising this material to an inspection bench only three feet above the floor level would, in the case of a 9.2-in. howitzer shell, entail the expenditure of over 1,500,000 ft.-lb. of energy each day, providing 2000 shells were inspected during 24 hours.

After this system had been in operation for several months an expression of opinion was requested from the various executives who had made use of it from time to time. Sentiment was overwhelmingly in favor of continuing it, since it resulted in saving considerable sums and was of material benefit in gaging the efficiency of the plants and systematizing inspection work in them. It was found that the best application could be made in those cases where units were being manufactured at "quantity production" and that it was not applicable in cases where only one or two units were inspected during a semi-monthly period, as in the case of the railroad gun mounts.

Steel Inspection Results

Some of the most consistent results were obtained in the case of inspection of steel. Over a period of months the estimated unit cost of inspection was between 45 and 50c. per ton, and the cost of direct labor was between 50 and 51c. per hour. On the basis of approximately $80 a ton for steel, the percentage relation of the cost of inspection to the cost of material was about ½ of 1%. In Fig. 2 is given an illustration of the type of card compiled for ready reference, and in Fig. 3 is given an illustration of the material referred to in Fig. 2, both being self-explanatory.

The results obtained emphasize the importance of making *estimates* on a fundamentally sound basis rather than compiling elaborate cost statements by means of some typical accounting methods. These cost statements are apt to be submitted to executives who, by reason of their complexity, are not in a position to make advantageous use of them. The cost of such a system is very often excessive, whereas the cost of installing and operating the system outlined here was negligible in comparison to the total payrolls, and the results were speedily obtained, lent themselves to rapid analysis, and so made it possible to inaugurate corrective measures immediately.

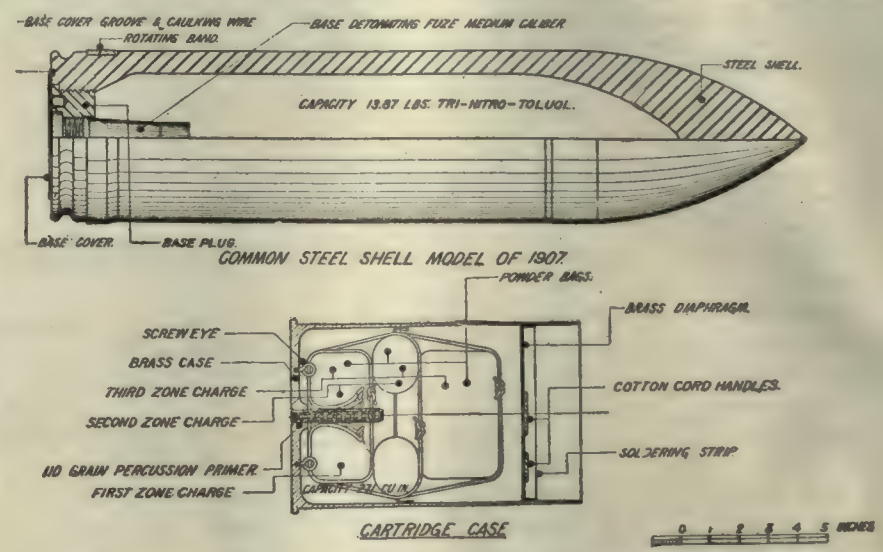


FIG. 3. COMMON STEEL 6-IN. HOWITZER SHELL REFERRED TO IN FIG. 2

Abstracts of Recent Office Orders of General Interest

No. 586, Mar. 13. Capt. Philip S. Charles is designated as alternate contracting officer for the Rochester District, with authority to approve vouchers.

No. 587, Mar. 14. Capt. C. A. Kanter is designated as alternate contracting officer for the Toronto Ordnance District, with authority to execute, in accordance with the determination of the Imperial Munitions Board and the assessors, settlement contracts on behalf of the United States, and other contracts incident to the termination of contracts and orders in Canada.

No. 588, Mar. 14. First Lieut. J. H. Little is designated as alternate contracting officer for the Chicago District Claims Board.

No. 592, Mar. 17. Maj. F. X. Colleton is designated contracting officer with authority to execute, where necessary, contracts incident to the sale or disposition of surplus material, equipment and property, in accordance with determinations of the Salvage Board, for the Boston District Ordnance Office, succeeding Lieut.-Col. Thomas F. Brown. Maj. Colleton has also been authorized to approve vouchers for this office.

No. 594, Mar. 19. Mr. Robert Kelly Prentice is designated as a member of the Philadelphia District Claims Board, appointment effective Mar. 14.

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No. 597, Mar. 19. Capt. G. L. Redman is designated contracting officer with authority to execute in accordance with the determination of the Bridgeport District Claims Board, settlement contracts incident to the suspension or termination of existing contracts and orders. He is also authorized to execute, where necessary, contracts incident to the sale or disposition of surplus material, equipment and property, in accordance with the determination of the Salvage Board.

No. 598, Mar. 21. Capt. Simon S. Martin is appointed Survey Officer for the Pittsburgh District Ordnance Office, and as such shall be attached to the staff of the Pittsburgh District Claims Board, appointment effective Mar. 8.

PERSONALS

Second Lieut. Perry S. Lewis, formerly sales manager for D. D. Aldrich Co., Vincennes, Ind., has been discharged.

* * *

Capt. C. Hedgcock, who is a mechanical engineer, has been discharged. He has been on duty continuously in Washington.

* * *

Second Lieut. Edward R. Fenn, who was commissioned in August, 1917, has left the service. He is a graduate of Yale and has served at Camp Upton and the Raritan Arsenal.

* * *

Second Lieut. Herbert Fiers has left the service. He is a graduate of Newark Institute of Technology and before being commissioned was employed by the Cadillac Motor Co., Detroit, Mich.

* * *

Capt. William H. Varley, a graduate of the Brooklyn Polytechnic Institute, has been discharged. He was formerly employed by the Chalmers Motor Co., Detroit, Mich., as motor service manager.

* * *

Capt. R. E. Blankenbuehler, who is a graduate of Washington and Jefferson, and was employed, before being commissioned, by the E. I. du Pont de Nemours & Co., has been discharged from the service.

* * *

First Lieut. Walter J. Devine, who entered the service as an enlisted man in May, 1917, has been discharged. He was formerly a student at Dartmouth College and was employed by the D. & H. Shoe Co., Harrisburg, Penn.

* * *

First Lieut. John F. Dryden has been discharged. He is a graduate of Yale and was formerly employed by the Prudential Insurance Co., Newark, N. J. His duties have been in connection with the priority of material for the department.

* * *

First Lieut. Charles P. Vauclain, who was a student at the University of Pennsylvania, and formerly employed by the Baldwin Locomotive Works, Philadelphia, Penn., has left the service. His home address is 2 Sagamore Road, Worcester, Mass.

Second Lieut. Edgar F. Heselbarth, who enlisted in January, 1918, has left the service. He has been on duty at Camps Cody and Green on supply work. Lieutenant Heselbarth was formerly a student at the University of Pittsburgh, and in civil life was a member of the firm of W. H. Heselbarth and Sons, Pittsburgh, Penn.

* * *

First Lieut. William M. Bowman, who has been on duty since he was commissioned, at Saltville, Va., under the control of the Nitrate Division, has been discharged. He was educated at Purdue University and was formerly employed by the Central Construction and Supply Co., 2222 Arch St., Philadelphia, Penn., as a refrigeration engineer.

* * *

Capt. Frederick D. Manning, who was employed by Cheney Bros., South Manchester Conn., as industrial engineer before he was commissioned first lieutenant in June, 1917, has been discharged. He is a textile engineer and a graduate of Lowell Textile School. Captain Manning has been on duty in the small-arms section, Production Division.

* * *

Second Lieut. Robert L. Giebel, who was commissioned in November, 1917, and served as production officer at the American Rolling Mill Plant and elsewhere in the Cincinnati Ordnance District, has been discharged. He is a mechanical engineer, a graduate of the University of Cincinnati, and was formerly with the Cincinnati Milling Machine Co.

* * *

Second Lieut. Marshall L. Fawcett has been discharged after 14 months' service. He is a graduate of the Ohio State University and was formerly employed by the Ohio State Civil Service Commission on organization work. His service has been with the civilian personnel section. He was stationed first at Washington and then at Toronto, Can.

* * *

First Lieut. John N. H. Christman, who was commissioned in May, 1917, has been discharged. He is a mechanical engineer, a graduate of the Case School, Cleveland, Ohio, and was formerly employed by the City of Cleveland, Ohio. Lieutenant Christman was for a long time in service with the Inspection Division and on duty at the Remington Arms Co., Ilion, N. Y.

* * *

Maj. Allen H. Clarke, who was commissioned in November, 1917, has been discharged. He has served as chief of the Cost Accounting Section since March, 1918. Prior to that time he was stationed at New York doing similar work. Before entering the service Major Clarke was a member of the firm of Clarke, Oaks, Trismen & Clarke, 68 William St., New York.

* * *

Capt. Dana M. Lasley has left the service. He was commissioned first lieutenant in August, 1917, and had previously been employed by the Domestic Engineering Co., Detroit, Mich. Captain Lasley is a graduate of the George Washington and Ohio State Universities. His service has been on engineering work in connection with motor equipment both in Washington and at the manufacturing plants through the Middle West.

Lending Versus Selling

FROM all parts of the country the friends of vocational education are inquiring about the fate of the Caldwell Bill which proposed to lend the government's surplus machine-tool equipment to educational institutions. This proposal was incorporated by the Senate Military Affairs Committee as an amendment to the Army Appropriation Bill. Our readers are aware, of course, that this bill as well as many others did not reach its final vote on account of the legislative jam in the last few days of the last session. It will come up when Congress again convenes.

In the meantime so many inquiries have been directed to the Secretary of War that the War Department has issued a special form letter which we reproduce herewith.

(The italics are ours.)

WAR DEPARTMENT
THE ADJUTANT GENERAL'S OFFICE
WASHINGTON

In reply
refer to March 17, 1919.

Dear Sir:

The Secretary of War directs me to acknowledge the receipt of your favor with reference to the lending of machine tools by the War Department to technical schools and universities (H.R. 15625.) Although no action on the matter was taken by the last Congress and the War Department has no authority to dispose of the tools along the lines proposed, this letter is sent to you to acquaint you with the attitude of the War Department. While there is every desire to assist these institutions, the department cannot, after a thorough study of the situation, approve the legislation in its present form. It is not believed that a loan of the tools can be acceptable either to the government or to the borrowers. ***There can be no certainty as to the length of time for which the borrowers may hold the tools, and any school or university would hesitate to make preparations in the way of expensive laboratories or shops to place the tools where they could not be sure of holding them.*** The distribution of tools in this manner would be exceedingly expensive to the government; first, in the organization necessary to lend the tools in an intelligent manner; second, the maintaining of an inspector service to protect the interests of the government inasmuch as the tools would still remain government property and the War Department would be responsible for them. Should Congress decide to act in the matter, it is believed that a much preferable solution of the problem would be to authorize the War Department to sell these articles at 10% of their cost value, the proceeds of the sale to go toward paying the expenses of the sale. In this manner the schools would receive absolute title to the tools and machines at a nominal price and the expense to the government would be practically limited to the value of the tools.

Very truly yours,
(Signed) P. C. Harris,
The Adjutant General
per J. C. A.

JEH

"There can be no certainty as to the length of time for which the borrowers may hold the tools." Why not?

Surely the efficacy of the proposed League of Nations deserves a better opinion on the part of its advocates than this! Is the next war so imminent as to make it unprofitable for a trade school or college to install machines borrowed from the government because

Machine Tools to Schools

of the likelihood of its being asked to relinquish these tools to a munition factory in the immediate future?

We hardly think so. This generation has had all the war that it wants. The same widespread, almost universal, horror of war which has been engendered by the last four years and which, more than any other factor, guarantees the success of a League of Nations to prevent war, will insure a satisfactory tenure of possession to educational institutions borrowing war tools. These are the evident probabilities.

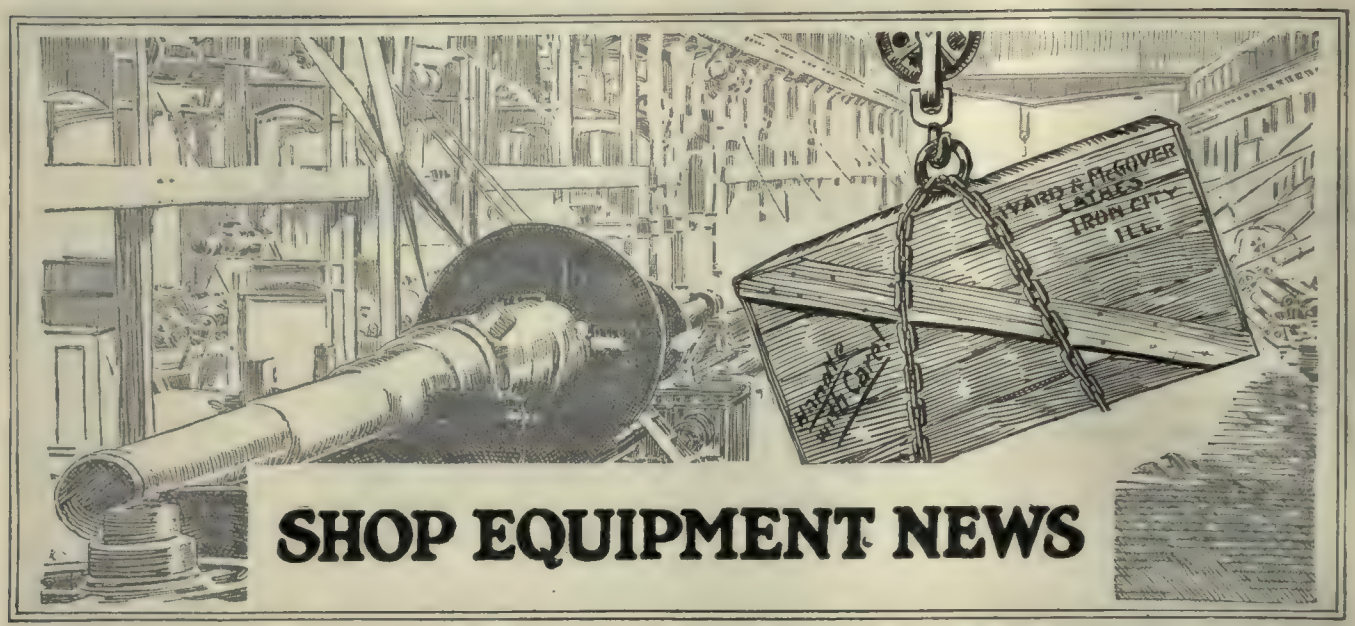
But if the above italicized contention of the War Department is correct, how much more necessary is it then for the government to retain the title in these tools?

The logic in the Adjutant General's letter strikes one as being on a par with that of Cole Hargis of Breathitt County. A neighbor asked him for the loan of his rifle to use on a squirrel hunting trip. "Ef I loan yo' all that gun I'm liable to spile yo' trip by comin' after it in a hurry any minute, 'cause I seen the Jackson brothers a hangin' aroun' town an' they're layin' for my scalp, so I guess it'll be better for yo' all to buy that gun."

Better for the neighbor perhaps but rather risky for Cole.

There are other objections to the War Department's suggestion of selling these tools instead of loaning them. A sale proposition at 10 or even 5% of the cost price of the tools would favor the wealthy institutions and discriminate against the poorer ones. The measure of capability of securing equipment would not be the need of the institution but the wealth of the institution. The country school which drew upon the limit of its purse to provide quarters and instructors for vocational training would be unable to raise the additional cash (however modest this sum might seem to a more fortunate city institution) wherewith to buy equipment. It is not a democratic plan. It is a plan to save the War Department the bother of using judgment and discrimination in distributing these tools and to save them the trouble of looking after them afterwards. There is no necessity for an elaborate organization to accomplish these purposes, providing business methods are used in handling them. The Ordnance Department at present lends rifles and all sorts of military equipment to state military organizations and military schools. There has been no uncertainty of tenure of possession of these war implements by the borrowers nor has there been any considerable amount of expense involved in keeping track of them.

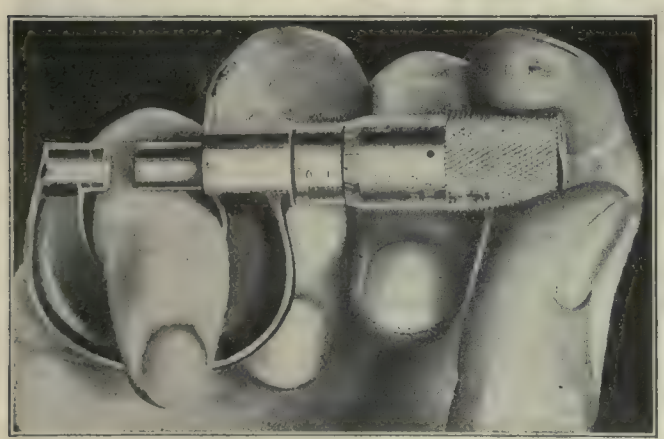
We believe that the proposal should go through in its original form. This will take care both of the probability of peace and the possibility of war, and after that possibility has been eliminated and the League of Nations becomes a demonstrated reality, these loans can readily be changed into gifts or sales.



SHOP EQUIPMENT NEWS

"Reed Junior" ½-In. Micrometer

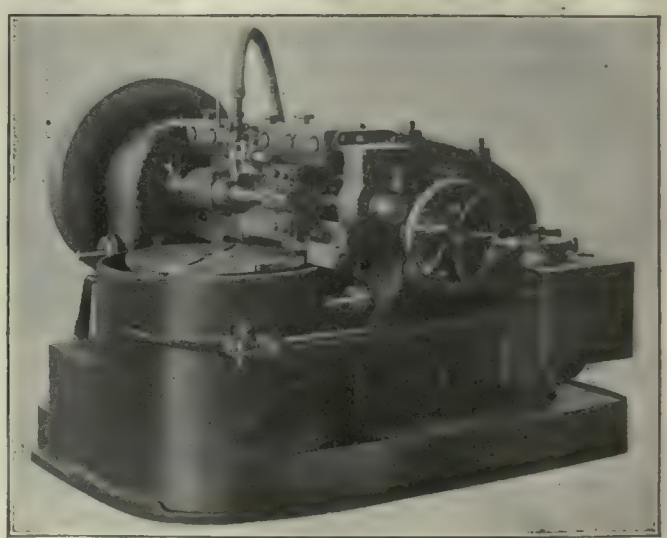
The Reed Small Tool Works, Worcester, Mass., has developed a new ½-in. micrometer caliper of sturdy construction known as the "Reed Junior." The barrel, spindle and thimble diameters are the same as those in the larger micrometers of the same series but the lengths have been reduced. It is equipped with a solid anvil and instantaneous two-part thimble adjustment. It is small enough to be slipped into the vest pocket but large enough to be operated by one hand. It is claimed that a firm grip can be obtained on the concave web of the frame even under oil. The finish is in dull nickel to reduce reflection and care has been taken to make the graduations easy to read. The micrometer will be finished with English or metric graduations and with a locknut and ratchet stop if these features are desired.



"REED JUNIOR" ½-IN. MICROMETER

Gould & Eberhardt 18-In. Worm-Wheel Generating Machine

Gould & Eberhardt, Newark, N. J., have just placed on the market the 18-in. wormwheel generating machine shown in the illustration, which has been brought out in answer to the demand for a machine for the manufacture of wormwheels for use in motor trucks, tractors, elevators, and other types of work where gear reduction is necessary. The machine is automatic in action and will generate wormwheels with a tapered hob, having a tangential feed; with a straight hob, the hob being fed into the wormwheel and not across it; and will also cut wormwheels with a fly tool.



GOULD & EBERHARDT 18-IN. WORMWHEEL GENERATING MACHINE

Maximum diameter of wormwheel cut, 18 in., from 10 to 100 teeth, including even and prime numbers also from 100 to 120 teeth in even numbers, with hobs having from single to quintuple thread inclusive; maximum diameter of hob, 5⅝ in.; maximum length of hob, 8 in.; tangential travel of cutter slide, 10 in.; maximum distance from center of cutter to center of work spindle, 13¼ in.; minimum distance from center of cutter to center of work spindle, 3 in.; fixed distance from top of faceplate to center of cutter arbor, 7 in.; diameter of portable cutter arbor, 1¼ in.; countershaft speed, 800 r.p.m.; driving pulley, 16 x 4½ in.; weight, 8600 lb.

The latter application is said to be particularly desirable where experimental work is being carried on, and it would be an expensive proposition to make up a hob to cut one worm gear. The drive to the cutter spindle is through a worm and wormwheel, a large flywheel being mounted directly on the end of the cutter spindle. To insure rigidity the table is mounted in a permanent bearing in the base, while the cutter or hob carriage is mounted on a stanchion adjustable in

a horizontal direction. This construction permits the work table to be arranged with a long cylindrical hub bearing, in addition to a conical and flat bearing and an indexing wormwheel of large diameter which could not be incorporated if the work table were mounted in an adjustable carriage. Another feature is that the work table or faceplate is at a height that is convenient for unloading and loading. All running parts are accessible, and all necessary operating levers are conveniently located at the front of the machine, giving an operator full and instant control without changing the position. The machine is driven from a single pulley, a high-speed clutch being incorporated to provide for stopping and starting. This clutch is operated by a lever located at the front of the machine.

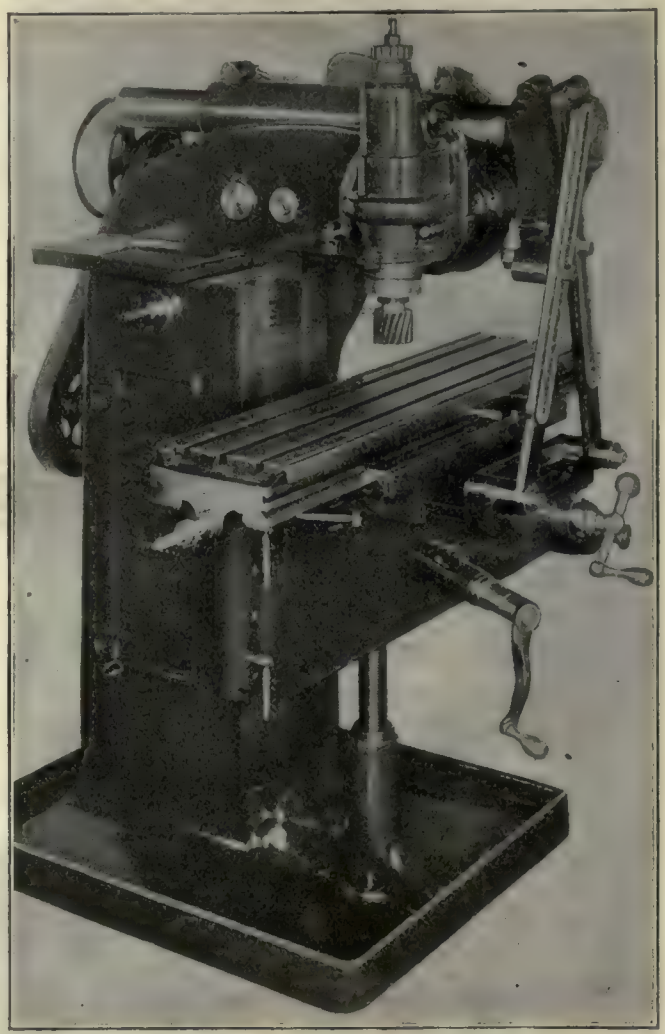
There are six speed changes for the cutter, ranging from 58 to 183 r.p.m., in order to allow hobs of various diameters to be run at the proper speed for the material being cut. To enable the operator to take a second cut through a wormwheel when using a tapered hob or fly tool without losing the lead, a differential mechanism is incorporated. This is also an advantage, as it permits changing the feed without changing the lead gears. When using a straight hob with automatic infeed, however, the differential is not required and a means is provided for locking it.

The cutter arbor is portable and the cutter carriage has automatic tangential feed, in one direction, and a power return. An automatic stop on which is located a graduated dial is incorporated and may be set to stop the cutter carriage at any predetermined point. The stanchion is equipped with automatic infeed and power return. When feeding automatically into the revolving wormwheel blank an automatic stop is used. The latter is also equipped with a graduated dial so that the operator can set it to stop the work at any predetermined point. When tangential feed is being used, the stanchion is adjusted to the proper depth of tooth and then securely bolted to the base of the machine. In adjusting the stanchion by hand, a dial graduated in thousandths and furnished with a vernier is used to set the hob and wormwheel blank at the required center distance.

The cooling compound is circulated by a centrifugal pump attached to one side of the machine and driven by gears. The pump may be disconnected by means of a clutch when the material is such that its use is not necessary.

Van Norman No. 20 "Duplex" Milling Machine

The Van Norman Machine Tool Co., Springfield, Mass., is bringing out a small "Duplex" milling machine to be known as No. 20. The ram is 30 in. long and can be moved in and out 11½ in. over the top of the column by means of a crank handle. Two lever binders are fitted to lock the ram in position. The cutter head is attached to the side of the ram and can be held in any position between the vertical and the horizontal. The spindle is 15¾ in. long with cone-type bearings and the front end has a No. 13 B. & S. taper hole. The gear mechanism runs in an oil bath inside the ram and gives 12 changes of spindle speeds from 21 to 350 r.p.m. The gear mechanism is driven through steel bevel gears by a splined shaft supported by a bracket at the side of the column and carrying a 10½-in. drive pulley. The latter runs at a constant speed of 385 r.p.m. A chain-driven gear box affords a range of 16 table feeds from ⅜ in. to 12 in. per minute. The table has a working surface 42 x 9¾ in. and a 28-in. automatic longitudinal feed. The saddle is 24½ in. long and has a 12-in. automatic traverse feed. The box-type knee can be moved vertically a distance of 18 in. by hand. Suitable harness with



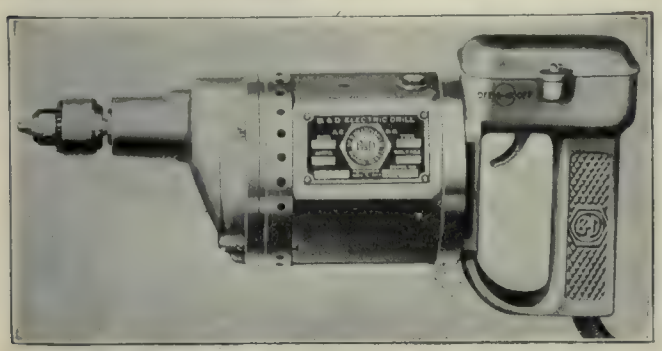
VAN NORMAN "DUPLEX" MILLING MACHINE

straps is provided to secure the solid-steel 4-in. overhanging arm to the knee to improve its rigidity under either vertical or horizontal cuts. With the machine are supplied a countershaft with 10 x 4-in. pulleys for forward and reverse drive at 335 r.p.m., a swivel vise with 7 x 1½-in. jaws opening 4½ in., a draw-in spindle for holding large taper-shank mill mounts or arbor, one ⅞ in. split collet, one reducing collet with No. 7 B. & S. taper hole, one 2¾-in. end mill, one cutter arbor and a set of wrenches. If desired semi-universal or full-universal centers, a sub-head and a universal slotting attachment can be furnished separately.

Black & Decker Portable Electric Drills

The Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md., has recently placed on the market two new types of portable electric drills. These are $\frac{3}{16}$- and ¼-in. sizes and are equipped with a pistol grip and trigger switch. Both models are one-hand drills. The current is controlled by pulling the trigger, without the necessity of changing the position of the

hand holding the machine. It is also claimed that drill breakage is less because the operator does not have to change the position of his hands to switch off the current. Both models have ⅛-hp. motors with series compensated windings, and operate on any current from direct to 60-cycle alternating. Cooling is accomplished by means of a vane impeller mounted on the armature shaft which causes a forced circulation of air through



BLACK & DECKER ¼- AND ⅛-IN. ELECTRIC DRILLS

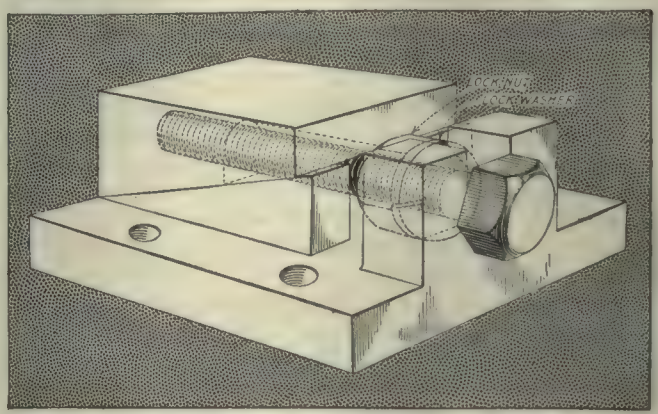
the housing. Gears run in a grease-tight compartment. The speed of the $\frac{3}{16}$-in. drill is 1600 r.p.m. with no load, while that of the ¼-in. drill is 1200 r.p.m. with no load, the energy consumed in both cases being 175 watts.

Anderson Pneumatic Scraping Machine

The illustration shows a pneumatic scraping machine made by the Anderson Bros. Manufacturing Co., Rockford, Ill., as it is operated in a shop. It is claimed that this device will enable one operator to do three times as much work as he could do by the old hand method and without tiring him nearly as much. Various forms of mounting are supplied to suit the needs of the user. As shown the ram is pivoted on a small truck which runs back and forth on the 4-in. I-beam which is mounted at any convenient height on the column. When the machine is operated, the truck is locked on the forward stroke, but is released on the return stroke, and is then free to be moved along the beam as desired. The scraping tool is held in a similar position to a hand tool and operated in the same manner, freedom of motion being insured by the universal joint connecting the ram to the truck. The rod which carries the scraping tool is mounted on ball bearings so that the tool can work at any angle and on either side. The ram requires about 8 cu.ft. of free air at 80 to 90 lb. pressure to operate it, and its forward speed is controlled by an oil governor. The length of stroke is determined by the operator as he moves the sensitive valve control with his right hand, the length of stroke varying with the opening of the valve. When the valve is released, the ram returns the tool to its original position ready for the next working stroke. For smaller work a turntable with T-slots for clamping the work is provided. It has a tilting top mounted on a universal joint, and the whole upper section rotates on ball bearings. The tilting and rotation are controlled by a foot pedal mounted at the side of the base.

Cincinnati Planing-Machine Leveling Blocks

To overcome the difficulties encountered in trying to keep a planing machine leveled up on the old style leveling blocks, the Cincinnati Planer Co., Cincinnati, Ohio, has brought out the block shown in the accompanying illustration. It consists of a baseplate and



A PLANING-MACHINE LEVELING BLOCK

a sliding member operated by a drawbolt having a fine thread and fitted with a locknut and lockwasher. The baseplate is cast with an extra wide flange and is drilled with four 1-in. holes. Its inclined surface is

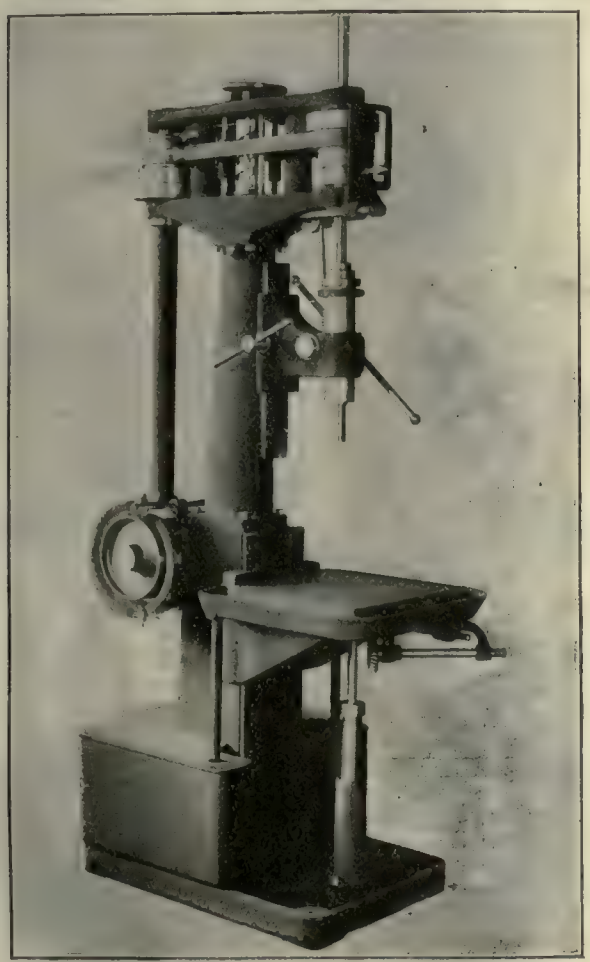


PNEUMATIC SCRAPING MACHINE

ground as is also the bearing surface of the leveling block which is tapped for the drawbolt and so designed that 2½ in. of thread are always engaged. The drawbolt is ⅞ in. in diameter and is threaded practically its entire length. The locking arrangements are intended to hold the adjustment against any changes due to vibration.

Pierle Sensitive Drilling Machine

The illustration shows the high-speed, ball-bearing sensitive drilling machine recently put on the market by the Printing Machinery Co., Cincinnati, Ohio. High-duty, double-row ball bearings are mounted in the various members in what is claimed to be a dustproof and grease-tight manner. Four spindle speed changes are obtainable by means of the combination plate and face cam, belt-shifting device carried on the top bracket.

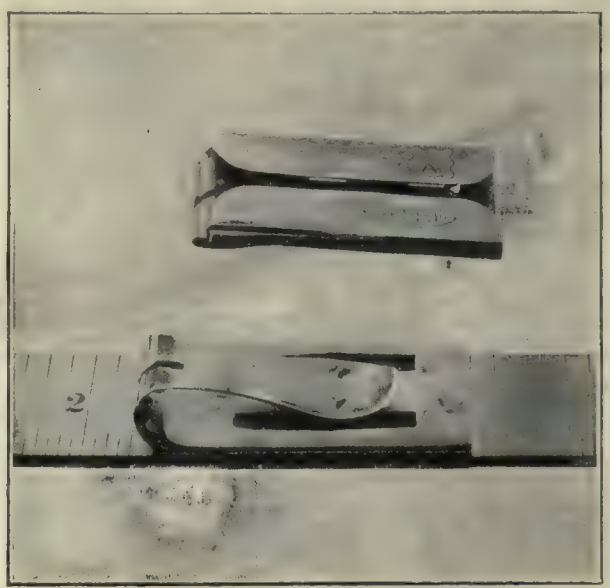


PIERLE DRILLING MACHINE

The shift is so arranged that the belt is shifted off the step on one cone before it starts onto the step on the other cone, thus permitting a tight belt to be used. The tension is increased by a spring-actuated, ball-bearing idler pulley which is released from contact before the belt is shifted. The cones are finished inside and out to improve the balance and are mounted on steel sleeves running in ball bearings. The steel spindle sleeve has an inserted wide-face rack operated by a hardened-steel pinion and carries a thrust and two radial bearings in which the spindle runs. In the gear box mounted on the rear of the base are hardened, chrome-nickel-steel spiral gears running in oil. The drive shaft running from the gear box to the top bracket is inclosed in a tubular casing which helps to stiffen the machine and also guards the revolving shaft. The machine is being built with single or multiple spindles, with and without pump-power feed, and with two types of motor drive.

"Tamco" Pocket Scale and Square Holder

The "Tamco" pocket scale and square holder manufactured by the Automatic Machine and Tool Co., Inc., 87 Frankfort St., New York, is shown in the illustration. It is made for machinists, toolmakers and other mechanics who use pocket scales and squares, and serves two purposes. As a holder for either of these tools, it can be clipped to the pocket, apron or overalls, keeping the tool in a convenient place and reducing the chances of loss. When the tool is to be used, it can be clipped outside the pocket and when it is no longer required the clip can be reversed and the tool secured inside the pocket. In addition, the holder can be used as a scale reader as it slides freely and has a straight edge. It is made in one piece from nickel-plated spring steel, has no sharp corners to do damage and no small parts to be lost or broken or to get out of order.



"TAMCO" POCKET SCALE HOLDER

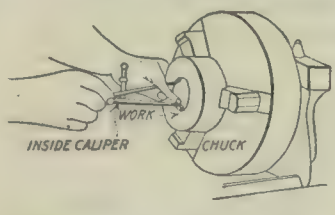
Students' Chart

By R. H. Kreider

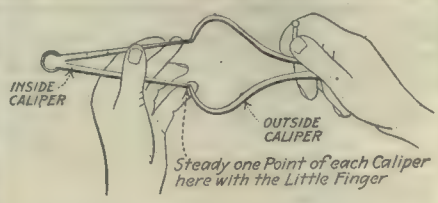
The illustration on the next page shows a chart which was designed for the assistance and convenience of the students in a trade school. This and similar charts are mounted on a board and attached to the machine which it represents.

The central figure shows the machine (a lathe in this case) with the names of the parts, and the surrounding figures show details of various rudimentary operations. The charts can be made for any of the standard machine tools, such as milling, grinding and planing machines, etc.

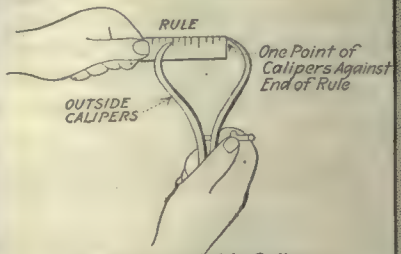
This method of imparting information need not be confined to schools alone, but would be quite helpful in regular machine shops, especially now when handy men and laborers are doing machinists' work.



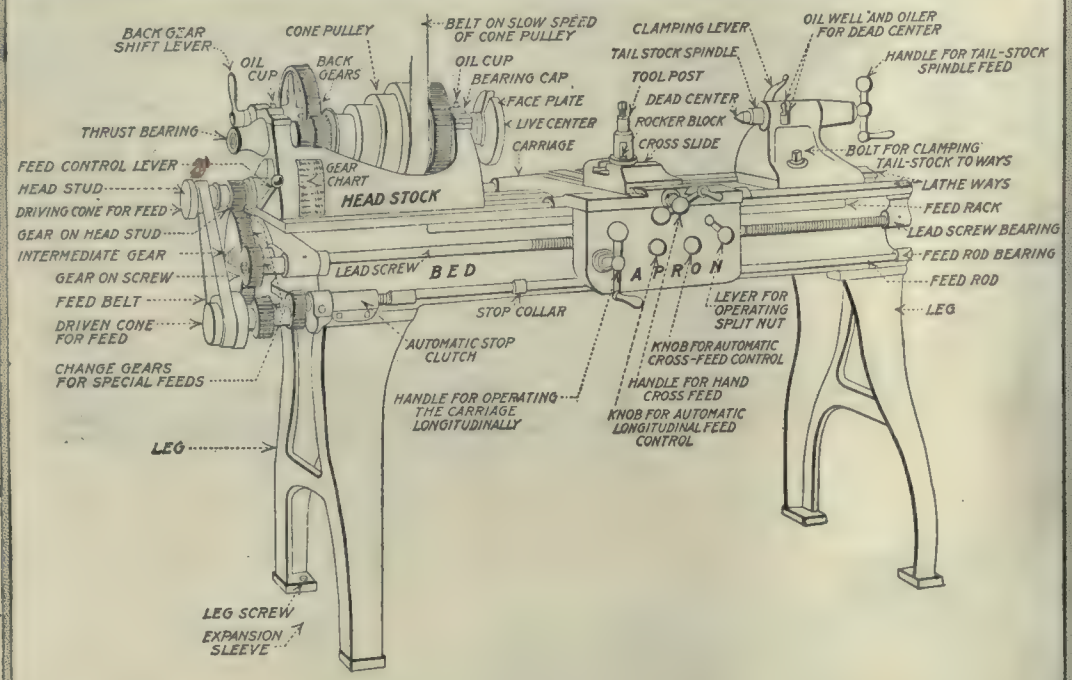
Measuring with inside Calipers

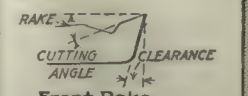


Transferring Measurements from One Caliper to Another



Setting Outside Calipers

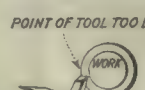




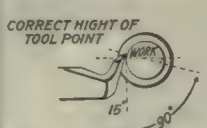
Front Rake Clearance and Cutting Angle



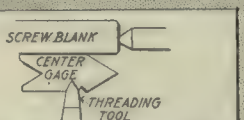
Diamond Point Tool Set Above Center too Far Avoid this



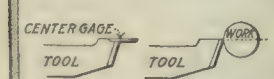
Diamond Point Tool Set Below Center too Far Avoid this



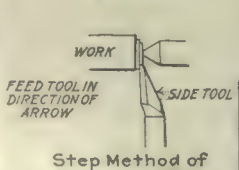
Diamond Point Tool Set Theoretically Correct



Setting U.S. Standard or Sharp V-Threading Tool at Right Angles with Work



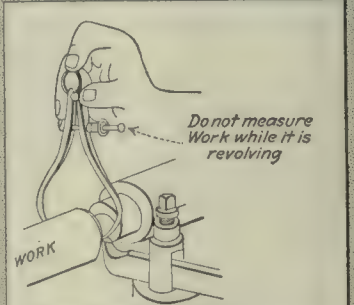
Setting Threading Tool with Center Gage and to Hight of Centers



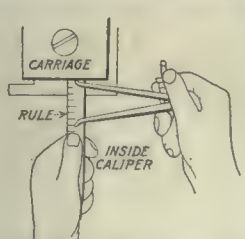
Step Method of Squaring Ends



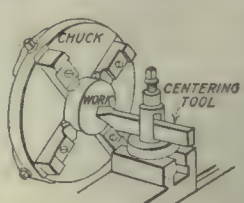
Side Tool For Squaring Ends of Shoulders



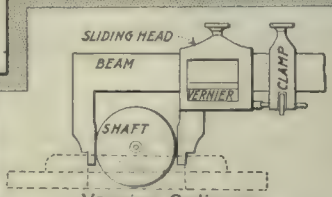
Measuring Work with Outside Calipers



Setting Inside Calipers by Holding Rule Perpendicular to a Machined Surface

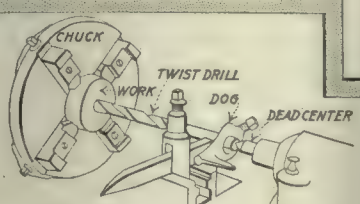


Cutting a Cavity Axially True to Start Drill Central



Vernier Calipers

Shows measuring both outside and inside Work, the Reading shows the Actual Size of the Shaft or outside Measurement to this same Reading must be added the Thickness of the two Jaw Points to obtain inside Measurements



Method of Chucking Hole

To prevent Drill from jumping off The dead Center as it goes through the Work



Measuring Work with Micrometer Held with one Hand

INSTRUCTION CHART

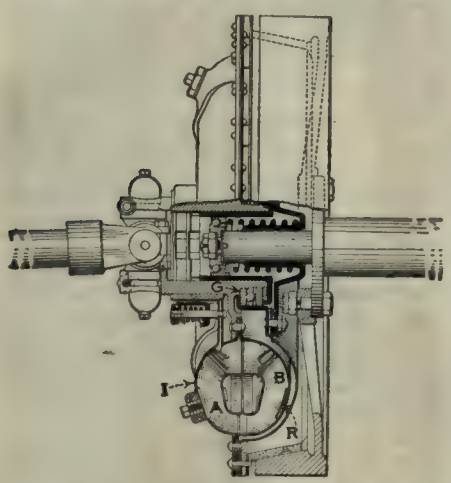


LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft • Motor Trucks • Tractors



A promising form of liquid-operated automatic transmission called the Radcliffe turbine drive has been placed on the market by the Automatic Transmission Co., New York. This transmission is a combination of a centrifugal pump and a hydraulic turbine, and it consists of two moving parts, a driven member or runner *R* and a driving member or impeller *I*. The driving member is a pressed-steel housing carrying the impeller of a centrifugal pump and is fastened to the motor shaft. The driven member is a turbine runner located in the driving member



and rotated absolutely independent of the driving member. These two members are not connected, their only contact being at the bearings, both running submerged in oil. A double-acting thrust bearing *G* is provided to take any thrust produced on the driven member, but mainly serves to take the pull exerted in disconnecting the drive from frictional engagement with the flywheel of the motor. The spring and thrust bearing in the center of hub are of standard construction and serve to hold the drive in engagement with the flywheel and also to permit it being disconnected to enable the gear-shifting lever to be operated if desired. This is, however, seldom necessary. The action of the transmission is as follows: The two members *I* and *R*, which are constructed exactly alike, are so placed that the oil leaving the impeller blades *A* impinges upon the blades *B* of the runner *R*. These blades absorb the greater part of the velocity energy, and the fluid with its residual velocity energy flows toward the center of the runner *R* and back into the eye of impeller *I*, thus completing a closed circuit for the impelling fluid. The flow of the fluid at low engine speeds is so gentle that no rotation is imparted to the driven member *R*, the oil simply circulating through the runner back into the impeller *I*. By increasing the speed of the motor an increased torque is obtained until with wide open throttle the full torque of the motor will be transmitted to the rear wheels of the car at a standstill or at whatever speed they may be turning. This gives a very smooth but rapid acceleration, without shock or jar of any description, and a flexibility of drive and ease of operation. It is also said to be possible to so proportion the passages as to make a reduction gear of any desired ration which is practically positive in action.

At present the main interest of the aircraft industry is concentrated around the efforts of the United States and England to cross the Atlantic Ocean by airplane or dirigible. Both competitors in this contest possess machines the past performances of which bear out the possibility of fulfilling the prediction that there are machines in existence today that are capable of making a transatlantic flight. Without discussing the abilities of the different types of machines, an analysis of the nature of such a flight will show that the enterprise includes questions of navigation which are not as yet satisfactorily answered.

A transatlantic air voyage may be fairly called a blind flight, as it is flying in fog, clouds and darkness when the direction of the machine depends solely on navigating instruments. When an airplane is flying straight its course laterally and directionally may be determined quite accurately from the compass, the banking indicator and lateral clinometer. The compass will not, however, indicate accurately and instantly when the airplane is turning and is not dependable for a short interval after straight flight is resumed. If an airplane is banked steeply and turning rapidly, the banking indicator merely shows whether or not it has the proper bank for the turn it is making.

It is therefore evident that to solve these problems of navigation the airplane has to be provided with an instrument which would accurately and instantly indicate any change from a straight course or from the horizontal. The developing of a perfect instrument of this kind is naturally closely bound up with the establishing of an air route between America and Europe and would be one of the biggest factors in solving the future aerial transportation problems.

Plans have been worked out by the Kerr Steamship Co. to operate a fleet of airplanes to deliver mail to ships 24 to 36 hours after they leave port. The mail, in waterproof bags, will be dropped on deck by the pilot.

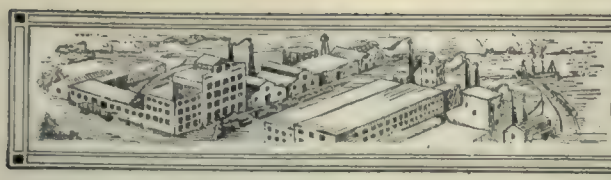
The Texas Airplane Manufacturing Co., capitalized at $1,000,000, has recently organized in Dallas, Tex., for the purpose of constructing and operating an airplane manufacturing plant. The chief promoter of this project is Lieut C. C. Taylor of Lexington, Ky.

The Federal Board of Vocational Training expressed the opinion that the extensive use of motor trucks, tractors, lighting and power systems on farms will create a demand for skilled mechanics, to operate and repair all farm machinery operated by gasoline

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The Rogers Una-Drive Motor Truck Corporation was recently incorporated at Sunnyvale, Calif., for the manufacture of a new type of four-wheel drive truck. The main feature of the design is the simple type of drive employed on the front axle. It is similar to the rear full-floating type, having a toggle to allow for steering, inclosed inside a ball cast integral with the housing. The steering is accomplished through a socket fitting over the ball and held in place by two steering pins.

In the course of his remarks on "The Case for the Airship" at the aeronautic meeting of the Society of Automotive Engineers on Mar. 7, Ladislas d'Orcy announced that he had private advices to the effect that an English concern had under construction four Zeppelin-type dirigible airships for trans-Atlantic passenger and mail service. These craft are to be 800 ft. long with a maximum diameter of 100 ft. and will be equipped with engines that will develop a total hp. of 3500. Their endurance will be 80 hours with full load and it is expected that they will make the eastern trip between America and the British Isles in 50 hours and the western trip in 60 hours. They will have accommodations for 140 passengers and their baggage and will be manned by a crew of 19. It is planned to charge $225 for passage and six cents an ounce for mails. At first the airships are to be regularly operated during the months from May to October only, but all the year service is merely a question of time and improvements. There are to be two sailings weekly from each side.



Sparks from the

British Machine Tool Situation

Demand Continues Good in Most Lines But Considerable Uncertainty Still Exists

There is a somewhat peculiar condition in the Sheffield district due to the inactivity in openhearth-steel departments. This comes from the lack of orders to replace the war-time activity for shell steel. The crucible-steel branch is also quiet on account of the slackened demand for turning tools for shells and other munitions.

On the other hand there is a large demand for wire rods, especially of the cheaper grades, to be used in reinforced concrete. The production of tools and finished steel goods is being pushed and the supply does not as yet anywhere near keep pace with the demand. Boilers and electrical machinery seem likely to continue to be busy.

Machine-tool makers in the Yorkshire district report good-sized orders, but labor conditions are not settled and they are unable to judge of the future with certainty. In the Sowerby Bridge district there is a demand for a large variety of machine tools and similar machinery and excellent prospects are reported. F. Berry & Sons are building heavy triple-geared 40-in. swing lathes with beds up to 30 ft. in length. There is also considerable plate handling machinery for ships and boilers going through.

In some districts there seems to be something of an oversupply of lathes, while on the other hand some makers have a fair amount of lathe business booked. This is particularly true of H. Broadbent, Ltd., while Summerskill Bros., continue to be busy on planing machines up to 60 in. Some of these are of the two-belt type while others are motor-driven.

The Scottish labor situation is reported to be more settled and work is on the whole proceeding steadily on the 47-hour week basis. There is some increase in unemployment, but not enough to be alarming and it is expected that this will very shortly decrease. The British Industries Fair will be held in Kelvin Hall, Glasgow, from Sept. 8 to 19. It is also expected that there will be a motor exposition at the same place in January, 1920, and that an engineering and shipbuilding exhibition will follow next spring.

The demand for shipping seems to continue and some of the large shipbuilding firms report plenty of orders on their books. Concrete vessels with electrically-welded reinforcing steel are being talked of more favorably, and standard ships are being turned out along the Clyde. One company, Barclay, Curle & Co., Ltd., built during the war 45 vessels of various types for the Admiralty, ships for the French Navy and merchant tonnage to the number of 57. They also repaired 3,243 vessels and delivered 400 airplanes and seaplanes. They are one of the oldest concerns on the Clyde, having just completed their hundredth year in business. Forgings and both iron and steel castings are in demand, and boilermakers and general engineers are managing to keep busy.

Machine-tool builders in the Johnstone district report orders enough to keep them busy. This includes lathes, planing machines, hydraulic and motor-driven presses and general woodworking machinery, as well as plate machinery for the shipyards.

There seems to be an increase in the tendency to use jigs and fixtures in manufacturing, and this is reflected in the manufacture of special small precision horizontal milling machines by Hunt & Sons of the Manchester district. These machines are designed particularly for jig and fixture work, the table swivelling on trunnions for angular work. There is also a demand for fluting machines for twist drills up to 2 in. in diameter indicating an extension in the manufacturing facilities for these tools.

There is still some question as to the continuance of women in the machine shops and this is likely to be heard from later. Those employed on strictly war work are practically out of the shops at the present time. The success of the various training schools during the war will probably lead to the utilization of more apprentices or unskilled labor unless there is some arrangement made to the contrary.

One notable case in which the management should be congratulated is that of the National Gas Engine Co., Ltd. This shop has been able to turn over from war to peace work without the necessity of discharging a single old employee and, at the same time, they have reinstated all their demobilized men. The Manchester municipal tramways are preparing to build 100 new cars which will help take up the labor slack in this district.

London, Mar. 27, 1919.

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Aeronautic Convention Starts May 1

The second Pan-American aeronautic convention and exhibition will be held at Atlantic City, N. J., on May 1 and will last until June 1. The convention will be under the auspices of the Aero Club of America, the Aerial League of America and the Pan-American Aeronautic Federation. A program outlining each day's activities has been issued.

Foreign Trade Committee Organized

It is officially announced that a committee on foreign trade, composed of members of virtually all government departments and boards, has been formed to stimulate and coördinate American trade abroad.

The foreign trade committee has been organized under an authorization signed by President Wilson. All government offices dealing in any way with foreign trade questions are represented. Among the urgent questions to be treated immediately are tonnage allocation, marine freights, cable and radio facilities, reconstruction loans, Latin-American loans, labor and immigration, key industries, such as dye making, strategic raw materials and a unified organization for buying in Europe.

The committee will act as a clearing house for government departments involved in foreign trade questions, it was explained. Business men will deal with the same agencies of the government as heretofore and the committee will be concerned only with subjects that relate, in a general way, to foreign trade policy and development of American interests abroad. Its functions will be advisory to the government executives actually dealing with specific trade affairs.

The committee held a preliminary meeting last week and a sub-committee on organization was formed.

It is understood that the persons actually sitting in conference will vary from time to time, but the departments represented include: State, Commerce, Treasury, Agriculture, Labor, War, Navy and Shipping Board, War Trade Board, Federal Trade Commission, Tariff Commission, Railroad Administration, Interstate Commerce Commission and Post-Office Department.

* * *

New Fuel for Motors

Development too late for use in war time of a motor fuel which adds 10 miles an hour to the speed of airplanes, and has possibilities for use in automobile racing has been announced by the Bureau of Mines. The liquid, a combination of benzol and cyclohaxane called hector, costs about $1 a gallon. While of military value, it is not regarded as practical for commercial purposes.

Another combination developed by the bureau, consisting of benzol and gasoline, has been found to be more powerful than gasoline alone, and is expected to prove of value in industry. The comparative scarcity of benzol makes its production to supplant gasoline on a large scale improbable at present.

World's Industrial Forge

By E.C.Porter, News Editor

General Meeting of Engineers of New York

An engineers' symposium was held at the Engineering Societies Building in New York on Mar. 26 for the purpose of discussing "The Engineer as a Citizen." Gano Dunn, fellow and past president of the A. I. E. E. presided and formal addresses were delivered by Philip N. Moore on "The Civic Responsibility of the Engineer," Calvert Townley on "The Relation of the Engineer to Legislation," Nelson P. Lewis on "The Relation of the Engineer to Administration," Spencer Miller on "The Relation of the Engineer to Public Opinion," and Comfort A. Adams, recently appointed dean of the Harvard Engineering School, on "The Relations of the Engineer to Production and Distribution."

The meeting was held under the auspices of the Mining, Mechanical and Automotive Engineers and the members of the other societies were invited to attend. At the conclusion of the program, the meeting was opened to discussion and a resolution adopted directing the appointment of a committee to take steps toward the formation of an organization to include all the local engineering societies with the idea of closer coöperation and consequently increased power. Similar organizations of other cities were described and pleas were made for the formation of one national organization of engineers to bear somewhat the same relation to the many existing national societies as does the national government to that of the states.

* * *

Exhibit of Personnel Work

Employers and others interested in personnel work have an opportunity to examine the methods developed by the Committee on Classification of Personnel in the army at an exhibit being shown on the third floor of the Engineering Societies Building, 29 West Thirty-ninth St., New York. The exhibit, which began on Apr. 1 and will continue until Apr. 12, consists of a collection of wall charts, forms, photographs and models showing how the army finds out what men can do best and how it uses that information; how soldiers are trade tested, and how officers are rated and fitted into place; how the work is checked and supervised, and its results in the war.

The collection is being shown under the auspices of the National Association of Corporation Schools and the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It was on exhibition for several weeks at Washington, where it excited so much interest that in response to many requests the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its various features.

* * *

To Establish Permanent Exhibit of War Materials

The engineering and standardization branch of the Purchase, Storage and Traffic Division of the army will establish and maintain an exhibit of standard war equipment and supplies. The exhibit will contain samples of all varieties of standard articles necessary for war. It is especially intended for the information of manufacturers, and in order to have available at all times approved samples or specifications of samples needed to facilitate production. A list of the articles to be exhibited will be made public later.

* * *

Engineers' Club of Philadelphia Will Hold Informal Meeting

The Engineers' Club of Philadelphia will hold an informal meeting Apr. 9 at which Roland L. Cummins, of the Packard Motor Car Co., will give a demonstration of the Liberty motor. The method of manufacturing Liberty motors will be illustrated by motion pictures. The regular monthly meeting will be held Apr. 15 and will be addressed by S. M. Swaab on "Main Interchange Station Under the City Hall, Philadelphia Subway System"; the address will deal with unique construction methods made necessary by conditions imposing exceptional difficulties. A special meeting will be held Apr. 23 at which Arthur J. Baldwin, vice-president of the McGraw Hill Co., Inc., will present an illustrated paper entitled "The Devastated Area and Its Reconstruction." Mr. Baldwin was a member of a party of technical and business paper editors and publishers who were invited by the British Ministry of Information, as its guests, to visit Europe.

* * *

Argentine-American Chamber of Commerce Formed

Formation of an Argentine-American Chamber of Commerce in New York City, under the auspices of the Chamber of Commerce of Buenos Aires, has been announced by Enrique Gil, secretary of the organization. Its purpose is to foster trade relations between the two countries, to encourage investment of American money in Argentina, and to serve as a clearing house for all business. The membership will include citizens of both countries.

Aircraft Surplus Material Being Sold

Materials Disposal Section Has Been Formed and Machinery Will Be Sold at Appraised Price

There has been formed a Material Disposal Section of the Bureau of Aircraft Production, organized on a basis similar to that followed by large commercial houses which handle sales through branch offices. This section will be under the direction of First Lieut. Charles S. Shotwell. Sales will be made under the supervision of a sales manager stationed at Washington.

The Bureau of Aircraft Production will probably have for sale the following classes of material, and as soon as this material has been established as surplus and a policy for the sale of the same determined, the bureau will issue bulletins covering the material for sale.

Machine tools and fixtures.
Electrical machinery.
Dies, tools, jigs and gages.
Chemicals, paints and oils.
Metals.
Motor accessories.
Lumber.
Hardware.
Buildings and lands.
Fabrics.
Scrap.
Shop equipment.
Office equipment.
Miscellaneous.

Sales negotiations will be handled by salesmen in each of eight district branches, to be located in Boston, Buffalo, Chicago, Dayton, Detroit, New York, Pittsburgh, and San Francisco. These salesmen will be authorized to make sales of property wherever located, after the same has been cleared by the Board of Sales Review of the office of the Director of Sales, so that the prospective buyers will communicate with the branch office in the city located nearest them.

This arrangement, it is expected, will make it possible for manufacturers needing machinery and supplies to purchase conveniently and at fair prices. The salesmen will have full authority to sell at the best offer made, provided that offer is at or above an appraised value arrived at independently, or at market value in the case of raw material.

* * *

Ships Now Owned by the U. S. Government

The United States Government now owns 555 ocean-going steel cargo ships aggregating 3,385,475 deadweight tons. In addition it has under contract 1,336 similar vessels of 9,275,006 deadweight tons. If our present program be car-

ried out, there will be under the American flag next year 16,732,700 deadweight tons of ocean-going steel cargo and passenger ships. This fleet will be the equivalent of almost half the merchant tonnage which plies the seas today under the flags of all nations combined. The government will own about 70 per cent. of it.

Business Items

The Gorham Tool Co., Detroit, Mich., is placing on the market a complete line of standard milling cutters and reamers which are designed for salvaging several times.

The Walcott Lathe Co., the Jackson Shaper Co., and the Jackson Machine Tool Co., of Jackson, Mich., have opened joint display and salesrooms at 254 E. Jefferson Ave., Detroit, Mich.

The Bettcher Manufacturing Co. of Cleveland, Ohio, manufacturer of steel stampings has opened a Chicago office at 30-32 N. Clinton St., with A. C. Dunn as its representative.

The Bridgeford Machine Tool Works, Rochester, N. Y., have opened branch offices at 50 Church St., New York, with F. C. Severin in charge, and also at 549 Washington Boulevard, Chicago, in charge of A. W. Van Buren.

The Colonial Tool Co., 33 Woodward Ave., Detroit, Mich., has been formed by R. H. Anderson and Otto Lundell for the exclusive manufacture of broaches. Their interests in the Michigan Tool Co. are still retained.

Baxter D. Whitney & Son, Winchendon, Mass., has been incorporated recently as Baxter D. Whitney & Son, Inc., with a capital stock of $1,250,000. The officers are: W. M. Whitney, president; Marcus L. Foster, treasurer; and Frank C. Smith, Jr., secretary.

The British branch of the International Oxygen Co., known as the Integral Oxygen Co., Ltd., has commenced the manufacture of I. O. C.'s electrolytic cells and other products for the British market. E. L. Byrns is the general manager in charge, with offices at 38 Victoria St., Westminster, London, S. W.

Wheelock, Lovejoy & Co., Inc., 1800 Columbus Road, Cleveland, Ohio, is building an addition to its warehouse, which will nearly double the present storage capacity. In addition to Hy-Ten special machinery steel, it will now carry in stock a complete line of Whelco carbon and high-speed steels as well as globe drill rods.

The Baldwin Engineering Sales Co., Baltimore, Md., has recently established its office, representing as manufacturers' agent, the Reliance Steel Co., Pittsburgh, Penn., and the National Forge and Tool Co., Erie, Penn. The territory of the new company includes the states of Maryland, Delaware, Virginia, District of Columbia, and part of Pennsylvania.

The Raybestos Co., Bridgeport, Conn., has placed on the market a new type of molded facing for multiple disc clutches. This new facing presents an unusual amount of frictional surface to the steel disc, providing it with more capacity than usual for a given size of clutch. It is composed of pure asbestos with a suitable binder, molded under tremendous pressure.

The New Britain Machine Co., New Britain, Conn., at its annual meeting of stockholders held recently, elected the following directors: F. G. Platt, H. H. Pease, R. S. Brown, A. Buol, H. E. Erwin, C. R. Hare, S. P. Goss, A. J. Sloper, M. C. Swift, J. E. Cooper, C. J. Parker. Subsequently the directors elected the following officers: President, F. G. Platt; vice president, M. C. Swift; treasurer, H. H. Pease; secretary, R. S. Brown; assistant treasurer, A. Buol; assistant secretary, H. E. Erwin.

Louis Besse, 39 Rue de Lappe, Paris, has opened an office at 120 Liberty St., New York. This is in charge of Mr. Arva Stroud who has recently returned from France where he spent over three years in machine-tool lines. During the past year Mr. Stroud was connected with the Machine-Tool Section, both as a civilian and as a commissioned officer, directing the purchasing of machine tools for the general purchasing agent of the American Expeditionary Forces. Being thoroughly familiar with conditions in both France and Belgium, Mr. Stroud is interested in furthering the sale of machine tools in those countries and can be of considerable assistance to any who desire to trade with either of these countries.

The American Hardware Corporation, New Britain, Conn., held its annual meeting of stockholders recently, and the following directors were elected: C. H. Baldwin, Philip Corbin, James S. Elton, Charles Glover, Benjamin A. Hawley, George T. Kimball, Henry H. Peck, Charles B. Parson, A. J. Sloper, C. F. Smith, H. W. Whittemore, Henry C. M. Thomson and Rollin S. Woodruff. The directors, at a subsequent meeting, elected the following officers: President, Henry C. M. Thomson; first vice president, Charles Glover; vice president, Benjamin A. Hawley; vice president, Carlisle H. Baldwin; vice president, Charles B. Parsons; treasurer, Isaac D. Russell; assistant treasurer, G. Ernest Root; secretary, G. T. Kimball.

Obituary

CHARLES F. BACHMANN, master mechanic of the Essex County Division, Public Service Railway, N. J., died recently after a brief illness from pneumonia at his home, 402 Williams St., East Orange, N. J. He was 33 years old and a mechanical engineering graduate of Cornell University. He had been employed by the Public Service Railway for 11 years.

Personals

J. E. MCCAULEY has been made vice president and general manager of the Birdsboro Steel Foundry and Machine Co., Birdsboro, Penn.

F. J. SCHWARB, formerly of Beals & Co. and the Cygnet Manufacturing Co., is now associated with the Aborn Steel Co. at Buffalo, N. Y.

ALBERT A. SCHEUCH of the sales department of the Epping-Carpenter Pump Co., Pittsburgh, Penn., has been made assistant sales manager.

NATHAN LESTER, who has had long experience in the die-casting industry has been made superintendent of the Acme Die-Casting Corporation, Brooklyn, N. Y.

GEO. K. ATKINSON, formerly superintendent of the Cincinnati Planer Co., is now eastern manager of the Manufacturers' Equipment Co., with offices in New York.

C. H. BREAKER has been made assistant sales manager of the Diamond Chain and Manufacturing Co., Indianapolis, Ind., in charge of their sales promotion.

F. R. CONROY, for many years connected with Strong, Carlisle & Hammond Co., has been appointed Cleveland manager for the Cadillac Tool Co., Detroit, Mich.

GIFFORD K. SIMONDS, general manager of the Simonds Manufacturing Co., Fitchburgh, Mass., has been added to the board of directors of the First National Bank of Boston.

CHARLES B. GILBERT, recently discharged from the navy, has taken a position as purchasing agent with the Babcock Printing Press Manufacturing Co., New London, Conn.

WALTER WILSON of the American Machinery Syndicate, 35 West 39th St., New York, has sailed for Spain to investigate the industrial machinery and mining apparatus lines.

F. W. SEBELIN, formerly master mechanic of plant No. 2 of the National Malleable Castings Co., has been made plant engineer of the Ferro Machine and Foundry Co., Cleveland, Ohio.

PAUL D. GOODMAN, formerly of the McClary, Jemison Machinery Co., of Birmingham, Ala., has been added to the sales personnel of the Epping-Carpenter Pump Co., Pittsburgh, Penn.

LEON E. THOMAS, vice president and general manager of the Birdsboro Steel Foundry and Machine Co., Birdsboro, Penn., has been elected president of the Reading Iron Co., Reading, Penn.

A. E. CARLE, formerly with the Baush Machine Tool Co., and Manning, Maxwell & Moore, has joined the Cadillac Tool Co., Detroit, Mich. as sales engineer in the machine-tool department.

C. E. LONG, has joined the engineering force of the Hart-Parr Co., Charles City, Iowa. Mr. Long has been for the past seven years with the Curtiss

Aeroplane Corporation, Hammondsport, N. Y.

W. H. DIEFENDORF, Syracuse, N. Y., has resigned his position as chief engineer and as a director of the New Process Gear Corporation, and is now with the Weeks-Hoffman Co., also of Syracuse.

EDMUND C. MAYO, who has held the office of general manager of the Worcester Pressed Steel Co., for the last five years, has resigned and accepted a similar position with the American Tube and Stamping Co., Bridgeport, Conn.

F. R. STILL, vice president and secretary of the American Blower Co., has left on an extended trip through Japan, China, Australia, and most of the European countries where he will investigate trade conditions in connection with export work.

E. F. CARLSON of Brooklyn, N. Y., has joined the engineering department of the Hart-Parr Co. During the war he was with the Subchaser Division with headquarters near the Brooklyn Navy Yard. Mr. Carlson was formerly with the Hart-Parr Co.

WILLARD B. JACKSON, who for a number of years has been Boston district manager for Wm. Jessop & Sons, is now associated with the Simonds Manufacturing Co., Lockport, N. Y. He has opened a New England office for them at 120 Milk St., Boston, Mass.

FRED H. WALDRON, formerly Minneapolis representative of the Chicago Pneumatic Tool Co., has been appointed manager of the pneumatic tool sales division suceeding J. G. Osgood, resigned. Mr. Waldron's offices are now at the company's headquarters in the Fisher Building, Chicago, Ill.

CHARLES W. UNBEHAUN, formerly of New York, and general eastern salesman for the Bailey-Drake Co., Chicago, Ill., has joined the Black & Decker organization as branch manager. Mr. Unbehaun will cover eastern New York and the state of Connecticut with the Black & Decker line of portable electric drills and accessories.

LEON BARD has resigned his position of assistant superintendent of the Naval Factory, League Island Navy Yard, Philadelphia, Penn., and has formed a partnership with E. Bowker under the name of Bard & Bowker, 967 North Warnock St., Philadelphia, Penn. They are conducting an authorized Ford service station in connection with their machine shop.

ERNEST T. GREGORY, formerly representative of the American International Corporation and manager of the International Banking Corporation, Pekin, China, has been elected vice president of the First National Corporation of Boston. Mr. Gregory at one time was connected with Lee-Higginson & Co. and later was a partner in the firm of Hambleton & Co., Baltimore, Md.

CLINE B. FINNELL has recently been appointed private secretary to Walter A. Zelnicker, president of the Walter A. Zelnicker Supply Co., St. Louis, Mo. Mr. Finnell, who has just returned from the Officers' Training School at Camp Pike, Arkansas, was formerly traveling secretary to the general superintendent of the C. B. & Q. R.R., and later private secretary to Clarence H. Howard, president of the Commonwealth Steel Co.

CAPT. GEORGE SYKES, R. A. F., A. M. I. E. E., who has been in this country nearly four years, attached to the British War Mission in a commercial capacity, sails for Europe in May. He has joined Messrs. Dutilh-Smith McMillan Co., as London manager of their engineering and railroad departments. For many years prior to the war, Captain Sykes was connected with electrical manufacturers and power and traction corporations in the sales and engineering departments. Captain Sykes will be interested in hearing from firms wishing to introduce the following products in Europe: Electrical and mechanical specialties for use in power and traction corporations, mining, aeronautical, steel, automobile, electrical, machine-tool, shipbuilding and cement industries and electric railway equipment. His New York address is 50 Broad St., and his London office is the Central Buildings, Totehill St., Westminister.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An agency is desired by a man in France for the sale of small tools. Correspondence should be in French. Reference. No. 28824.

A manufacturer in Italy desires to purchase iron, steel, brass, copper, aluminum, and lumber used in the construction of railway cars, and also machinery for making household utensils and hardware. Correspondence should be in Italian. Reference. No. 28776.

A member of a firm in New Zealand is in this country and desires to secure an agency from manufacturers only, for the sale of dairy machinery and supplies (including parchment and cheese bandage), can-making machinery, electrical supplies, electrical steel-tool blanks, copper wire (plain and coated), woven wire fencing, steel wire, wire nails, galvanized sheets (plain and corrugated), tin plate, tin steel, machine tools, woodworking machinery, sawmills and supplies, light-six motor cars, tires, trucks, road-building machinery, and engineering supplies. References. No. 28749.

A firm in Switzerland desires to purchase immediately and to secure an agency for the sale of machine tools, agricultural implements, and tools of all kinds. No. 28750.

Ing. A. Stauble, Foro Bonaparte 76, Milano, Italy, is desirous of extending the range of his electric and mechanical machinery business and would like to hear from American firms who desire to establish an agency for their products in Italy. He states that he is interested in electric appliances, fittings and materials, machines, tools, technical articles and instruments for the use of public work, dock yards, naval arsenals, etc., and in supplying mills and factories of all kinds.

Catalogs Wanted

The Artillery Ammunition Metal Components Division, Ordnance Dept., U. S. A., 7th & B St., E-7-208, Washington, D. C., desires duplicate files of catalogs from all machine-tool manufacturers who have made machines used in the manufacture of artillery ammunition. It is particularly desired to obtain drawings and general specifications of these special tools that have been manufactured and which do not appear in the general catalog.

Trade Catalogs

Bulletin No. 260. Walter A. Zelnicker Supply Co., St. Louis, Mo., Circular. Pp. 4, 3½ x 8½ in. A price list of steel sheet piling, any make, weight or length, also, of all kinds and sizes of pipe.

Broaching Equipment, Machines and Tools. The J. N. La Pointe Co., New London, Conn. Catalog, Pp. 56; 8½ x 11 in., illustrating and describing the various types of broaching machines and tools.

Pneumatic Tools. The Independent Pneumatic Tool Co., Chicago, Ill. Circular No. 30. Four-page pamphlet descriptive of the Thor line of pneumatic tools. Illustrations and specifications are given.

Tite Flex All-Metal Flexible Tubing. Titeflex Metal Hose Corporation, Newark, N. J. Bulletin, No. 102. Pp. 20, 4¾ x 7 in. This bulletin tells how Tite Flex is made, giving the various forms, sizes and prices.

Twist Drills, Reamers, and Special Tools. The Buckeye Twist Drill Co., Alliance, Ohio. Catalog No. 6. Pp. 60; 5 x 7½ in. A complete illustrated price guide of the line of reamers, drills and special tools put out by this company.

Automobile Jacks for Passenger and Commercial Cars. Republic Auto Parts Co., Long Island City, N. Y. Catalog, Pp. 24; 7 x 10 in., describing the line of Sterling jacks which are made in 14 styles. Many useful auto accessories are also illustrated and described.

Gasoline and Oil Handling Outfits. Gilbert & Barker Manufacturing Co., Springfield, Mass. Catalog 8-B. Pp. 28; 6 x 9 in. This is a catalog of the Gilbert & Barker equipment for handling gasoline and oil. Various sizes and styles of pumps and tanks are illustrated and described.

The Quigley Powdered Fuel System. Quigley Furnace Specialties Co., 26 Cortlandt St., New York. Bulletin No. 11. This is a 16-page booklet describing the equipment employed in the Quigley system for preparing, distributing and burning powdered fuel which is in successful operation on a variety of furnaces.

Landis Pipe Threading Machinery. Landis Machine Co., Inc., Waynesboro, Penn. Catalog No. 25. Pp. 48; 6 x 9 in. This catalog illustrates and describes in detail Landis stationary pipe die heads, pipe threading and cutting machines, rotary pipe and nipple threading die heads, pipe nipple threading machines and the Landis chaser grinder.

Markets for Electrical Goods in China and Japan. A report by Trade Commissioner R. A. Lundquist, published by the Bureau of Foreign and Domestic Commerce, giving a full description of the conditions governing the sale of electrical goods in China and Japan. Copies can be obtained for a nominal sum from the Superintendent of Documents, Washington, D. C.

Twist Drills, Reamers, Wrenches, and Drop Forgings. No. 91. The Whitman & Barnes Mfg. Co., Akron, Ohio. Catalog No. 91. Pp. 184; 5½ x 7½ in. A catalog covering the complete list of products manufactured by this company in the machinists' supply line, carbon and high speed twist drills and reamers, screw and drop forged wrenches, spring cotters and keys. Illustrations and prices are given.

Checking Thermocouple Pyrometers. Bulletin No. 867-B. The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Penn. Catalog, Pp. 24; 7¾ x 10¾ in. It discusses the importance of maintaining standards and of checking in pyrometry, and points out sources of error and the remedies for troubles in therocouples, millivoltmeters,

cold junctions and standardized thermocouples. This bulletin is distributed free of charge upon application to the above company.

Newton Slotting Machines. Catalog 49-A. Newton Machine Tool Works, Inc., Philadelphia, Penn. Pp. 28, 6 x 9 in. This catalog contains the latest information on slotting and upright generating planing machines. In the insert pages are shown photographs of cold-sawed, cutting-off machines, locomotive link grinding machines and horizontal milling machines, vertical milling machines, rotary planing machines, key-seat milling machines, and duplex locomotive rod boring machines.

Safety Grinding Wheels. Safety Emery Wheel Co., Springfield, Ohio. Catalog 9. Pp. 138; 6 x 9 in. Published to give information relative to the making of grinding wheels as well as to list special wheels used on various grinding machines. Descriptions of materials and processes of making are given, together with a description of the safety collar and directions for its use. There are suggestions for operating grinding wheels with tables for determining surface speed of wheels, decimal equivalents, etc. Following this are descriptions, specifications and prices of special wheels for different types of grinding machines. The catalog is fully illustrated and a complete index is given.

N. G. E. A. Data Sheets. National Gas Engine Association, Lakemont, N. Y. Bulletin. Pp. 82; 5½ x 8½ in. Divided into three volumes, as follows: Vol. I, N. G. E. A. Standards and General Engineering Data; Vol. II, Pumps; Vol. III, Electrical Outfits. Vol. I gives useful information on gas engines and carbureter fittings, tables of standards and equivalents and data of general engineering; Vol. II is devoted to pumps, and it gives tables on atmospheric pressure, friction of pipes and elbows, stroke of piston speed, water equivalents, etc.; Vol. III contains data on battery sizes, generator sizes, wire sizes and lamps and gives a comparative table of resistances.

Structural Steel For Ships. Carnegie Steel Co., Pittsburgh, Penn. 2nd Edition, with additional tables and commentary. Pp. 60, 5 x 7§ in. This pamphlet is of great value to the ship builder because it is the latest work on the subject of structural steel for ships and contains a great store of information and working data. The booklet gives tables on structural shapes recommended for ships and also includes facsimiles of standard order forms for shapes, plates and bars. The commentary describes and illustrates the kinds of rolling mills utilized in the manufacture of ship steel traces, the route followed by an order from a shipyard, through district and general offices to the mills, through the mills, to the shipping beds and thence back to the shipyard. It also recommends a convenient and uniform marking system for cargo vessel materials and a practical method of plain material storage at the yards—all fully illustrated by diagrams and figures.

New Publications

Gasoline and Kerosene Carburetors: Their Construction, Installation and Adjustment.—By Victor W. Page. Two hundred and thirteen 5 x 7½-in. pages; 89 illustrations; bound in dark-green cloth boards. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York. Price. $1.50.

This is a simple, comprehensive treatise for practical men explaining the basic principles pertaining to carburetion, showing how liquid fuels are vaporized and turned into gas for operating various types of internal-combustion engines intended to operate on vapors of gasoline, kerosene, benzol and alcohol. The leading types of carburetors are described in detail, special attention being given to the forms devised to use the cheaper fuels such as kerosene. Carburetion troubles, fuel-system troubles, carburetor repairs and installation, electric primers and economizers, hot-spot manifolds and modern carburetor developments are considered in a thorough manner. Methods of adjusting carburetors are fully discussed, as well as suggestions for securing maximum fuel economy and obtaining highest engine power.

The various chapter headings are Liquid Fuel Suitable for Power; Liquid Fuel Supply Methods; Carburetor Action and Construction; Modern Gasoline Carburetors; Kerosene Carburetors; Manifolds and Carburetor Installation; Carburetor Faults, Location and Remedies. The book will be of considerable value to repair men, students and motorists.

The Starrett Book for Machinists' Apprentices.—Published by the L. S. Starrett Co., Athol, Mass. Fourth edition. One hundred and seventy-six 4½ x 7-in. pages. Price, 50 cents.

The book, now in its thirty-fifth thousand, is well illustrated and designed to answer in an authoritative manner questions as to how to do the everyday work of the average machine shop. It is bound in red Athol leather. The different classes of work are taken up separately, the most common errors pointed out and the correct practice indicated. Much attention is given to the proper use and care of tools, the reading of micrometers and verniers, bench work, lathes and lathe tools, grinding, bolts, gears, etc. The book is essentially for the apprentice rather than for the expert machinist, though the latter will find much of interest and value, and is intended to provide the answers to the many questions usually asked of the foreman or superintendent. Distribution is being made exclusively through the hardware dealers handling the Starrett line of tools.

Johnson's Materials of Construction.—Fifth edition, rewritten by M. O. Withey and James Aston; edited by F. E. Turneaure. Eight hundred and forty 6 x 9-in. pages; fully illustrated; bound in heavy red cloth boards. Published by John Wiley & Sons, Inc., New York. Price, $6.

This is a revised, rewritten and enlarged edition of the book originally compiled by the late J. B. Johnson, dean of the College of Engineering of the University of Wisconsin. Two of the present editors are connected with the same university, while Mr. Aston is metallurgist for the A. M. Byers Co., Pittsburgh, Penn.

The book contains an enormous amount of information of value to anyone interested in the various materials of construction. It is intended both as a text and a reference book, and in arrangement it differs markedly from the former work, which was somewhat cumbersome. The division into parts has been discarded and the related subject matter has been more closely coördinated. This is a great improvement. The various chapter headings are: Synopsis of the Principles of Mechanics of Materials; Machines and Appliances for Mechanical Tests; The Mechanical Testing of Structural Materials; Characteristics, Physical Properties and Uses of Wood; The Deterioration and Preservation of Timber; The Mechanical Properties of Timber; Building Stone; Structural Clay Products; Portland Cement; Natural and Other Hydraulic Cements; Limes and Plasters; Methods of Testing Hydraulic Cements; Making Mortar and Concrete; The Physical Properties of Mortar and Concrete; Portland Cement Products; Metals and Their Ores; Manufacture of Wrought Iron and Steel; The Manufacture of Iron and Steel Shapes; Formation and Structure of Alloys; Constitution of Iron and Steel; Properties of Wrought Iron; Properties of Steel; Alloy Steels; Cast Iron and Malleable Cast Iron; Nonferrous Metals and Alloys; The Effect of Temperature on the Mechanical Properties of Metals; Fatigue of Metals; The Corrosion of Metals.

Man to Man: The Story of Industrial Democracy.—By John Leitch. Two hundred and fifty 5 x 7½ pages. B. C. Forbes Company, 299 Broadway, New York. Price, $2.

The author directs the reader's attention to the condition of industrial unrest which because of the changing status of industry itself and the constantly increasing cost of living has become more and more in evidence for the past decade and which greatly intensified by the events of the past two years imperatively demands remedial action. Ten years ago Mr. Leitch, himself a workman in the Chicago stockyards, realizing that something must be done to meet the condition which even then assumed an ominous aspect, set himself to study the causes with a view to applying the remedy.

He explains that industrial democracy did not come full fledged into being, but was evolved through years of experiment based on the fundamental principle of justice between employer and employee. Its machinery, which is modeled after the legislative machinery of our federal Government, provides the means of communication by which the opposed ends of the industrial organization may get together, learn each other's trials and limitations and cease to be opposed—to become one single unit working in harmony and coöperation toward the definite end of mutual advancement

Four chapters are devoted to the citation of the workings of the system as installed in industrial establishments, varying from velvet mills to iron foundries, and show that in all cases where it has been put into practice it has had the effect of increasing production and profits while at the same time it increased the financial return to the employees, eliminated the spirit of unrest and antagonism and substituted a feeling of mutual confidence, respect and good-will.

By no means the least of the virtues claimed for Industrial Democracy is that the practical application of its principles teaches the employee Americanism, helps him to understand his relation to his government, and in the case of the foreign-born worker it discourages the tendency to segregation that has become a serious menace to peace and prosperity.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Supply and Machinery Manufacturers' Association. They will hold a convention in Pittsburgh, Mar. 14-16. W. G. Clyde, general manager of sales for the Carnegie Steel Co. is general chairman.

American Society for Testing Materials. The 22nd annual meeting of the society will be held at Atlantic City, N. J. on June 24-27, 1919, with headquarters at the Hotel Traymore. Alfred D. Flinn, secretary, 29 West 39th St., New York.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, April 15, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, New York.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce Annual convention to be held at St. Louis Apr. 28, 29 and 30.

Western Society of Engineers, Chicago Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Grinding Attachment, Thread

Presto Machine Works, 124 Pearl St., Brooklyn, N. Y.

"American Machinist," March 13, 1919

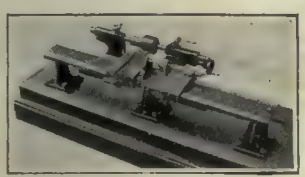


Intended to be attached to a bench lathe and its range on external work is up to 6 in. outside diameter and on internal work up to 4 in. in diameter. Is so arranged that the wheel is permanently located with relation to the center line of the work and adjustments for diameter and depth of cut do not disturb the original setting of the head. The wheel is dressed after being adjusted to the helix angle and the dresser can be swung out of the way when not in use. The spindle is mounted in a quill provided with adjustable bearings, the entire assembly of spindle, quill and bearings being easily removed from the machine. The bearings are bronze, tapered on the outside with a cylindrical hole for the spindle. The thrust is taken care of by a collar on the spindle which bears against a hardened-steel thrust washer.

Thread-Lead Testing Device

Arrow Tool Co., 200 Cannon St., Bridgeport, Conn.

"American Machinist," March 13, 1919

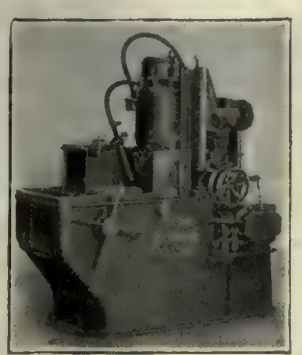


To use the device the gage to be tested is placed on the centers and tightened. One of the gaging points is then brought into contact with the gage, observation being made against a piece of white paper or other reflecting material laid on the base. After this adjustment is made the slide is clamped, and the measuring spindle of the micrometer head, which has been brought to some predetermined reading—say 0.100 in. is brought into contact with the raised hub, and slide is then clamped. The micrometer spindle is then turned back, the first gaging point is withdrawn and the second one advanced to contact with the thread. The gage under test must not be allowed to rotate on the centers. If any error exists it must be met by moving the slide along the slideway until the second gaging point is in contact. When this is done the variation from true lead is measured directly plus or minus with the micrometer.

Grinding Machine, Vertical Spindle Surface, No. 10.

Blanchard Machine Co., 64 State St., Cambridge, Mass.

"American Machinist," March 20, 1919



Capacity, work up to 18 in. in diameter and 6 in. high under a new wheel; work table, one-piece steel magnetic chuck, 16 in. in diameter. Wheel, 10 in. in diameter, 4 in. deep, with rim 1 in. thick; wheel speed, belted machine, 1800 r.p.m., direct motor-driven machine, 1740 r.p.m.; four chuck speeds, 10, 17, 29 and 50 r.p.m.; feed, hand or power, with variations in the power feed from 0.0002 to 0.004 in. per revolution of the chuck, in steps of 0.0002 in.; capacity of water tank, 52 gal.; pump, submerged centrifugal; floor space of direct motor-driven machine, 6 ft. 5 in. by 4 ft. 2 in.; floor space of countershaft-driven machine, 6 ft. 10 in. x 4 ft. 2 in.; weight of direct-driven machine, 6000 lb.; weight of countershaft-driven machine and equipment, 5800 lb.

Foot Warmer for Outdoor Service

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," March 20, 1919



Intended for the use of watchmen, gatemen, or other persons where it is necessary for them to stand for long intervals of time in one position in winter weather. The warmer is waterproof, and in order to supply the proper amount of heat for moderately cold, cold, or extremely cold weather, is provided with a three-heat control. A three-heat control snap switch is used to connect two equal circuits of 100 watts each in parallel, thus using 200 watts; 100 watts by using one circuit only, and 50 watts by connecting the two circuits in series. The resistance is of the slotted ribbon type distributed uniformly over the entire surface, the ribbons being assembled between two plates of built-up mica, 0.025 in. thick, cemented together to form a unit. The heat is of low temperature at all times in order to prevent the possibility of chilblains. The entire device is 14 in. wide, 20 in. long, and 2½ in. high.

Die-Forming Machine

Anderson Die Machine Co., Iranistan Ave., Bridgeport, Conn.

"American Machinist," March 13, 1919

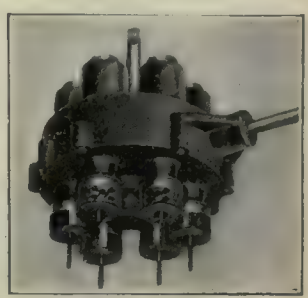


Capacity, cutter, $\frac{1}{16}$ to $\frac{5}{16}$ in. in diameter; thickness of dies worked, 1½ in.; working surface of table, 8 in. square; height from bench over all, 12 in.; main spindle, chrome nickel steel hardened and ground; main spindle bearing, S. K. F. radial ball; chuck, draw back, with maximum capacity of ¼ in.; weight of bench type with motor, 85 lb.; weight of floor type, with motor, 290 lb.; regular equipment consists of machine equipped with 110 or 220 volt alternating current, 60 cycle single phase motor, or 110 or 220 volt direct current motor with flexible cord attachment, plug and switch, portable tool rack, one set of 12 cutters, pivoted universal feed lever and necessary wrenches.

Tapping Attachment, Multiple Spindle

John H. Dorman & Son, 1-9 Bethune St., New York City

"American Machinist," March 13, 1919

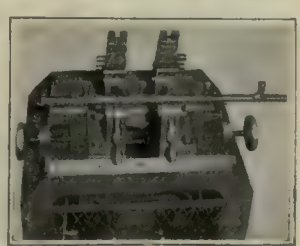


One of a line of multiple-spindle tapping attachments made by this concern. The particular device shown is for tapping six holes at one time in ⅜-in. sheet steel, 10-32 taps being used. The attachment is intended to be attached to the ordinary drilling machine by means of a taper shank and it is stated that it will tap from six to eight pieces per min. The case is made of aluminum in order to reduce the weight, and the spindles are gear driven.

Brazing Machine, Electric

Electric Brazing and Welding Co., 30 Church St., New York.

"American Machinist," March 20, 1919



For brazing parts by application of heat through the medium of electricity. The process is not in any sense welding, but the joint is secured by molten spelter in the same manner as in more common forms of brazing apparatus without the more or less undesirable accompanying effects due to gas or whatever heating medium is used. The machine weighs approximately 800 lb., is 28 x 38 in. and about 30 in. in height. It can be adapted to any commercial supply of alternating amount up to 440 volts and has a capacity of 8 to 10 kilowatts. It is stated that joints made by the process are very ductile and can be drawn. Joints can be made with copper to copper or steel, and with steel to steel.

Glue Pots, Electrically-Heated, Dry-Type

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," March 20, 1919



The advantages claimed for these pots over the old wet type with a water bath are that there is no water to evaporate and cause the heater to burn out or the glue to burn; the entire elimination of the necessity for the addition of water to the bath, and the consequent inconvenience and sloppiness; with the dry type it is possible to use a single-heat constant input heater, there being no need of having two heats, one for high and one for running; the dry glue pot is more efficient, as none of the energy is required to heat the water bath; and the dry-type heater also saves time, as there is no water bath to be heated. Designed to take the proper electrical input to maintain the glue at the correct working temperature, whether the glue is being used or not, and there is no danger of overheating. The time taken to heat the glue to working temperature is approximately 15 minutes. Made in three sizes, 1 pint, 1 quart, and 4 quarts, and the power used being 60, 80, and 140 watts respectively.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$34.60
Northern Basic	27.55	31.80
Southern Ohio No. 2	28.55	32.80
NEW YORK, Tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	36 15
Southern No. 2 (silicon 2.25 to 2.75)	34.70	39.95
BIRMINGHAM		
No. 2 Foundry	26.75	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	31.90*	36 15*
Virginia No. 2	33.25†	38.10†
Basic	29.65*	33.90*
Grey Forge	29.65*	33.90*
CHICAGO		
No. 2 Foundry Local	26.75	31.00
No. 2 Foundry Southern	33.00	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.25	31.00
Basic	25.75	30.00
Bessemer	29.35	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.04	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.04	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.14	3.37	4.10
Soft steel bands	4.07	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.39	3.67	4.45

* For ⅜-in. plates the extra is 30c. per 100 lb.

BAR IRON

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	.....	$3.50
Warehouse, New York	$4.17	4.70
Warehouse, Cleveland	3.22	3.98½
Warehouse, Chicago	3 37	4.10

STEEL SHEETS

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.62	6.22	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.52	6.12	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.47	6.07	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.42	6.02	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	5.37	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	5.27	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	5.17	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	7.42	7.57	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	7.12	7.27	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.97	7.12	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c per lb.

WELDING MATERIAL (SWEDISH)

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 1/12, 5/64, 3/32, 7/64, 1/8 No. 8, 5/32 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
5/32, No. 14 and 1/16		3/8 by 19 in. long	10.00
No. 18		1/2 by 21 in. long	10.00
No. 20		**Special Welding Wire, Coated**	
Domestic 20c. for 1/16, 15c. for 1/8 to 5/32.		1/8	33.00
		5/32	30.00
		1/4	38.00

MISCELLANEOUS STEEL

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.50	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.02	8.25	8.10
Floor plates	5.67	6.00	5.92

PIPE

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	50½%	24%	½ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	½ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.37½	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.20	5.10	7.75
Spelter	6.52½	6.85	7.75
ST. LOUIS			
Lead	4.95	4.80	7.10
Spelter	6.17½	6.50	7.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	24.50	32.50	26.00	36.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	28.50	22.00	33.50
Brass sheets	18.75	23.75–28	30.75	25.00	32.00	21.50	33.50
Brass pipe	28.00	34.00–37	36.50	33.00	38.00	31.00	38.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	41.50	48.50	39.00	40.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

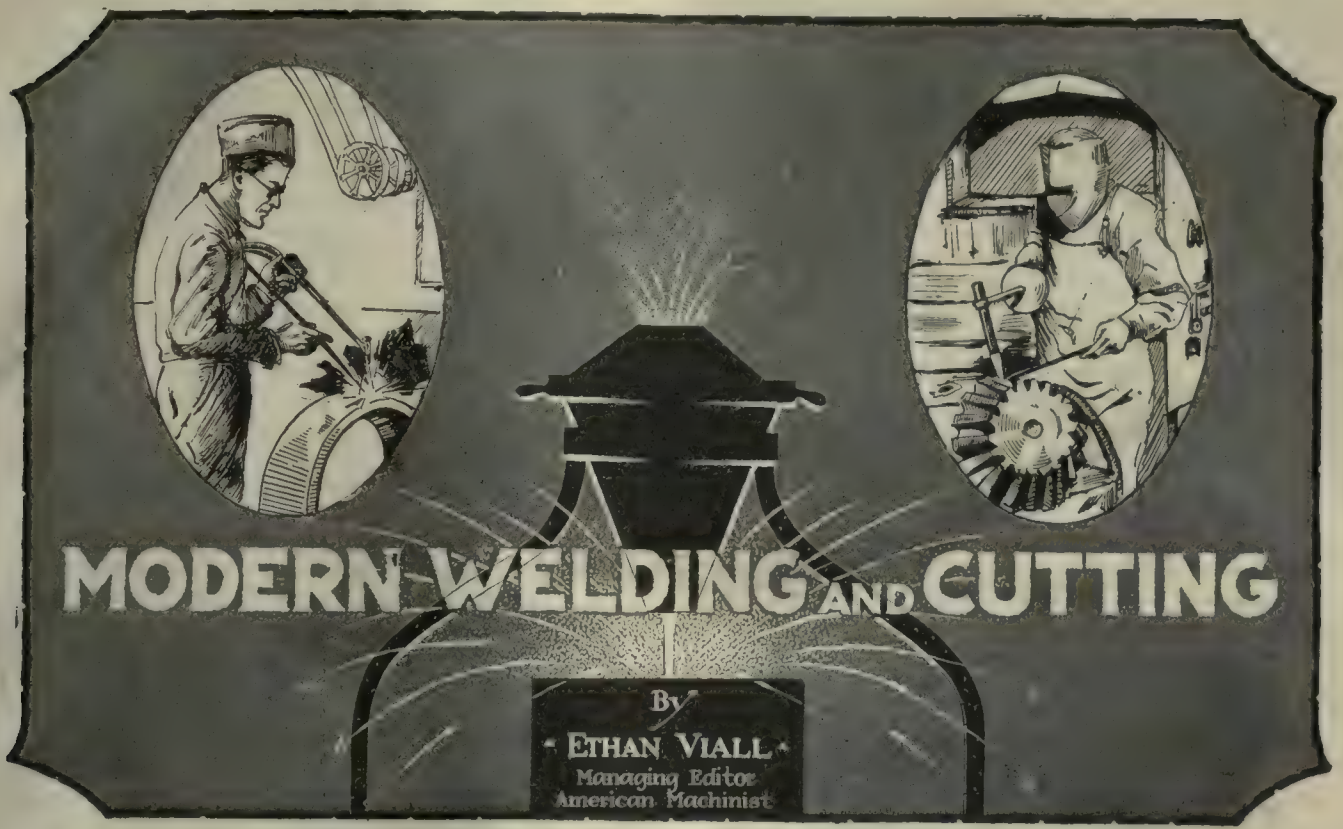
BRASS RODS

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras: 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	35.00

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VIII. History and Uses of the Gas Torch

This the first of the articles dealing with the use of the gas torch for welding and cutting. While the fields of the gas torch and thermit welding overlap in some places, in general, their limitations are pretty well defined. These limitations will be brought out clearly as the series unfolds. The present series dealing with gas torch work, is planned to cover the subject more comprehensively from the standpoint of the actual user, than anything that has ever been published.

ACCORDING to common usage, the term "autogenous welding" is eroneously applied only to hot gas flame fusion welds. The gas combinations used for the production of the hot flame for welding or cutting are oxy-acetylene, oxy-hydrogen, oxy-thermalene or any combination that will produce sufficient heat, and is applied by means of a torch or blow-pipe. The welds so produced are strictly fusion welds, as no pressure or hammering is employed to effect the union. The word "autogenous" means "self-produced" or "self-generated," that is, joined with the same metal, and as such applies equally to hot gas flame, electric arc or thermit welds, although as just stated, the present custom is to apply the term generally to hot gas flame welds. However, owing to the wide field that the term "autogenous" really covers, and to the looseness with which it is often applied, we prefer to use the term "gas torch" in connection with welding and cutting by means of the hot gas flame.

While the use of a blow-pipe or torch in some form was known to the ancients, the high temperature gas flame is a development of the last quarter of a century. The more commonly known gas combination is oxy-acetylene. Acetlyene (C_2H_2) was discovered by Edmund Davy in 1836, but it remained only a laboratory gas until T. L. Willson of North Carolina, and H. Moisson, the Frenchman, developed commercial methods of producing calcium carbide (CaC_2) in large quantities in 1891-92. In 1895 Le Chatelier read a paper before the Paris Academy of Sciences in which he stated that: "acetylene burned with an equal volume of oxygen gives a temperature which is 1000 deg. C. (1800 deg. F.) higher than the oxy-hydrogen flame. The products of the combustion are carbon monoxide and hydrogen, which are reducing agents." Further along he said: "this double property makes the use of acetylene in blow-pipes of very great value for the production of high temperatures in the laboratory." This statement of Le Chatelier is especially noteworthy, since he set the ratio of the gases at equal volumes, and not at the theoretical proportion of 2½ volumes of oxygen to 1 of acetylene.

The application of the oxy-acetylene gas torch to metallic welding dates experimentally from 1901, and industrially from 1903. Edmond Fouche, of Paris, who did considerable experimenting in conjunction with Picard, is generally credited with having devised the first really practical and safe torch. In February 1904 Fouche sent two of his torches to Eugene Bournonville, of New York, with which the latter repaired a machine that was still in use years later. The Fouche and Picard torch first developed, used both oxygen and acetylene under high pressure. There proved to be serious objections to this, and Fouche next produced the low pressure

or injector type of torch which employed only the oxygen under high pressure. Following these was the Gauthier-Ely positive pressure or medium-pressure type which used both gases under moderate and independent pressures. This type was later brought to the United States by Augustine Davis and Eugene Bournonville in 1906. During this year Bournonville designed the first acetylene pressure generator produced in connection with the oxy-acetylene process.

In 1905 and 1906 considerable welding work was done but the process was handicapped by the inadequacy and poor quality of the oxygen then obtainable, and also by the imperfect knowledge and technique necessary to good work. In 1902, Carl Linde patented in England a process for liquefying air and producing oxygen and nitrogen. In 1906 a plant for the production of oxygen by the Linde process was established in Buffalo, N. Y. From that time on, oxygen plants of various kinds have constantly increased in number and the commercial production of oxygen of good quality has been a great factor in the development of gas torch welding.

At first, operations were limited to the simplest repair work on iron or steel. As the apparatus was improved and the efficiency of the welders increased, the field widened. New uses have been found for the process and the range of metals coming within its scope has steadily expanded. It has its limitations, however, which will be pointed out elsewhere.

Used for Both Welding and Cutting

In addition to welding, the oxy-acetylene flame, as well as a number of others, is applicable to cutting. In fact so closely allied are welding and cutting in this field, that an operator is usually called upon to do both many times in a day's work. Cutting by means of an oxygen jet was first made commercially possible by Jottrand who took out his basic patent in 1905.

Aside from the manual operation of welding or cutting torches, a large number of machines have been designed. These range from simple wheel or radius attachments for the torch itself, to huge automatic pipe making machines or others of a complicated nature.

The oxy-acetylene flame consists of two parts, a small inner luminous "cone" which is bluish white in color, and a larger enveloping non-luminous flame. The temperature at the apex of the cone is estimated to be about 6300 deg. F. This heat is not surpassed by any burning gas with the possible exception of thermalene, for which 6500 deg. F. is claimed.

For welding purposes the high efficiency of acetylene is due to its high carbon content and to the fact that it is endothermic, that is to say, heat-absorbing in its formation. Energy stored up in formation is given off again in the form of heat by the acetylene upon dissociation. It is calculated that of 1475 heat units in a cubic foot, 227 are due to the mere breaking up of the gas. While theoretically two and one half volumes of oxygen are needed to completely burn one volume of acetylene, the ratio in which the gases are employed in practice is about one volume of oxygen to one volume of acetylene. The flame yielded by such a mixture is the correct one, or the so-called "neutral" flame. By increasing or decreasing the proportion of oxygen, flames known as either oxidizing or reducing may be obtained, the appearance of the cone changing as the proportions are modified.

While the use of oxy-acetylene for welding is more commonly known than any other combination, there are several gases, which when mixed with oxygen, will produce more or less satisfactory welds. Some of them are to be preferred to acetylene for certain cutting purposes. The better known gases are described as follows, it being understood that they are to be used with oxygen.

Hydrogen gas is a chemical element which exists in nature in great quantities in various chemical combinations. The most common is its union with oxygen to form water (H_2O). As a consequence, water is used as a basis for making both oxygen and hydrogen. Oxy-hydrogen welding was the first gas torch welding system employed, and it was used quite extensively until the introduction of the more advantageous system of welding with oxy-acetylene. While hydrogen may be manufactured on the premises, it is also handled commercially in steel cylinders. In using this flame for welding there is an existing danger that the oxygen may unite with the metal causing it to be overheated or burnt. To prevent the burning of the metal, it becomes necessary to use a supercharge of hydrogen so that oxygen liberated within the flame will combine with the free hydrogen instead of with the metal. This, however, increases the size and decreases the temperature of the flame. The temperature of the oxy-hydrogen flame according to Kautny, can never go higher than the dissociation temperature of water, which is estimated at 2000 deg. C (3632 F.). For welding thin metal sheets hydrogen is practical on account of its comparatively low heat. The quality of the weld, however, decreases as the thickness of the metal increases. While theoretically only two volumes of hydrogen are required to one of oxygen, in actual practice when employing an oxy-hydrogen torch, it is necessary to use four or five volumes of hydrogen to one of oxygen in order to insure a non-oxidizing flame. This in itself is a wasteful process, since the maximum heat obtained is limited to the amount produced by combining two volumes of hydrogen to one of oxygen. For heavy cutting it is preferred to acetylene on account of its longer flame. It is also used extensively for lead burning, preheating, soldering, brazing, annealing, special forging or rivet heating and a number of other things.

Thermalene is one of the latest gases to be produced. It is the discovery of Linus Wolf, Zurich, Switzerland, and it is handled in this country by the Thermalene Co., Chicago Heights, Ill. It is a combination produced by the decomposition of calcium carbide and hydrocarbon oils, the heat generated by the carbide being used to vaporize the oil. It is used for either welding or cutting.

Blaugas is a liquid under pressure. It is the discovery of Herman Blau and it is made from gas oil, a product of the oil refineries. It probably has the lowest explosive range of any gas used for illuminating purposes, the range being about 4% while that of coal gas is about 13%. Like coal gas however, it is little used for welding, though sometimes used for cutting. Blaugas is marketed in steel cylinders having the equivalent of 1300 cu.ft. of city gas, by the American Blaugas Corp., New York. Its largest field is for cooking and lighting purposes where coal gas is not readily obtainable. Owing to its portability it may be used to advantage for preheating work.

Drigas is a light oil gas, which is a vapor under pressure. It is sold in steel cyclinders of about 150 cu.ft. by the same concern handling blaugas. It is

especially good in combination with oxygen for cutting metal from 1 to 12 in. thick, and is also considerably used for preheating. Its explosive range is about ⅓ that of coal gas, and it is non-poisonous and non-asphyxiating.

ILLUMINATING GAS (coal gas or water gas) can only be used for welding very thin pieces owing to the low temperature of the flame. It may however, be used for preheating or cutting.

BENZINE OR BENZOL VAPORS have the same properties, approximately, as blaugas. The temperature is a little higher than that of illuminating gas, but much lower than acetylene. It is only used for welding under special circumstances.

While a number of gases, which are used with oxygen, have been mentioned, only the production and use of hydrogen, acetylene and thermalene will be described, along with that of oxygen.

EXPLOSIVE LIMITS OF WELDING GASES

In order to be explosive, a combustible gas or vapor must be mixed with a certain amount of oxygen or air, the proportions of the mixture ranging between certain limits depending on the character of the fuel. Any figures showing these explosive limits of the gases can only be approximate at best, since so many things enter into the calculations, such as the purity of the gas, means of ignition, temperature, pressure, and so on. In general, the mixture that has just enough oxygen for complete combustion of the fuel gives the highest pressures and temperatures, and very nearly the highest speed of ignition. If the proportion of oxygen (air) is increased beyond, or decreased from, the theoretical proportion, the maximum pressures and temperatures are lowered and the speed of ignition decreases until at certain upper and lower limits the mixture ceases to be explosive, and only slow combustion can occur.

The figures here given are believed to be a fair average of those given by the various authorities. The explosion is supposed to be caused by an electric spark, at atmospheric pressure and a temperature of about 65 deg. F.

ACETYLENE—3 per cent. gas plus 97 per cent. air to 55 per cent. gas plus 45 per cent. air, or a range of 52 per cent. (one writer says 73 per cent. gas plus 27 per cent. air.)

BLAUGAS—4 per cent. gas plus 96 per cent. air to 8 per cent. gas plus 92 per cent. air, or a range of 4 per cent.

COAL GAS—6.5 per cent. gas plus 93.5 per cent. to 19.5 per cent. gas plus 80.5 per cent. air, or a range of 13 per cent.

DRIGAS—4 per cent. gas plus 96 per cent. air to 8 per cent. gas plus 92 per cent. air, or a range of 4 per cent.

HYDROGEN—10 per cent. gas plus 90 per cent. air to 66 per cent. gas plus 34 per cent. air, or a range of 56 per cent. (one writer says 6 per cent. plus 94 per cent. to 72 per cent. plus 28 per cent.)

THERMALENE—12 per cent. gas plus 88 per cent. air to 30 per cent. gas plus 70 per cent. air, or a range of 18 per cent.

The ignition temperatures of some of the gases, at atmospheric pressure are: Acetylene, 760 to 820 deg. F.; city gas, 1100 deg. F.; hydrogen, 1075 to 1100 deg. F.

According to McCormack, the cu.ft. per pound of gases was calculated for the specific gravity and found to be: Acetylene, 14.8 cu.ft.; coal gas, 24.3 cu.ft.; hydrogen, 192.4 cu.ft.; thermalene, 13.97 cu.ft.

THE FIELD OF GAS TORCH WELDING AND CUTTING

In a general way, the field of the gas torch welding and cutting may be outlined as follows, though some of the applications enumerated are more advantageously done by other methods. This is especially true with reference to the welding of heavy sections which should, as a rule, be done with thermit.

AEROPLANE CONSTRUCTION.—Welding water jackets to cylinder, valve cages to cylinder, of manifolds (intake, exhaust, and cooling), flanges to the manifold connections, spark plug thimbles, tubular sections for frame, splice plates, sockets to frames, aluminum crank cases, water tank.

AUTOMOBILE INDUSTRY.—Welding rear axle housings, defective gears and pinions, manifolds, shafts, steering posts, automobile bodies (aluminum and steel), tubing used in wind shields, etc., crank cases, transmission cases, wheels which are made of stamped-out parts, mufflers, valve stems to valves, rims, repairing crank shafts, frames, extending frame to make a truck out of a car.

COPPER PLATE.—Welding manifolds, flats, kettles, vats, tanks, copper, stills, and chemical ware.

ELECTRIC RAILWAY.—Welding of bonds, worn boxes, motor housings, building in teeth of defective pinions and gears, reclaiming of broken trucks, welding air receivers on air-brake system, steel trolley wires, side frames.

FORGE SHOP.—Welding ornamental iron, complicated parts.

FOUNDRIES.—Steel foundry: Welding up of blowholes, porous spots, blocks, cutting of risers, gates and heads; welding moldings which are cast in parts. Cast iron foundry: Reclaiming castings.

LEAD BURNING.—Burning of connectors on storage batteries, battery repairs, lead linings in vats, tanks, etc., lead-pipe joints.

PIPING AND GAS MAIN WORK.—Welding of steam, air, gas, oil, and water lines, welding for high pressure gas distribution, ammonia systems. Fittings, such as T's, Y's, S's, crosses, which are cut and welded on the job, meter connections for houses, traps, drip pots.

PLATE WELDING.—Ammonia receivers, generators, air receivers, tanks for oil, vacuum driers, digesters, vats, steam driers, tanks of all kinds which are to be subjected to heat and pressure, plate assembly work for gas manufacture by-products, recovery work, stills.

POWER PLANT MAINTENANCE.—Building up worn or broken parts, welding of cylinders, pistons, valve chests, etc. Welding of steam lines, of pump castings broken in service. Repairing of flywheels.

RAILROAD REPAIR.—Firebox repairs (including patches), replacing side sheets, welding in flues, cutting off rails, mud rings, welding cracked steam chest, valves, crossheads, cylinders, building up worn pins, cutting out links, irregular shapes of steel, filling worn spots on wheels, welding spokes, cutting and welding up locomotive frames. Welding together parts of car seats, chair and window frames. Reclaiming bolsters, couplings, slotting forged engine rods; building up frogs and diamond crossings, scrappings, building steel cars.

ROLLING MILL.—General repair of engines, rolls, hot beds, plates, furnace equipment, fabricating open-hearth water jacket doors, reclaiming copper tuyeres, cutting up lost heats, cutting up "kindling" or scrap, bar stock billets, plates.

SHEET METAL.—Manufacture of metallic furniture, steel barrels, transformer cases, range boilers, kitchen utensils, light air tanks, tubing, oil storage tanks.

SHIPYARDS.—Cutting of plates, channels, special sections, welding and reclaiming of broken parts of machinery and propellers, patching of hulls, stringers, building up of worn chocks.

SMALL ARMS MANUFACTURE.—Reclaiming component parts, spot hardening of different parts.

STRUCTURAL STEEL.—Cutting as applied to coping, splicing and fitting rails, channels, I beams and other shapes. Cutting holes for rivets, welding up misdrilled holes, cutting of all kinds of gusset splice plates, cutting wrecking, welding structural parts where riveting is not possible.

THE PRODUCTION OF WELDING GASES

Oxygen is a gas which constitutes about 23% by weight and 21% by volume of the air we breathe, most of the other percentage being nitrogen, a gas which does not support combustion. Oxygen itself will not burn, but it is the greatest supporter of combustion known. It was probably discovered by Stephen Hales in 1727, though Priestly was the first to publish a description of it in 1774. The name "oxygen" was later applied to the gas by Lavoisier. Pure oxygen is colorless, odorless

and tasteless. For welding work it is important that the oxygen used be as pure as it is commercially possible to obtain it. The impurities which decrease its efficiency are usually hydrogen and nitrogen.

There are three ways to produce oxygen commercially; by means of liquid air, by chemicals and by the electrolytic process. When oxygen is made by the liquid air process, there is a certain amount of nitrogen present. In the chemical methods, a number of impurities may cause trouble. By the electrolytic process, the impurity is hydrogen.

Oxygen by the Liquid Air Process

As a general rule, taking everything into consideration, it is far better for the average or small user to buy his oxygen from a reliable concern and not try to manufacture it himself. The oldest concern in this country making oxygen by the liquid air process, is the Linde Air Products Co., with offices in New York City. Their cylinders are regularly furnished in two sizes of 100 and 200 cu.ft. capacity respectively. They are charged to a pressure of 1800 lb. at a temperature of 70 deg. F. Customers are furnished cylinders free

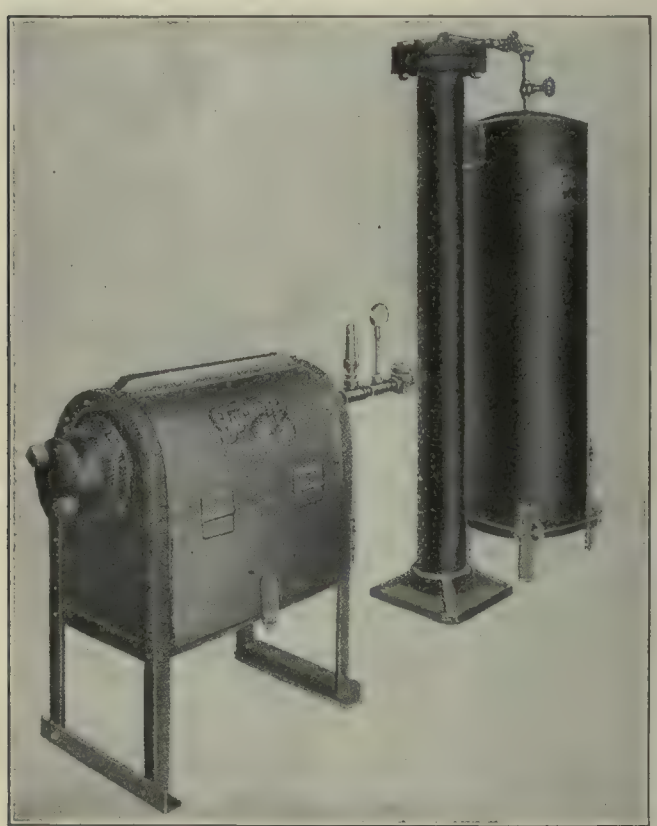


FIG. 86. THE BUCKEYE CHEMICAL OXYGEN GENERATING SET

and pay only for the oxygen. Empty loaned cylinders are exchangeable for filled ones at stations in practically every city of fair size in the country. A 50 ft. size of cylinder is obtainable for those whose requirements are very limited. A number of other concerns supply electrolytic oxygen for the market, the 100 cu.ft. cylinders being about 8½ in. in diameter and 48 in. high, weighing approximately 122 lb. when filled. The average purity of oxygen in cylinders is about 99%.

Since the production of oxygen by the liquid air process is only applicable to large installations any detailed description of the method would be out of place here. It is sufficient to say that in general, the process consists of first reducing the air to liquid form by means of the combined action of high compression and low temperature, and then separating the oxygen and nitrogen of which it is composed, by taking advantage of the different boiling points of the two. Under atmospheric pressure the boiling point of very pure liquid oxygen is —182.7 deg. C. (—296.9 deg. F.) and of very pure nitrogen—195.5 deg. C. (—319.9 deg. F.) This means a difference in the boiling points of 12.8 deg. C., or 23 deg. F. These respective boiling points will, of course, vary under different pressures, and various degrees of purity, but the difference between the two is sufficient to allow of the nitrogen being vaporized in suitable apparatus and carried away before the oxygen vaporizes.

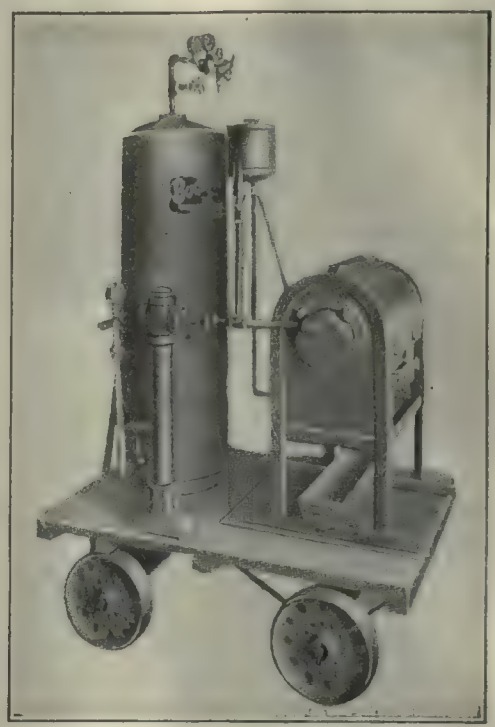


FIG. 87. BUCKEYE OXYGEN GENERATOR MOUNTED ON A TRUCK

Where circumstances make the chemical production of oxygen advisable, the chlorate of potash method is probably the most satisfactory at the present time. In this process chlorate of potash ($KClO_3$) and manganese dioxide (MnO_2) are mixed together in the proportion of 100 to 13 parts (about 8 to 1). This mixture is placed in a retort filled as full as possible to exclude air. The retort is then heated and the oxygen is driven off. As the oxygen gas passes off from the retort it is conveyed through a cylinder or vessel containing sodium hydroxide (NaOH) which removes most of the impurities. The oxygen is then piped to a gasometer from which it may be used direct or pumped into cylinders. A pound of the mixture is said to produce about 4 or 4½ cu.ft. of oxygen. The manganese dioxide is simply used to retard the release of the oxygen, which otherwise would be too rapid.

An oxygen generator working on the general principles just outlined, is made by the Macleod Co., Cincinnati, Ohio. This firm makes both a stationary and a portable type. A stationary type is shown in Fig. 86 and a portable one in Fig. 87. The generator, which consists of a furnace with retort, a scrubber for hold-

ing the purifying solution, and a receiver for the gas, is quite convenient for small shops or garages where a limited amount of oxygen is used. It is quite possible, however, to fill tanks from these generators for storage purposes and immediate use if needed. An oxygen generator may be used in conjunction with a cylinder of dissolved acetylene, or with a separate acetylene generator. Where portable generators are used for both oxygen and acetylene, it is advisable to have the outfits on separate trucks so as to decrease danger should any leaks develop.

The Buckeye generator is so made that it is adaptable to the use of wood, coal, coke or charcoal for fuel, or can be fitted with gas, gasoline, alcohol or oil burners. The portable type is shown fitted with a gasoline burner. The generators are tested to 2½ times the maximum working pressure of 300 lb. Safety devices are provided so that it is safe for practically unskilled tenders. These generators are made in three sizes, with a capacity of 40, 60 and 100 cu.ft. of oxygen per hour. The weight of the portable type will range around 650 lb. and of the larger stationary type about 1600 lb.

Improved Packing Methods for Carburizing

By WILLIAM H. ADDIS

Many times in carburizing operations small parts come out partly or imperfectly hardened, principally due to faulty spacing in packing. Two good methods of quickly spacing pieces are here described.

ONE of the most expensive factors in the carburizing of large quantities of small steel parts is that of packing the pieces to be carburized in pots filled with the carburizing compound. This class of work is generally done by girls. It is strictly an honor task, for after a pot is packed with parts and compound, there is no way to determine how thorough the packer's work has been without destroying her

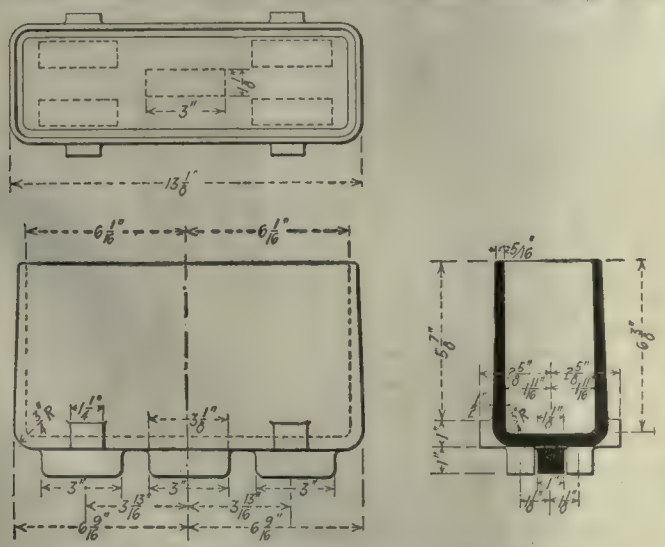


FIG. 1. A GOOD DESIGN OF CARBURIZING POT

labor by dumping the pot's contents. For this reason piecework has never proved very successful, as there is a tendency to slight the careful uniform placing of each part in order to show a large number of pots packed.

Carburizing in pots is accomplished by using a cast-iron pot, preferably the hard white iron of the malleable grade before annealing. This casting does not scale away, swell and break down under continual firing and cooling, as does the gray-iron casting. A very good design of pot is shown in Fig. 1. This type is provided with base lugs on the bottom, which permit an even distribution of heat under the pot, and also having sturdy side lugs which serve the double purpose of keeping the pots spaced a uniform distance apart, and providing a suitable grip for the pot fork which is used in removing them from the furnace. These pots should be provided in standard sizes to suit the work in hand.

The carburizing compound, which is made up of a proper blend of charcoal, petroleum coke, barium carbonate, soda ash and ground bone, properly granulated, is sprinkled in the bottom of the pot to a depth of at least ½ in., and then the work is uniformly spaced, leaving room enough between each part for a portion of the compound. If the parts are permitted to touch in packing, the result will be either a burning of the parts at the point of contact or a failure to carburize, and sometimes both occur.

For the same reason the work should be kept ½ in. or more, according to size, from the sides and ends of the pot. Having placed the bottom layer of work in the pot it should in turn be covered with compound and the

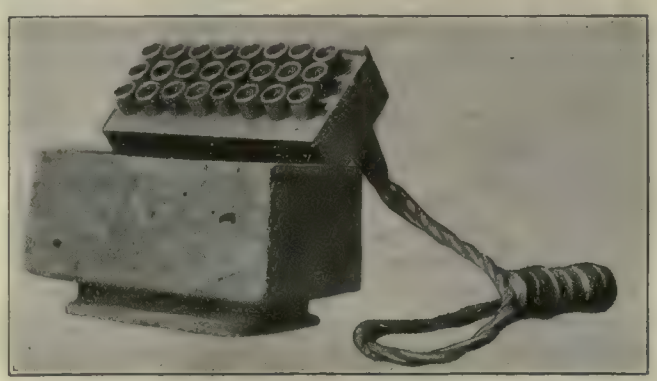


FIG. 2. MAGNETIC PACKING PLATE

process of alternating work and compound be continued until the pot is filled within 1 in. of the top. The top layer of work must be covered with a generous layer of carburizer to prevent the shrinking of the pot contents when heated to a carburizing temperature of 1650 degrees F. as some compounds shrink so much that the top layer of work will be left exposed. After placing the top layer of carburizer the pot is ready to be sealed.

In order to appreciate the importance of the simple operation of pot sealing we must consider the carburizing operation. After packing and sealing the pot it

is placed in the furnace and heated to a temperature approximating 1550-1700 deg. F. Within this range of temperature the outer surface of the steel parts in the pot have become so porous that the carbonaceous gases evolved within the sealed pot penetrate the steel. It is the degree of penetration that determines the depth of case. If the pot was improperly sealed and 20 per cent. of the gases evolved in the pot escaped there would be

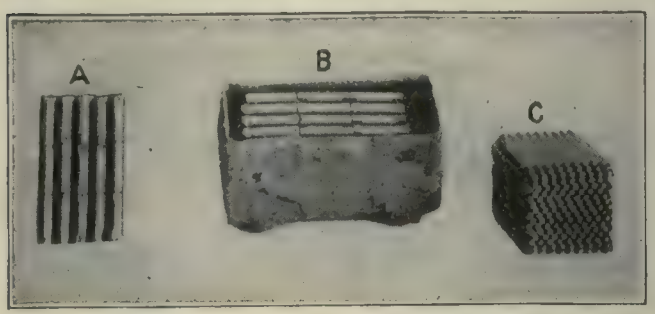


FIG. 3. CORRUGATED PAPER SPACERS

an evident loss in the efficiency of the carburizing agent and a corresponding lack of uniformity in the carburized work. . . . The most efficient seal that the writer has ever observed consists in placing on the top of the packed pot a ½-in. steel plate of such dimension that it will just fit inside the pot; the pot is then sealed by luting with a mixture of 1 lb. of coarse salt to 10 lb. of good fire clay generously applied. . . .

Improved Methods

It will readily be seen from the above detailed description of the ordinary methods of pot packing that there is an opportunity for improvement in the handling of large quantities of like pieces. One of the first ideas to be developed by the writer was the magnetic packing plate shown in Fig. 2. This chuck is so designed that the packer quickly spaces the parts to be packed on the plate; then by use of a foot switch energizes the magnet and places the work in the pot, pressing it firmly into its bed of compound, and, releasing the magnet, has packed a whole pot layer with one motion of the hands. This method makes for speed and uniformity of spacing.

Another novel and highly efficient way of packing small pins and cylindrical parts is illustrated in Fig. 3. Here small corrugated paper plates are used to provide the speedy alignment of parts. This paper is known commercially as single-faced corrugated. It may be purchased cut to inside pot dimensions from paper-box factories. At *A* is shown a paper plate containing 15 pins ½ in. in diameter and 2½ in. in length. Notice their regular spacing. At *B* is shown a like plate of pins in the pot ready for packing, while at *C* is pictured 17 plates packed with work and stacked until such a time as it will be convenient to place them in the pots. Again the uniformity of spacing is shown by the projecting ends of the pins. With the use of corrugated paper plates there is a doubling of packing-room production and a great improvement in the quality and uniformity of the work.

Both of these methods described here have the advantage of making the packer's work a lighter task, while they guarantee a uniformity of spacing and packing that makes it possible to place this class of work on a piecework basis by removing the only objection thereto—that of wilful neglect to properly fill and space the pots.

Reducing the Labor Turnover

By George E. Kuhne

In looking over his records, the employment manager finds there is a vacancy in the press department and, although the applicant for a job has had no previous experience in the line of press work, he is accepted and is assigned to a foot press. About 3 p.m. the foreman notices that the new operator is lagging, yet his work is all right. Next day the same thing happens, but the operator is a bit slower than before and the foreman mentions it to him. After lunch the operator says he would like to go home, explaining that he is not well. Permission is granted and that is the last seen of him. Another inexperienced man is hired, with a similar result.

Now the question arises as to what is the difficulty in the press department. The foreman intimates that the wrong men are being selected for the work; this entails strained relations between the employment manager and the foreman. The latter is a good fellow, conscientious, and a hard worker, but he does not realize that other things, seemingly insignificant, would prove to be of value if he would use them properly. When an inexperienced man is hired, it is a good plan for the foreman to explain to him the little aches and pains that are very usually attendant upon the beginner in such work.

An Instance Cited

In order to illustrate the value of such a procedure I will cite an instance of one week ago. A girl was assigned to a hand-milling machine, the job requiring the usual operations in the matter of manipulating levers and clamping the work. She was an experienced employee on other work, but on the second day I was notified that she desired a change of jobs or permission to go home, as she was not feeling well enough to continue. Investigation disclosed the fact that she had pains in the arms and shoulders, but when I explained that they were most likely due to the manipulation of levers, etc., to which she was unaccustomed and that a consultation with a doctor was in all probability not required, she consented to remain. A little later she said, "I guess you were right; the pains have all gone. I'll stay." She remained on the job for some days after that, apparently contented with her work and making no further complaint.

Such small matters as stated require little effort, and will oftentimes be of value in maintaining standards of production as well as preventing the loss of desirable help. It matters not what the duties are; it is well for each foreman to study the conditions under which they are performed and familiarize himself with their effect upon an inexperienced person. Thus he will put himself in a position to offer sympathy and advice at the right moment, and thereby hold an employee that he might otherwise lose. When a man is fatigued, he is literally "not himself"; his best efforts are not exerted, his "control ability" is lowered far more quickly than his ability to become angry, and he does not see things in the proper light.



Making Gun Sights for Anti-aircraft Guns

By Fred H. Colvin

The special fixtures used in connection with the main parts of these gun sights are full of suggestions for other purposes. They show the adaptability of the good mechanic, as without previous experience they made gun sights which not only passed all inspection, but were also made in record time.

WHEN it is considered how quickly the anti-aircraft gun must be handled in order to aim accurately at enemy aircraft, it is natural that the sighting mechanism must be very delicate and more or less complicated, as well as being capable of quick handling in various directions. Some idea of the problems involved in the manufacture of these sights may be had from a study of Fig. 1, which shows how universal the various movements must be. This is perhaps one of the most completely universal movements of any piece of mechanism of its size, and it involves an ingenious combination of slides and trunnions, as can be seen. Needless to say it requires very accurate work to bring these slides and trunnions into proper alignment to obtain the necessary movement in all directions. The sighting mechanism consists primarily of the yoke *A*, which is attached to the recoil cylinder at *B*. This allows the sight to be swung up and down on the gun by means of the curved rack *C*. This movement is governed by a worm-actuated pinion in the case *D*.

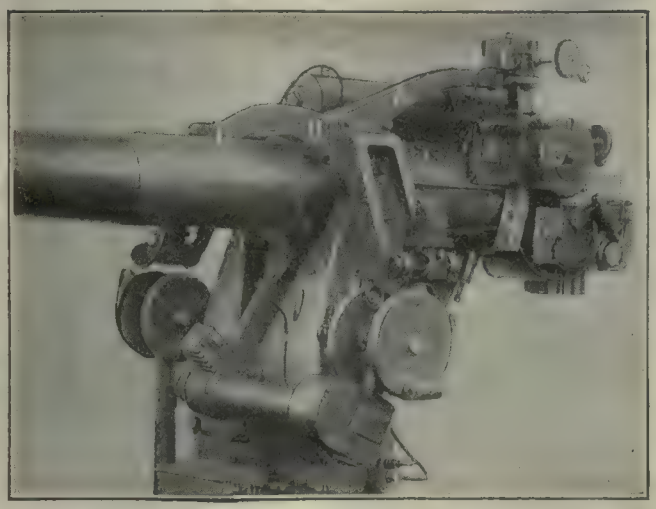


FIG. 1. THE SIGHT IN PLACE ON THE GUN

Cross-movement to allow for windage is had by a similar mechanism at *E*. In order to allow both these movements the connection between the yoke and the recoil cylinder is of special interest, being a combined slide and trunnion on one end and a hinged trunnion at the other. This is shown more in detail in Fig. 7 and 8. The main portion of the sight is the yoke, which is a steel casting, as shown in the foreground of Fig. 2. A similar yoke and a pile of these waiting to be laid out are shown on the other surface plate and on the floor behind it. The casting is painted with a cold-water paint to leave a

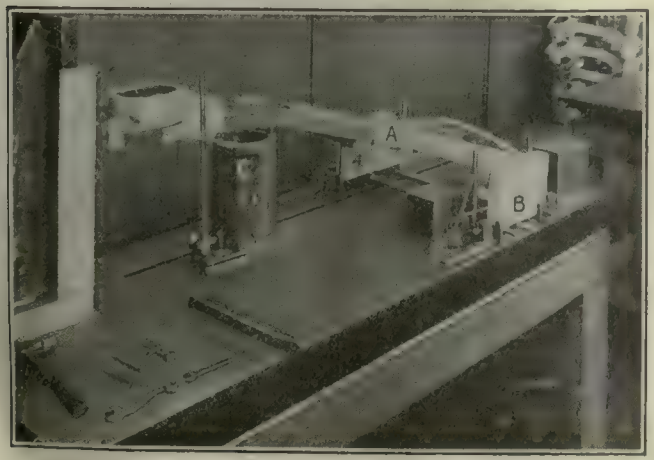


FIG. 2. LAYOUT BENCH ON THE YOKE



FIG. 3. PLANING BOTTOM OF PADS

good surface for scribing the various lines and locating the different points. The yoke is supported on the surface plate in its proper position, as shown at *A*, the seat, or pads, being located by means of the setscrews and block shown at *B*. The upper end is supported on the jack *C*, this being simply a cast-iron cylinder supplied with four setscrews and check nuts, which are easily handled. The first step is to see if the castings will clean up in all directions, there being a tendency for them to warp after coming out of the mold, in which case they are simply heated and straightened in much the same manner as malleable-iron castings. They are then laid out at the various points by means of surface gages, distance blocks and other devices. The first machining operation is to plane the bottom of the seat, or pads, to obtain a working surface for the operations which follow. The fixture in which this is done and the way in which the yoke is held are clearly shown in Fig. 3.

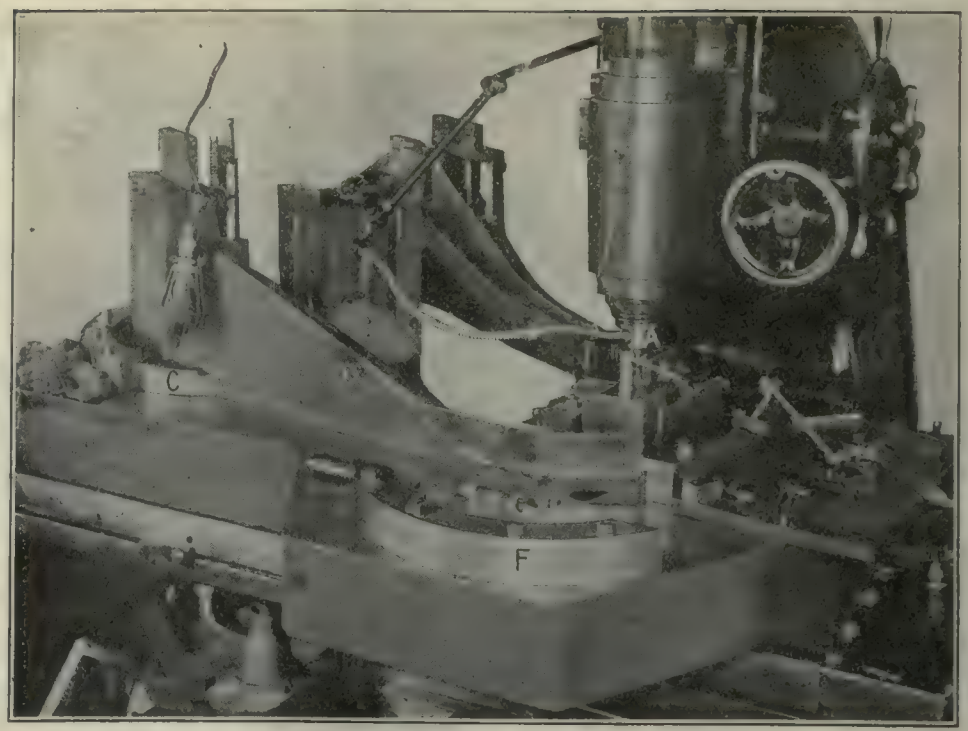


FIG. 5. A DOUBLE-RADIUS MILLING FIXTURE

The second planing operation is shown in Fig. 4, and is a double fixture in which the yokes are located on the steel strips at *A* and clamped at *B*, while the upper ends are held in position by the jaws and setscrews shown. The fixture makes it comparatively easy to handle these rather awkwardly shaped pieces, and they are machined in good time by means of the tools shown.

A Double Arc-Milling Fixture

The next specially interesting operation is that of milling the two arcs, one in the head and the other at the face of the yoke. These operations are performed in the fixture shown in Fig. 5. This fixture holds the yoke in the proper position by means of suitable clamps. In the position shown the long radius arc in the head is being milled at *A*, the body of the fixture *B* swinging from a fulcrum under the arc *C*. This portion of the fixture has a central pin, or fulcrum, and is also held in place and guided by the curved piece *D*.

For milling the other end, as may be seen at *E*, the fixture carrying the work is moved so that the arc *C* comes under the holding piece *F* and the center pin drops into the hole *G*. With the fixture in this position suitable milling cutters easily mill out the proper radius at *E*.

Details of this double fixture are given in Fig. 6, which shows the construction of the fixture and how the center pin gives the proper radius for the two arcs. These arcs must be very accurate, as the sights must move easily without either bind or shake. In order to be sure that this condition has been obtained the yokes are carefully tested in two positions. Fig. 7 shows the testing table for the long radius arc, the block *A* being substituted for the lugs on the recoil cylinder which hold the yoke in place on the gun. The yoke swings at *B* with relation to the block *A*, the arc at *C* allowing movement in a horizontal direction. The testing of the

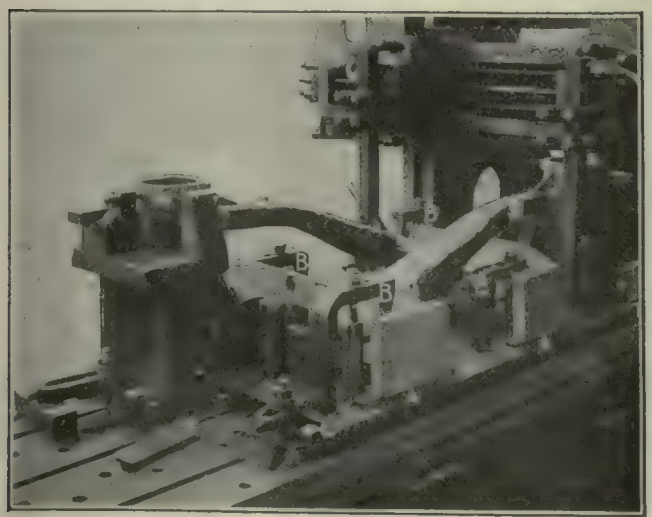


FIG. 4. A DOUBLE-PLANING FIXTURE

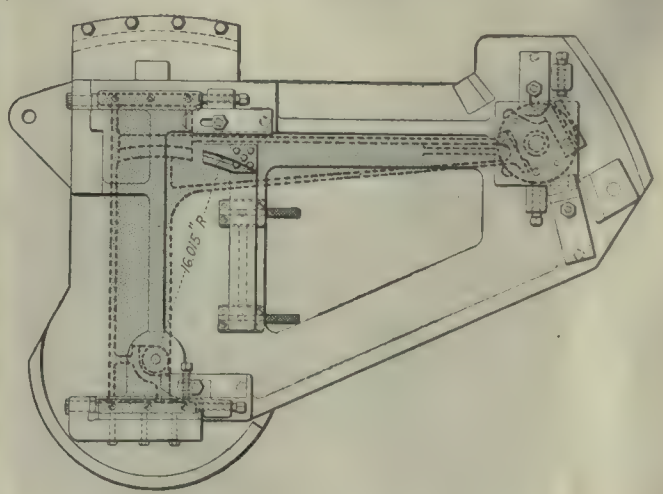


FIG. 6. DETAILS OF THE MILLING FIXTURE

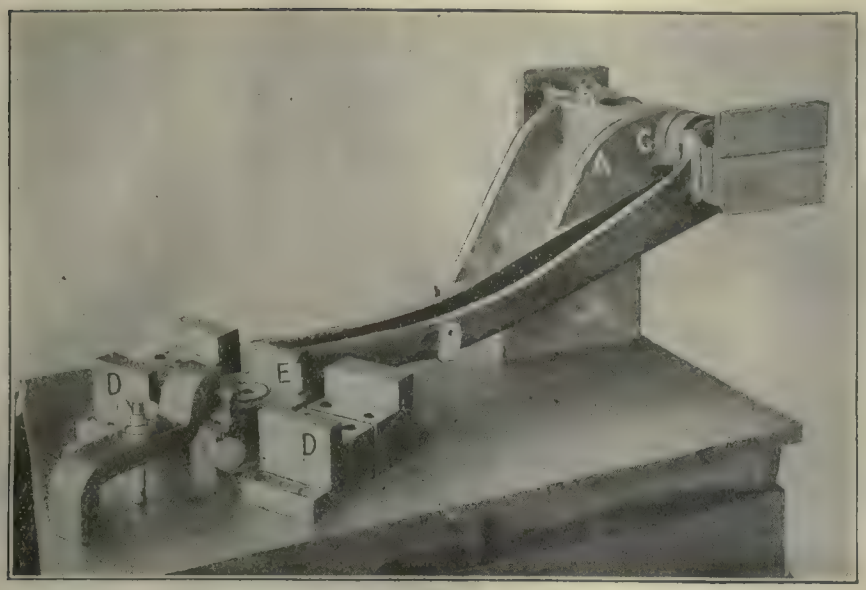


FIG. 7. TESTING THE LONG-ARM RADIUS

arc in the head is done by means of a templet or gage that is of the correct radius and which fits into the blocks *D* also of the proper radius. With the yoke clamped in the position shown, the curved block is moved through the hardened guide *D*, and it must show a good bearing in the curved end of the yoke at *E*. cuts the piece on the outside of the arc at *A* in Fig. 9, although the work shown in position in Fig. 10 is on the inside of the guided past the milling cutters by means of the arc *C* and also a similar arc *D* at the front of the fixture. This can be used with either hand or power feed, the handle *E* being used in the former case. For power feed it is only necessary to connect up the geared shaft *F* shown at the other end of the table.

Another operation is the cutting of curved racks, which is done by a special fixture on a Fellows gear-shaping machine as shown in Fig. 10. This fixture

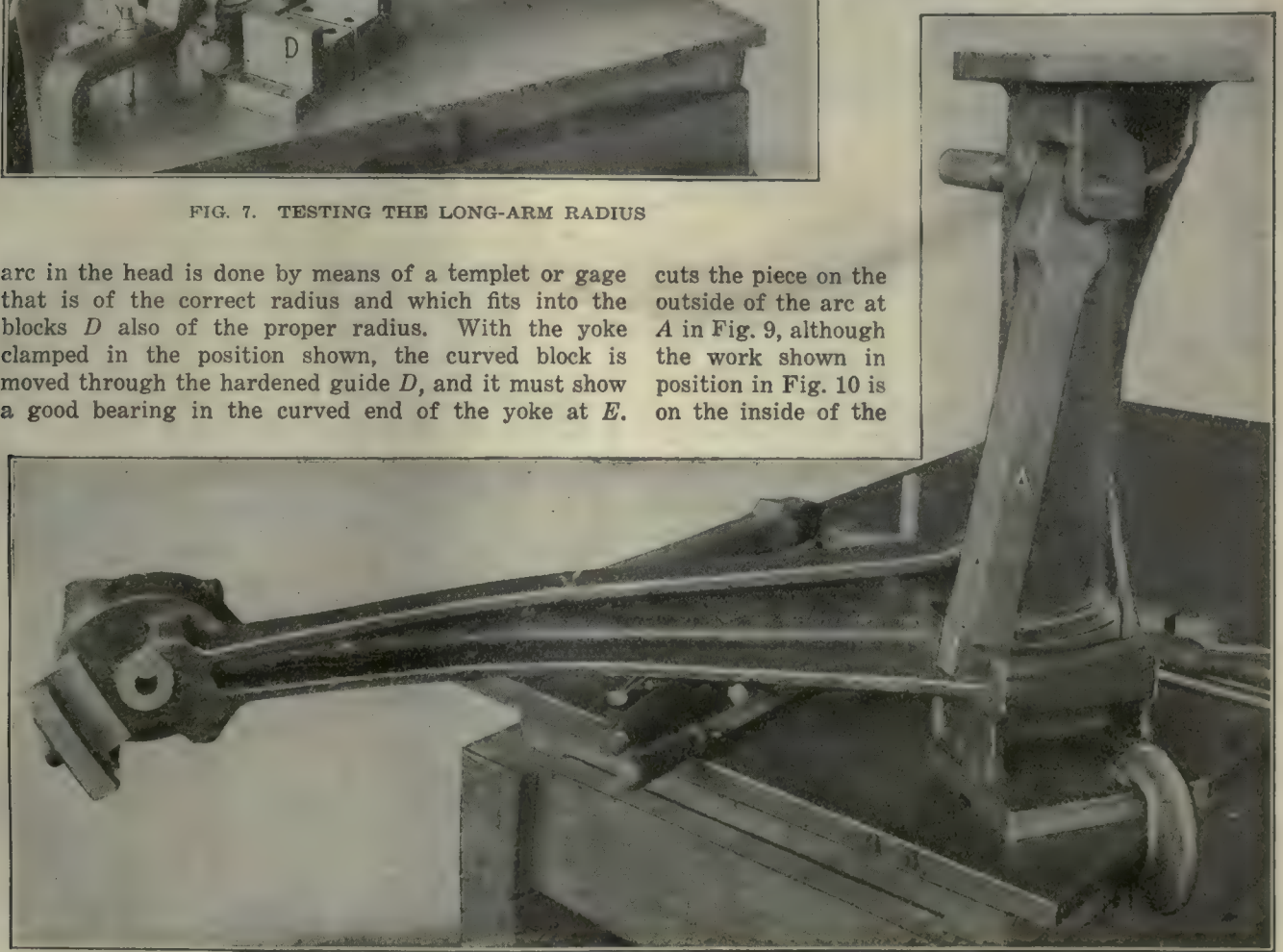


FIG. 8. TESTING THE CROSS-ARM RADIUS

Final fitting in this is done by an expert scraper, so as to get the exact fit desired.

A similar method is shown in Fig. 8, where the other arc is being tested by means of the bar *A*. Here also is shown the care that must be exercised in obtaining the proper fit besides giving another view of the yoke and emphasizing its awkward shape.

The Sight Bar

Another piece in connection with the sighting mechanism is the sight bar, one of them being shown at *A*, Fig. 9. These are steel forgings, as may be seen, and are also rather awkward in shape. The operation shown is the surfacing and shaping of the curved base *B*, while the forging is held in the special fixture shown on the milling machine. The illustration needs little explanation, as it may readily be seen how the work is



FIG. 9. A CURVED MILLING FIXTURE

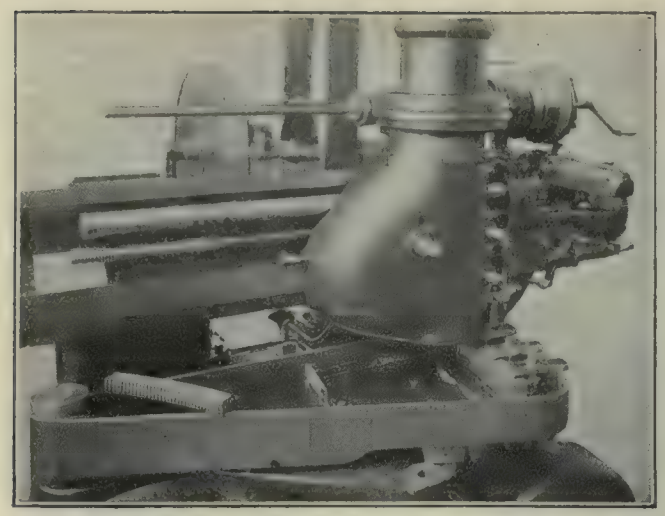


FIG. 10. CUTTING A CURVED RACK

curve. This fixture consists principally of the segmental table hinged at the left hand end, which is so located as to give the proper radius for the arc to be cut. The plate or table is supported by a slide directly beneath the cut so as to avoid all tendency to spring under the cut.

How to Handle an Employment Department

By A. J. Schneider
Employment Manager, Cincinnati Planer Co., Cincinnati, Ohio

In an employment department a good application blank, properly used, is very important. The employment department is under a positive handicap unless the application blank is right. In drawing up the application form, it is necessary to consider: Questions and answers, standard size of form, how to use it, and method of filing for quick and accurate reference.

It is impossible to make up a standard application blank that will work well in every employment department. The employment department in a machine shop, for example, is doing very well if it succeeds in making up one standard form that can be used in classifying and hiring help for every department of the organization. For instance if the same form can be used in connection with the Planer Department as for the Drafting Department, it must be a good one. However, the information in both cases need not be the same, because the form can be so drawn that the information can be written on one form that would not be written on the other. In other words, the form should be flexible, so that special or extra information can be added to suit particular requirements.

The Application Forms

To go into every detail as to just what information should be printed on the form would require a long discussion. It is a question how far to go with this printed form. The average applicant feels uneasy and as though he is running a gantlet if he must answer systematically and mechanically too many questions. On this account, I would handle that part of the work very carefully. Some applicants fill out our form very nicely in about five minutes without any trouble. Others start to struggle, blush or grumble right at the start. With the latter, I simply say: "Just fill in your name and I will finish the card for you." For some jobs we have it is not so important for a man to have the education required to fill out an application form. In this case it is better to fill it out for him, except that it is of value to have a record of the signature. However, the best method in most cases is to let the applicant fill out the form as far as he can and then let the employment department check it and make the necessary corrections and additions. After the applicant is finished with the application, the checking can be done in such a way that the applicant is in a friendly state of mind so that one can get the truth. Judging from the way some applications are made up and handled, it is no wonder that there are so many liars looking for a job. It is very easy to encourage the applicant to tell a lie.

Filing the Application

From my experience, I prefer a standard 5 x 7-in. card, as the applicant can see it well and has plenty of space for writing. All applications for applicants not hired, but considered desirable, are filed according to occupation by date. The applications for applicants hired are filed in alphabetical order according to first letter in last name, and by the date. Each card, of course, is properly indexed.

We have had so little success in analyzing letters of application that we usually pick out the best looking letters and ask the applicant to call for an interview. In other words, we do the work face to face. We have hired several applicants by mail, where all the correspondence seemed ideal, and the results were poor. I don't know of any rules to use in analyzing letters, we try to use good judgment by considering everything.

Interviewing the Applicant

Next to the general appearance of the plant and the employment department, the applicant gets the first impression from the interview. Surely we all agree that this is important and must be done right. One thing that should be accomplished in the interview is the careful checking of the information given on the application card, which is given wrong intentionally sometimes, and sometimes by mistake. An important feature is the time taken for the interview. It is just as bad to hurry an interview as it is to take too much time. It is hardly possible except in special cases to conduct an interview in less than ten minutes and very seldom should it take one hour. If I had my choice of the two evils, I would prefer to give too much time rather than not enough. The time required depends upon the applicant and the occupation. I prefer to interview on foot, that is, I prefer to stand with the applicant. I would never let the applicant stand while I am seated. Both should stand or be seated. The standard job analysis should be used, if there is one. The applicant if hired should always be given a "Rule and Information Book," to take home. It is hardly possible to explain every detail during the interview, therefore, this book will be of great assistance to avoid misunderstandings and help the applicant to get started right. The rate of pay whenever possible should be given during interview and the possible future should be explained conservatively. The entire interview should be void of exaggeration, loud talking and many promises so that the applicant leaves with the feeling that he has just the right job and that he is the right man for it Remember all during the interview that you are playing a two-handed game and give the applicant lots of opportunity to ask questions, in fact, encourage him to do so.



II. Formulas and Factors

This installment contains the simpler formulas and factors that are the basis of this series of articles, and which enable the cam designer to know in advance exactly how large to make any of the simpler cams in common use so that they will operate with known maximum pressure angles, or, in other words, that they will not run hard or bind. Various terms necessary to use in the application of these formulas and factors are introduced and defined. A method of constructing and charting each of the base curves in common use and for locating the essential pitch line with reference to the base curve is also given.

CAM chart (Fig.14). The chart is a rectangle the height of which is equal to the total motion of the follower in one direction, and the length equal to the circumference of the pitch circle of the cam, both laid off accurately to scale. The chart length represents

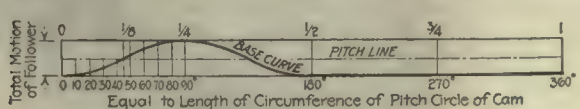


FIG. 14. CAM CHART

360 deg. and is sub-divided into equal parts marking the 5 deg., 10 deg. . . . points, or the $\frac{1}{8}$, $\frac{1}{4}$ . . . points, or any other convenient subdivision, according to the requirements of the problem. On the cam chart are drawn the base curve and the pitch line. The former becomes the pitch surface of the cam and the latter the pitch circle.

Cam-chart diagram (Fig. 15). The cam-chart diagram is a rectangle, the height of which represents the total motion of the follower in one direction. The length of the diagram represents the circumference of the pitch circle of the cam. In the cam-chart diagram the scales for drawing the height and the length of the rectangle are totally independent of each other and independent also of the scale of the cam drawing. In drawing the diagram no scale need be used at all, and the entire chart diagram with its base curve and pitch line may be drawn entirely freehand with suitable subdivisions marked off entirely by eye according to the requirements of the problem. The base curve may be

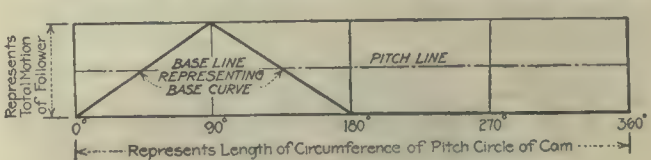


FIG. 15. CAM-CHART DIAGRAM

drawn roughly as a curve or it may be made up of a series of straight lines. The cam-chart diagram frequently serves all the purposes of the cam chart, especially in a preliminary study of the problem. It saves time and permits of chart drawings being made on small available sheets of paper, whereas the more precise cam chart often requires large sheets of paper which are impracticable and unnecessary in many circumstances.

Time charts (Figs. 16 and 17). Time charts are the same as cam charts or cam-chart diagrams and are constructed in the same way as described in the two pre-

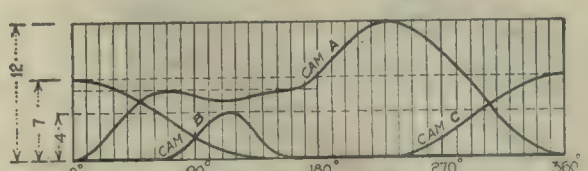


FIG. 16. TIME-CHART DIAGRAM, BASE CURVES SUPERPOSED

ceding paragraphs. The term time chart, however, is most appropriately applied to problems where two or more cams are used in the same machine and where their functions are dependent on each other. The time chart permits of allowances being made for avoiding possible interference of the several moving parts and for the desired timing of relative motions for each part. The time chart contains two or more base curves according to the number of cams used. When the base

curves are superposed as in Fig. 16 the time chart consists of a single rectangle whose height is equal to the greatest follower motion. The superposing of curves and lines often leads to confusion and error, and in general it is better that the time chart should consist of a series of charts or rectangles all of the same length and one directly under the other as in Fig. 17. Where there are many base curves it is desirable to separate

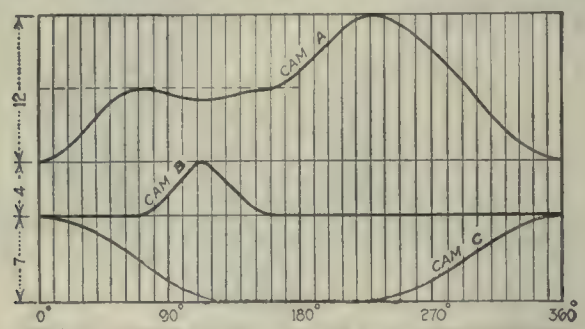


FIG. 17. TIME-CHART DIAGRAM, BASE CURVES SEPARATED

the rectangles by a small space to avoid any possibility of confusion due to different base curves running together. In many cases the term time chart diagram or timing diagram, will be more appropriate than time chart in the same way as the cam-chart diagram is more appropriate than the cam chart.

Base curve (Fig. 14). A base curve is made up of a series of smooth continuous curves or a combination of curves and straight lines, which represent the motion of the follower and which run in a wave-like form across the entire length of the cam chart or diagram. The base curve of the cam chart becomes the pitch surface of the cam.

Base line (Fig. 15). A base line is made up of a series of inclined straight lines or a series of inclined and horizontal lines in consecutive order, which zigzag across the entire length of the chart. The base line when used on the cam chart indicates the exact motion

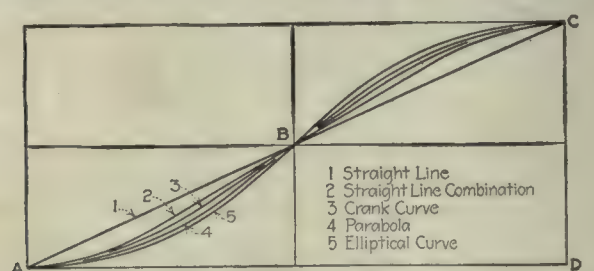


FIG. 18. COMPARISON OF BASE CURVES IN COMMON USE SHOWING VARYING DEGREES OF MAXIMUM SLOPE WHEN DRAWN IN SAME CHART LENGTH

of the follower, but when used on a cam-chart diagram it is merely a time-saving substitute for the drawing of the base curve.

Names of base curves or base lines in common use (see Figs. 18 and 19): (1) Straight line, (2) straight-line combination, (3) crank curve, (4) parabola, (5) elliptical curve.

Pitch line (Fig. 14). A pitch line is a horizontal line drawn on the cam chart or diagram, and it becomes the pitch circle of the cam. The position, or elevation, of the pitch line on the chart varies according to the base curve which is specified and according to the data of the problem. For cams which give a continuous motion to the follower during its entire stroke, or throw, the pitch line will pass through the point on the base curve which has the greatest slope, starting from the bottom of the chart. This does not apply to all possible base curves, but it does apply to all those mentioned in the preceding paragraph, a minor exception being made of the crank curve, which will be referred to in a later installment. When the cam causes the follower to move through its total stroke in two or more separate steps the position of the pitch line on the chart must be specially found, as will be explained later in problem 5.

Pitch circle (Fig. 20). A pitch circle is drawn with the center of rotation of the cam as a center and its circumference is equal to the cam-chart length. Its characteristic is that it passes through that point *A*,

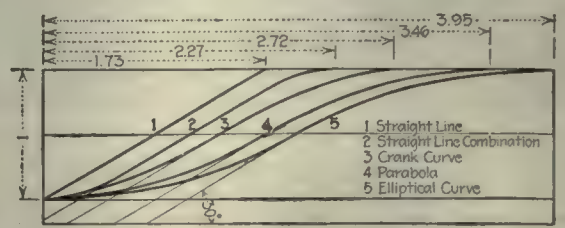


FIG. 19. COMPARISON OF BASE CURVES IN COMMON USE SHOWING UNIFORM MAXIMUM SLOPE OF 30 DEG. WHEN DRAWN IN CHARTS OF VARYING LENGTH

Fig. 20, of the pitch surface of the cam where the cam has its greatest side pressure against the follower. This applies to single-step cams in which the center of the follower roller moves in a straight radial line. For other motions of the follower roller and for flat-

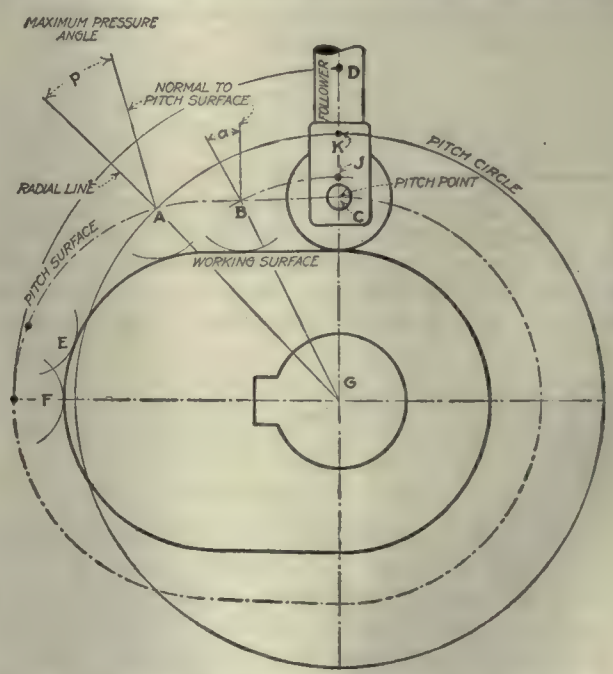


FIG. 20. SHOWING NAMES OF SURFACES, LINES AND POINTS OF A CAM

faced followers the pitch circle must be specially considered, as will be explained in some of the later problems covering these types.

Pitch surface (Fig. 20). The pitch surface of a cam is the theoretical boundary of the cam that is first laid down in constructing the cam. When the follower has a V-shaped edge the pitch surface coincides with

the working surface of the cam. When the follower has roller contact, as in Fig. 20, the pitch surface passes through the axis of the roller and the working or actual surface of the cam is parallel to the pitch surface and a distance from it equal to the radius of the roller.

Working surface (Fig. 20). The working surface of the cam is the surface with which the follower is in actual contact. It limits the working size and weight of cam. For exact compliance with a given set of cam data the cam has only one theoretical size which is bounded by the pitch surface, but the working size may be anything within wide limits which depend on the radius of the follower roller and the necessary diameter of the cam shaft.

The working surface is found by taking a compass set to the radius of the roller and striking a series of arcs whose centers are on the pitch surface. Such a series of arcs is shown in Fig. 20 with their centers at *B*, *A*, etc. The curve, which is an envelope to these arcs is the working surface.

Pitch point (Fig. 20). The pitch point of the follower is that point fixed on the follower rod or arm which is always in theoretical contact with the pitch surface of the cam. If the follower has a sharp V-edge the pitch point is the edge itself. If the follower has a roller end the pitch point is the axis of the roller. The pitch point is constantly changing its position from *C* to *D* as the follower moves up and down.

Pressure angle (Fig. 20). The pressure angle is the angle whose vertex is at the pitch point of the follower in its successive positions and whose sides are the direction of motion of the pitch point and the normal to the pitch surface.

Pressure angles exist when the surface of the cam presses sidewise against the follower; they cause bending in the follower arm and side pressure in the follower guide and in the bearings. The pressure angle is constantly varying in nearly all cams as the follower moves up and down. In assigning cam problems the maximum permissible pressure angle is usually given. In Fig. 20 the pressure angle is zero at *C*; it will be equal to a when *B* reaches *J*, and it will be a maximum when *A* reaches *K*.

The radius of the pitch circle of the cam may be found directly by the formula:

$$r = h \times \frac{360}{b} \times f \times \frac{1}{2\pi}$$

$$= 57.3 \frac{hf}{b} \qquad (1)$$

or, by the formula

$$r = h \times \frac{1}{e} \times f \times \frac{1}{2\pi}$$

$$= 0.159 \frac{hf}{e} \qquad (2)$$

in which r = radius of pitch circle of cam.
h = distance traveled by follower.
f = factor for a given maximum pressure angle.
b = angle, in degrees, turned by cam while follower moves distance h.
e = angle, in fraction of revolution, turned by cam while follower moves distance h.

The above formulas may be stated in words by rearranging, No. (1), for example, as follows:

$$r \times 2\pi \times \frac{b}{360} = h f$$

and saying that the necessary length of arc of the pitch circle for a given follower motion is equal to the follower motion multiplied by a suitable factor.

Factors have been determined for the base curves already mentioned and for a wide range of pressure angles, and are given below. Some of these factors will be used presently in constructing base curves, and the above formulas will be applied in the problems that will be taken up.

Cam Factors for Maximum Pressure Angle

The factors, or value, of f for various maximum-pressure angles for cams using the several base curves in common use are:

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of f				
	20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion.
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

These factors for 30 deg. are illustrated in Fig. 19 where each of the base curves is given such a length, in terms of the height, that they will all have the same maximum slope. The values given in this table are

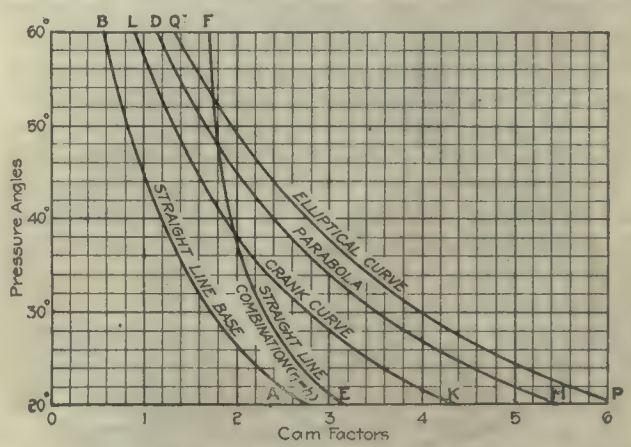


FIG. 21. CHART SHOWING RELATION BETWEEN PRESSURE ANGLES AND CAM FACTORS FOR THE ORDINARY BASE CURVES

also shown graphically in Fig. 21, thus enabling one to find the proper cam factor for any intermediate pressure angle between 20 deg. and 60 deg. The methods of determining the cam factors are involved in some instances and will be given in one of the later installments dealing with more advanced work.

Method of Construction of Base Curves in Common Use

Detail construction of base curves. The method of constructing the several base curves for a rise of 1 unit of the follower will be explained in the succeeding paragraphs. The curves will be constructed to give a maximum pressure angle of 30 deg. by selecting factors from the 30 deg. column in the above table of cam factors.

Straight-line base (Fig. 22). Lay off *A B* equal to the follower motion, which will be taken as 1 unit in

these illustrations. Multiply this by the factor 1.73 from the table of factors, and lay off the distance *A R* equal to the product. Complete the parallelogram and draw the diagonal. This will be the straight-line base and the angle *R A C* will be 30 deg. *A R* will be the pitch line. In this illustration and those that follow the base lines and curves will be laid off from right to left so that they may be used in a natural manner later on in laying out the cam so that it will turn in a right-handed or clock-wise direction.

The straight-line base gives abrupt starting and stopping velocities at the beginning and end of the stroke and causes actual shock in the follower arm. The velocity of the follower during the stroke is constant. The acceleration at starting and retardation at stopping is infinite and is zero during the stroke.

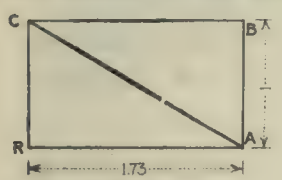


FIG. 22

FIG. 22. STRAIGHT BASE LINE

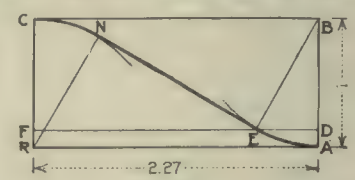


FIG. 23

FIG. 23. STRAIGHT-LINE COMBINATION CURVE

Straight-line combination curve (Fig. 23). Construct the rectangle with a height of 1 unit and a length of 2.27 units. With *B* and *R* as centers draw the arcs *A E* and *C N* and draw a straight line *E N* tangent to them. The angle *F E N* will then equal 30 deg. and the line *A C* will be a base curve made up of arcs and a straight line combined to form a smooth curve. *D F* will be the pitch line.

The straight-line combination curve, being rounded off at the ends, does not give actual shock to the follower at starting and stopping, but it does give a more sudden action than any of the base curves which follow, and the maximum acceleration and retardation values are comparatively larger.

Crank curve (Fig. 24). Construct the rectangle in the same general manner as explained in the two previous cases. Draw the semicircle *R G C* and divide it into

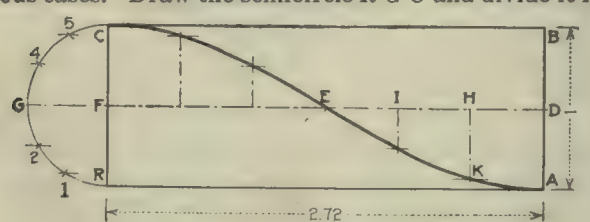


FIG. 24. CRANK CURVE

any number of equal parts. Six parts are best for practice work for this curve, but in general in practical work the greater the number of divisions the more accurate will be the curve and the smoother the action of the cam. The six equal divisions of the semicircle are readily obtained by taking *G* as a center and *F C* as a radius and striking arcs at *1* and *5*, then with *R* and *C* as centers mark the points *2* and *4* respectively. Divide the length of the chart into six equal parts, as at *H*, *I*, *E*, etc. From these points drop vertical lines, and from the corresponding divisions on the semicircle draw horizontal lines, giving intersecting points, as at *K*, on the desired crank curve. The tangent to the curve at *E* will then make an angle of 30 deg. with the line *E F*. The pitch line will be *D F*.

When the crank curve is transferred from the chart to the cam it gives an angle which is a fraction of a degree greater than 30 deg. at the point *E* on the cam in practical cases. This is not enough greater to warrant the special computations and drawing that would be necessary to be exact. Therefore the method of laying out the crank curve and the pitch line, as given above, will be adhered to in this elementary consideration of cam work because of its simplicity.

The crank curve gives a slightly irregular increasing velocity to the follower from the beginning to the middle of its stroke; then a decreasing velocity in reverse order to the end of the stroke. The acceleration diminishes to zero at the middle of the stroke and then the retardation effect increases to the end. The maximum acceleration and retardation values are much less than for the straight-line combination curve and are only a little greater than for the parabola.

Parabola (Fig. 25). Construct the rectangle as for previous base curves. Draw the straight line *R S* in

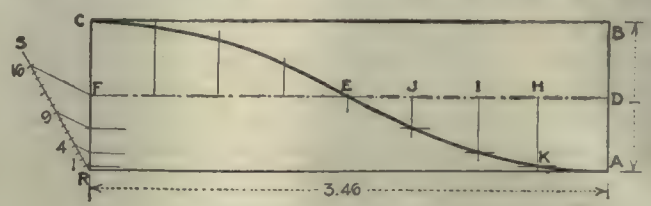


FIG. 25. PARABOLA

any direction and lay off on it 16 equal divisions to any scale. From the sixteenth division draw a line to *F*, the middle point of the chart; draw other lines parallel to this through the points *9*, *4* and *1*, thus dividing the distance *R F* into four unequal parts which are to each other in order, as *1*, *3*, *5* and *7*. From these division points draw horizontal lines, and from *H*, *I* and *J* drop vertical lines. The intersecting points, as at *K*, will be on the desired parabola. The points *H*, *I* and *J* divide the distance *D E* into four equal parts.

Requires Less Direct Effort

The parabola gives a uniformly increasing velocity from the beginning to the middle of the stroke; then a uniformly decreasing velocity to the end. The acceleration of the follower is constant during the first half of the stroke and the retardation is constant during the last half. The acceleration and retardation values are equal and are less than the maximum value of any of the other base curves. This means that the direct effort required to drive a parabola cam is less than for any other type of cam.

To better understand the smooth action given by the cam using this curve consider, first, *D H* as a time unit during which the follower rises one space unit; second, *H I* as an equal time unit during which the follower rises three space units; third, *I J* as the time unit during which the follower rises five space units, etc. Inasmuch as the follower travels two units further in each succeeding time unit it gains a velocity of two units in each time unit, and this is uniform acceleration.

The distance from *F* to *C* would be divided the same as from *F* to *R* and points on the part of the curve from E to C similarly located. The curve *E C* will be iden-

tical with *E A*, but in reverse order, and will give uniform retardation. The tangent to the curve *A C* at the point *E* will make an angle of 30 deg. with *E F*, and *D F* will be the pitch line.

Eight construction points were taken in developing the curve *A C*. Eight points will be sufficient for beginners for practice work, and later six points may be used. When using six points only nine equal divisions should be laid out on the line *R S*, the remaining construction being the same as described above, except that *D E* should be divided into three parts instead of four. In practical work many more construction points should be used for accuracy and smooth cam action.

Elliptical curve (Fig. 26). Draw rectangle *A B C R* as in previous cases. Draw semi-ellipse making *F G* equal to 7/4 *F C*. To draw the ellipse take a strip of

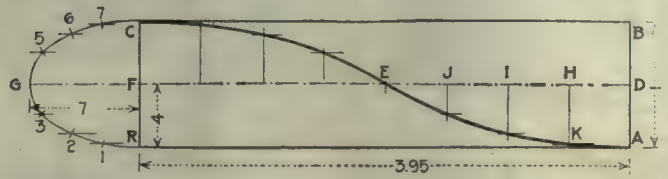


FIG. 26. ELLIPTICAL CURVE

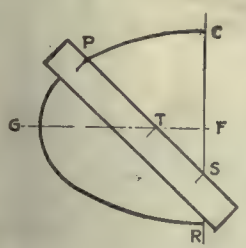


FIG. 26A. SHOWING METHOD OF DRAWING SEMI-ELLIPSE

paper with a straight edge and mark fine lines at *P*, *T* and *S*, Fig. 26a, making *P T* = *C F* and *P S* = *G F*. Move the strip of paper so that *S* will always be on the line *R C* and *T* on the line *F G*; *P* will then describe the path of the ellipse. Having the semi-ellipse, divide the part *R G*, Fig. 26, into four equal arc lengths as at *1, 2, 3*. This is quickest done by setting the small dividers to a small space of any value and stepping off the distance from *R* to *G*. Suppose that there are 18.8 steps. Set down this number and divide it into four parts, giving 4.7, 9.4 and 14.1. Then again step off the arc from *R* to *G* with the same setting of the dividers, marking the points that are at 4.7, 9.4 and 14.1 steps. The compass setting being small, the fractional part of it can be estimated with all necessary practical precision. If greater accuracy is desired it may be obtained by setting the dividers by trial so that the quadrant *R G* may be stepped off into a whole number of steps such as 12, 16, etc., and then every third or fourth step taken as a construction point. Divide *D E* into four equal parts as at *H, I, J*. Draw vertical lines from these points and horizontal lines from the corresponding points at *1, 2* and *3*. The intersections, as at *K*, will give a series of points on the elliptical base curve. The curve *E C* is similar to *E A* but in reverse order. The tangent to the curve at *E* makes an angle of 30 deg. with *E F* and *D F* is the pitch line.

The elliptical base curve gives slower starting and stopping velocities to the follower than any of the other curves, but the velocity is higher at the center of the stroke. The acceleration is variable and increases to the middle of the stroke, where its maximum value is greater than that of the crank but less than that of the straight-line combination curve. The retardation values decrease in reverse order to the end of the stroke.

Translating Drawings from Metric to English Measurement

By Dr. C. P. Schwarz

Sometimes it is necessary to translate metric dimension drawings into fractional inch drawings, or vice versa. Incidentally different standards for pipes, bolts, threads, etc., are incorporated so that ultimately the two designs are not interchangeable. The customary way is to look up the dimension in a conversion table and clutter up the drawings with a mass of superfluous and absurd decimals.

If we establish the arbitrary rule that 1 in. shall equal 24 mm., all sixteenths may be expressed in millimeters and only one decimal place is involved. Now, 4 in. = 101.6 mm., while we made 4 in. = 96 mm.; accordingly the metric version of the designer's pipe-dream has shrunk 4½ per cent. This is generally quite harmless but is eminently useful as it eliminates a great deal of figuring.

Gears of which the center distances have been translated in the above fashion will work out with metric (module) cutter with very little trouble. Take, for instance, two gears of 4 pitch with 14 and 19 teeth; the first has a pitch diameter of 3½ in. and the latter 4¾ in. and the center distance is 4⅛ in.

According to our way of figuring 4⅛ in. = 99 mm. To get the module we divide, 2 × 99, by the sum of the teeth, thus: $\frac{2 \times 99}{33} = 6$. The metric gears will thus figure out to be 6 × 14 = 84 mm., and 6 × 19 = 114 mm., and the center distance $\frac{84 + 114}{2} = 99$ mm.

Now you may take the American Machinists' Handbook and look up the table comparing the pitch and module cutters or gears and you will see that the translated gear is just as strong—for all practical purposes—as the original gear. This example is not doped out, it was picked at random, but if you have 7-pitch gears, you may not get results at the first shot. This scheme is also friendly to metric bolt sizes as they increase by 3 mm. To proceed in the reverse direction two rules may be selected from. The first, 25 mm. = 1 in., gives all even millimeters in two decimals; the design shrinks less than 1 per cent. but involves the use of unwieldy decimals.

The second, 24 mm. = 1 in., gives all millimeters which are multiples of 1½ in. sixteenths and the design swells about 5 per cent.; for instance: 419 mm. is not a multiple of 1.5, the figure nearest to it is 418.5 = $17\frac{7}{16}$ in. and the error introduced if the latter figure is taken is perhaps not sufficient to throw the design out of plumb.

Needless to say, the above way of figuring applies best when a design has to be adapted without attempt at interchangeability.

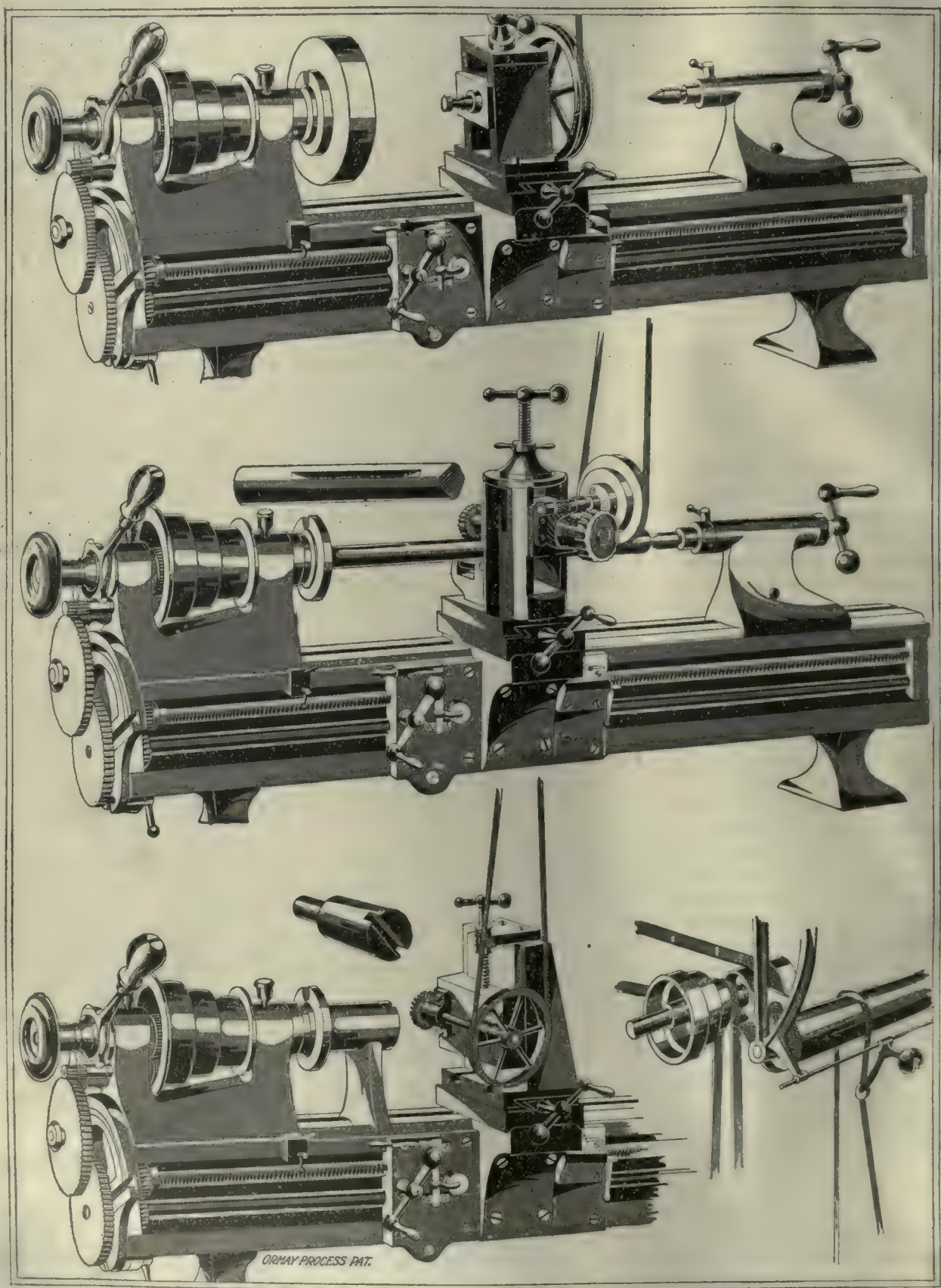
A Use for Broken and Worn-Out Drills

By John H. Blackman

In our shop we have for some time been using worn-out drills for end milling cutters as suggested by Oscar Craft on page 414 of *American Machinist*. We grind them straight across the end like a bottoming drill and then grind a small notch in the end of one lip so that the other is as long as half the diameter. They work much better ground this way and they can be fed straight into the work like a drill.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



AUTOMOTIVE CONSTRUCTION



Special Parts for FOUR-WHEEL DRIVE TRUCKS

By
Harry C. Satterthwaite,
CHIEF TOOL DESIGNER, PREMIER MOTOR CO.

The pieces shown present problems which might easily prove puzzling, and the methods illustrated are full of suggestions for fixtures and tools for handling difficult problems in other lines of work. The pieces are rigid in construction and substantial grades are provided for maintaining the alignment of hollow milling cutters and other tools.

EVER since automobiles have been used, attempts have been made to apply the power to the front wheels. Moving a loaded vehicle by applying power to the rear somewhat resembles moving a load with a rope or fishing pole—it can be pulled much more effectively than it can be pushed. Applying power to the front wheels and steering with the rear is "going ahead backward," for you must run into a curb or other obstacle in order to run away from it. Steering and drive both in front have never successfully appealed to the passenger-automobile buyer, but have proved very successful when used on four-wheel-drive trucks. The war proved the value of the "quad." One of the best-known trucks of this type uses a shaft drive on both front and rear axles similar to the usual passenger-car rear axle. The steering is through a ball-and-socket joint on each end of the front axle, the drive shaft operating through a universal joint the center of which is in line with the center of the ball-and-socket joint. The headpiece illustrated shows one of these trucks equipped with ammunition body and camouflaged ready to "carry the message to Fritz." Fig. 1 shows one side of a front axle with the wheel in place and the ball-and-socket joint *A*, assembled complete.

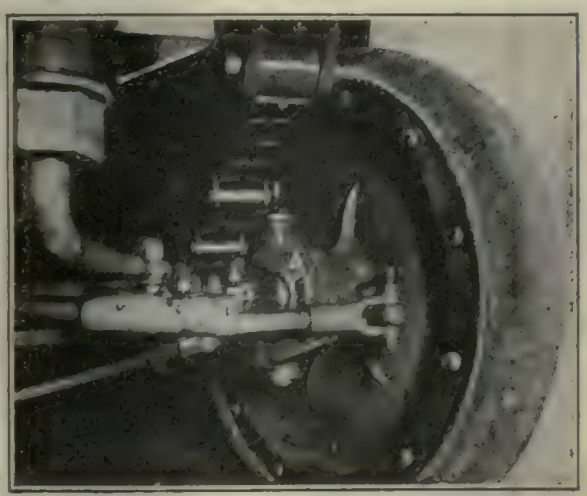


FIG. 1. FRONT-AXLE DRIVE STEERING JOINT

The sequence of operations on these balls as made by the Premier Motor Corporation, Indianapolis, Ind., which built several thousand of these trucks follows:

Anneal.
Snag.
Center both ends.
Rough-turn and face shank and flange; rough-turn neck.
Mill clearance notches in flange.
Drill through and rough concave.
Rough-turn outside diameter of ball.
Heat-treat; bore and ream and finish concave.
Finish-turn and face shank and flange.
Finish-form neck; bore and ream shank end.
Finish-turn outside diameter of ball.
Rough hollow-mill and face trunnions and turn collar.
Polish ball end.
Finish hollow-mill trunnions.
Drill oil holes in trunnions.
Drill bolt holes in flange.
Burr, complete.

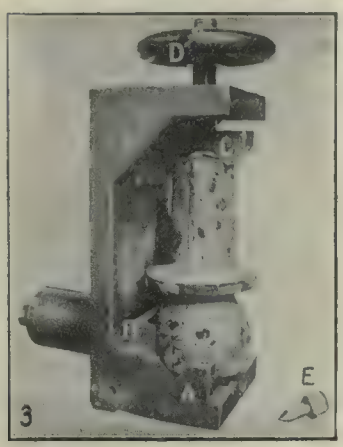
The ball part of the joint is made from a drop-forging of 30-40 point carbon openhearth steel, heat-treated after rough machining and finished all over as shown in Fig. 2. The maximum tolerance is plus or minus 0.010 in., the minimum plus 0.0005 in. and minus 0.0000 inch.

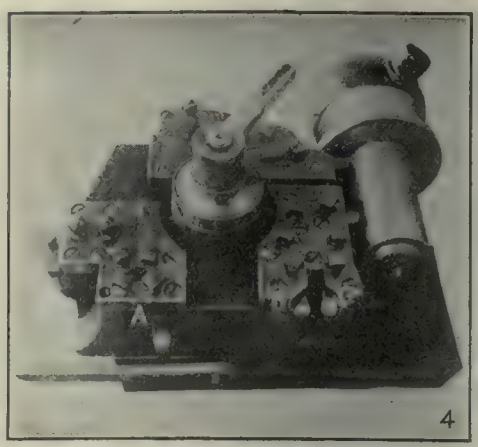
A fixture, Fig. 3, with V-blocks *A* to take the trunions, a spring-actuated V-block *B* to equalize the ball sidewise and a centering jaw *C* for the shank, on the end of a clamp screw, hold a forging for centering. Center punches operating through bushed holes in the clamp screw *D* and the lower end of the fixture body accurately center the forging with respect to vital locating points so as to equally distribute the metal left for finish. The fixture is mounted over a notch in the bench so that the small center punch *E* shown on the bench by the fixture may be reached with a hammer. This lower punch is held in the fixture by means of a spring-wire retainer. The punches are made with loose heads fitted on a slight taper to be readily replaced when worn out. The average time on this operation is 2 minutes.

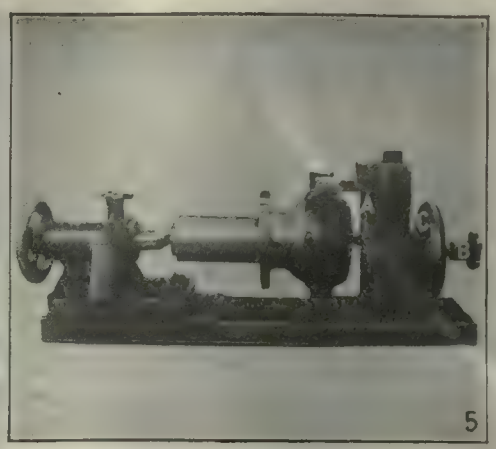
The centers are drilled and reamed with a combined drill and center reamer in a light drill press with a center on the table.

The shank and flange are rough-turned and faced and the neck between the flange and ball rough-formed, using the special turret head and tools shown in Fig. 4 fitted to a heavy-duty lathe. The illustration shows a forging on which this operation has been finished, placed in position for the first cut, which is made with three tools, one of which turns the flange diameter and the other two the shank. The right and left balls are slightly different on the shank ends, one of them having two diameters and a counterbore for shrinking over the axle tube. The other with the smaller shank is straight

AUTOMOTIVE CONSTRUCTION







FIGS. 3 TO 5 PUNCHING AND MILLING FIXTURES AND TURRET HEAD FOR LATHE

Fig. 3—Center-punching fixture. Fig. 4—Special turret head for lathe. Fig. 5—Fixture for milling notches in flange

and has no counterbore, it being assembled into one side of the differential housing.

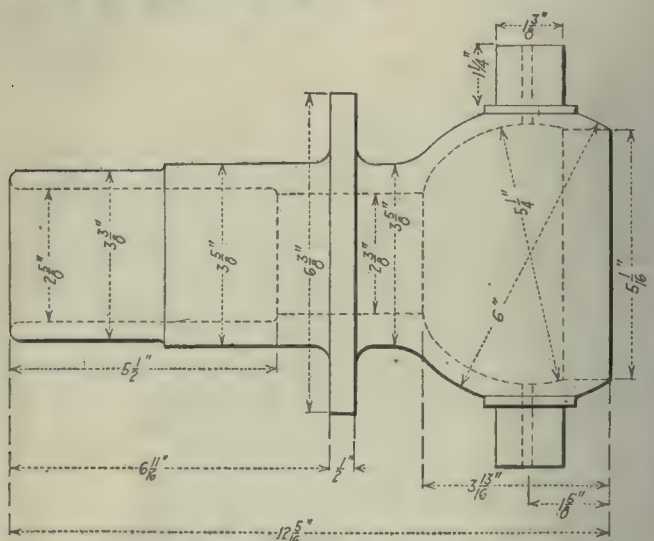


FIG. 2. LINE DRAWING OF FRONT-AXLE STEERING BALL

The tools *A*, *B* and *C* are for straddle-facing the flange and facing the end of the shank to length. The empty tool slot shown to the left is the position for facing the ball with the longer shank. The next face of the turret carries a serrated formed cutter for breaking through the scale on the neck and the fourth side a profile cutter for forming. Approximately $\frac{1}{16}$ in. of metal is left on each surface for finishing after heat treatment. The average time per piece is 23.3 minutes. Subsequent boring and turning operations are located from the shank and the adjoining face of the flange.

Rough-Boring and Concaving

The notches are next milled through the flange, using the fixture shown in Fig. 5, which is equipped with an equalizing device *A*, operated by the star wheel *B* and locked by the handwheel *C*. The notches, which are clearance for the spring seat, are thus milled parallel with the center line through the trunnions and are used in later operations for driving the forging while held in various chucking fixtures. The average time for this milling is 6.5 minutes.

Fig. 6 illustrates the rough-boring and the concaving operations. These consist of drilling all the way through with a $2\frac{1}{4}$-in. drill and concaving $3\frac{5}{8}$ in. deep and $4\frac{5}{16}$ in. diameter with the double cutter bar shown. This is

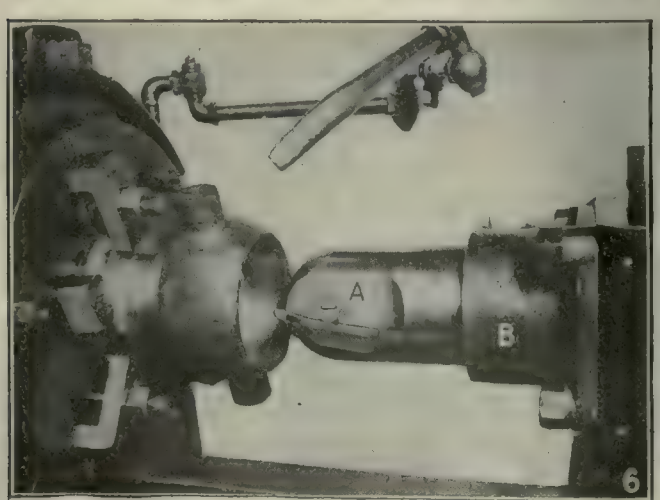


FIG. 6. ROUGH-BORE AND CONCAVE BALL END

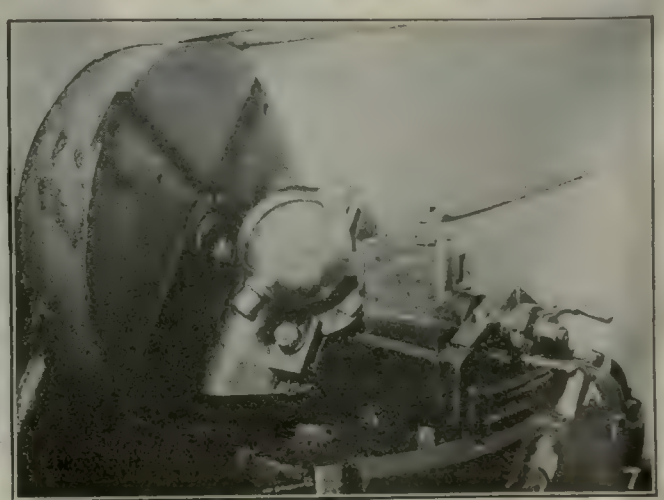


FIG. 7. FIXTURE FOR TURNING BALL SURFACE

AUTOMOTIVE CONSTRUCTION

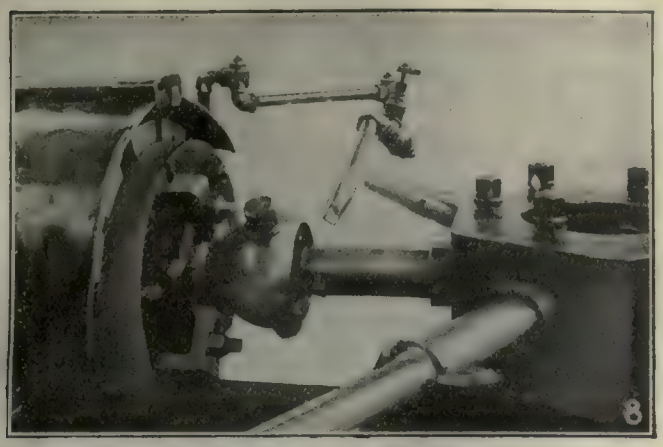


FIG. 8. FINISH-BORE AND CONCAVE BALL END

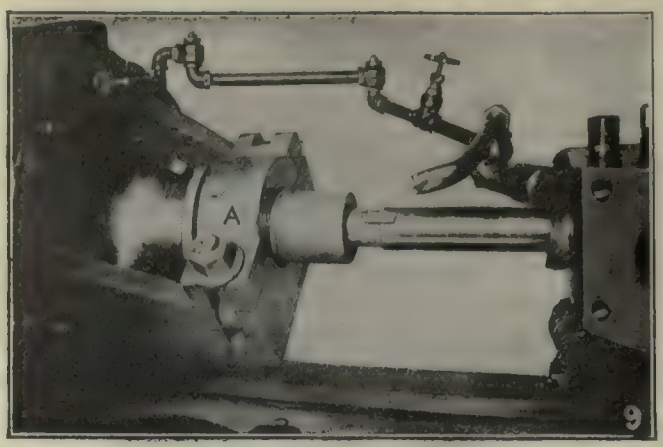


FIG. 9. COUNTERBORE FOR TUBE FIT

hardened-steel bar with high-speed-steel cutters set at an angle to give a good top rake. The cutters are held in position by small collars *A*, with one flat-tapered side, held down by fillister-head screws. The screw holes and the counterbores for the collars are drilled at a slight angle with the face of the cutter so as to give a wedging action against the flat side of the collar. The pressure of the cut forces the cutter to a seat, so the collars have very little duty to perform. The shank of this tool is keyed to a flanged turret adaptor *B*, which is bolted to the face of the turret. This prevents turning of the bar with consequent damage to the shank or breaking out the top of the turret as is possible if the clamp screw only were used. The chucking fixture holds the forging in a bushing for the shank, the flange being clamped against the face of the fixture which has a hardened ring fitted into the surface. One of the notches milled in the previous operation serves as a driver against a fitted stud *C* in the fixture. The average time for this entire operation on the Libby 16-in. turret lathe is 28.2 min., which include chucking, changing tools, etc.

In rough-turning the ball the forging is chucked in an angle fixture screwed on the spindle of a 25-in. LeBlond lathe as shown in Fig. 7. A radius-turning fixture doweled to the bed of the lathe replaces the carriage and swings a forged turning tool through the proper arc. This fixture is moved by means of a worm and gear shown at *A*. The depth of cut and consequently the diameter of the ball are regulated by a feed screw with a double-end handle. The tool carrier is gibbed to the swinging part of the radius fixture with V-ways similar to a lathe cross-slide and can be locked in position by means of the screw projecting through the top.

After the first cut is taken the lathe is stopped and the ball shifted to another position, six cuts being required to cover the entire surface. It could be done in four cuts if it were not for a slight interference of the flange and the radius to the neck of the ball. The average time for this operation, including chucking and changing positions, is 14.3 minutes per ball.

All surfaces of the ball except the trunnions have been rough-machined and the forging is next heat-treated. It is then placed in the same fixture as was used for rough-concaving, Fig. 8, and finish-bored, reamed and concaved. The tools shown in the turret finish the bores and bottom of concave up to the 5 1/16 in. diameter. The remainder of the concave is finished by means of a formed cutter held in the cross-slide tool turret, the carriage and cross-slide being operated by hand in order to match up the two cuts on the

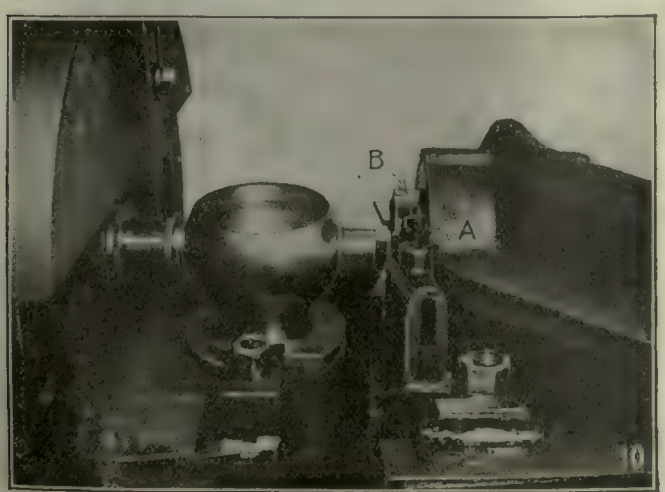


FIG. 10. ROUGH HOLLOW-MILL TRUNNIONS

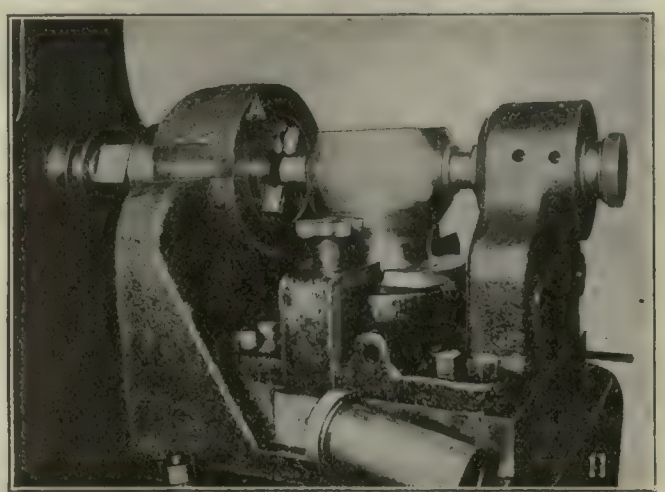


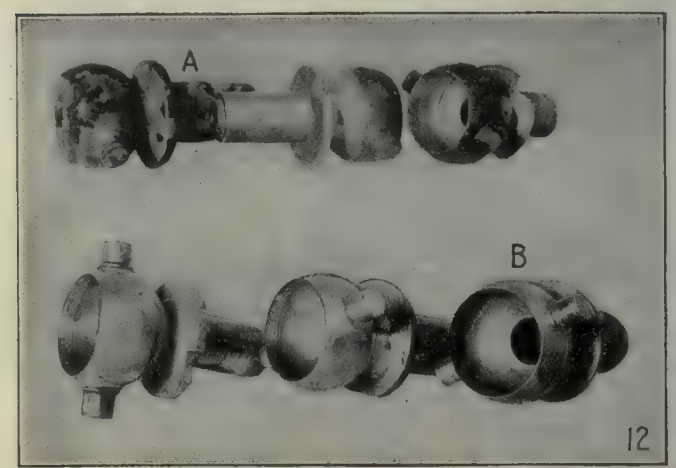
FIG. 11. FINISH HOLLOW-MILL TRUNNIONS

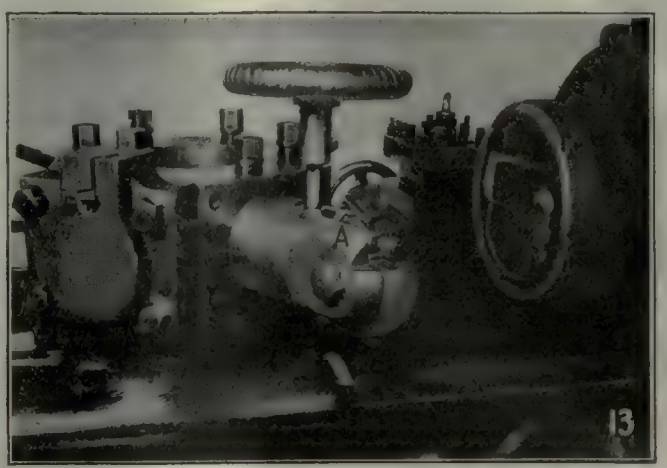
AUTOMOTIVE CONSTRUCTION

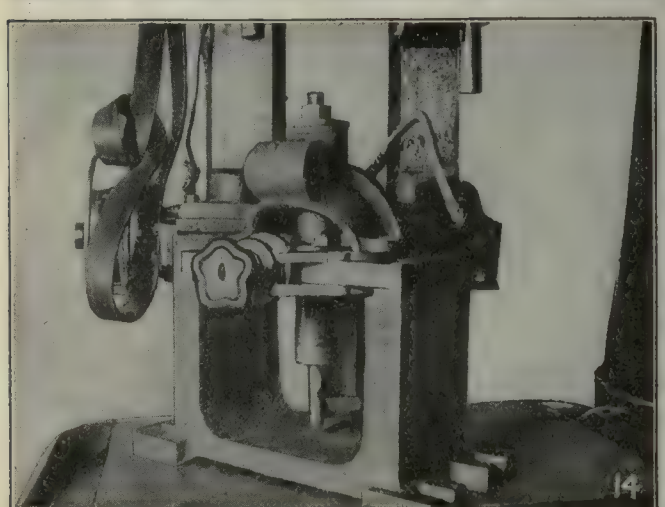
concave surface. The average time per piece is 28.7 minutes.

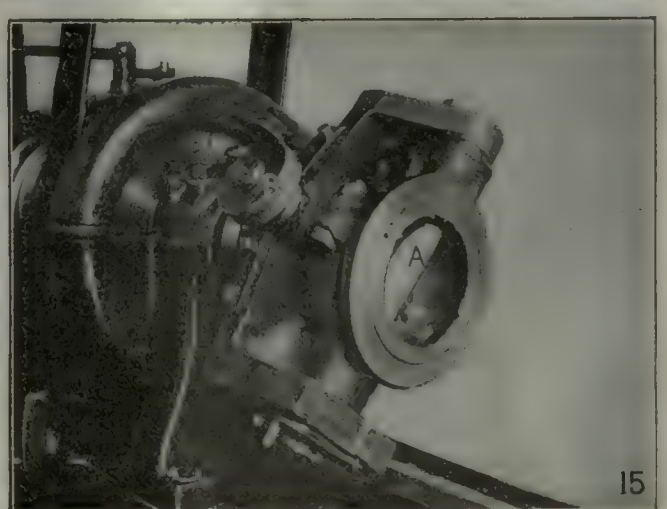
Both ends of the bore are chamfered in this operation so that the forging can be handled on pipe centers to finish turn and face the shank and flange and to finish-form the neck in the next two operations. The tools used are simple tool blocks, replacing the standard toolpost, using standard tool bits for one operation and a formed cutter similar to the rough-turning cutter for finishing the neck. The time on the finish turn holding the ball within 0.002 to 0.004 in. of a perfect sphere, although the tolerance is much greater. The time on this operation is the same as in the rough-turning, 14.3 minutes.

In mounting this fixture on the lathe bed great care was taken to see that the center of revolution of the radius-turning fixture was directly in line with the center of the chucking fixture. A special arbor was ground up to fit the bore of the stationary part of the turning fixture and also the bore of the chucking fixture









FIGS. 12 TO 15. THE BALL AND THREE FIXTURES FOR MACHINING IT

Fig. 12—Balls in various stages of completion. Fig. 13—Bore and concave socket member half. Fig. 14—Drill tie-bolt holes in socket member half. Fig. 15—Facing socket-member assembly

and face operation is 15 minutes, and on finish-forming the neck 10 minutes.

The right-hand ball, which is counterbored on the shank end, is chucked in the fixture shown in Fig. 9. It is clamped on the finished shank in hardened half-bushings *A*, located from the ball side of the flange and driven by one of the notches in the flange. The cap is hinged to a link so as to avoid any distortion or eccentric location as is often the case with a single pin hinge. The average time per piece is 14.9 minutes.

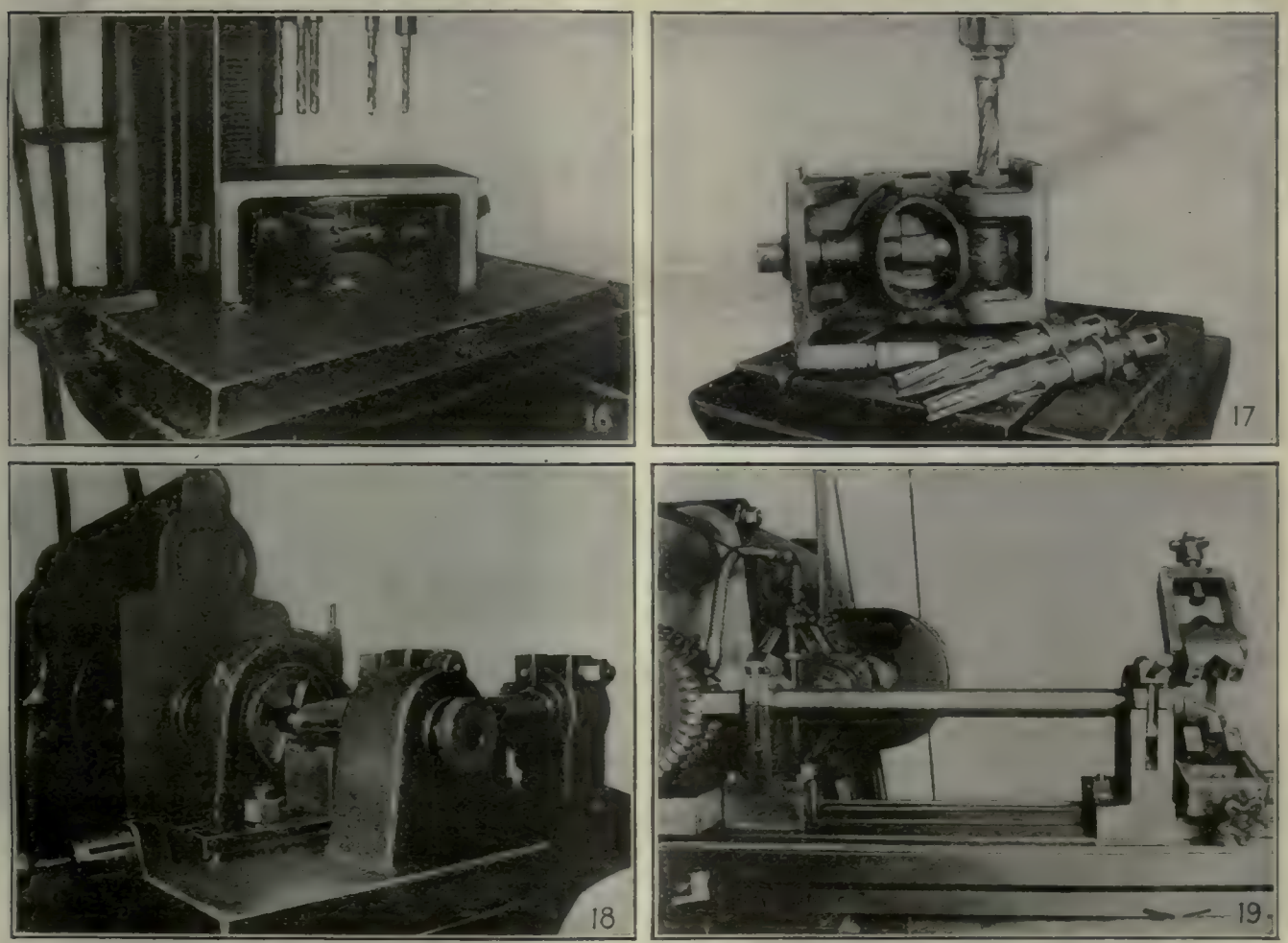
The outside diameter of the ball is next finish-turned, using the same tools as for roughing, Fig. 7, except for the bushing bore in the chucking fixture, which must now handle a finished shank. No trouble is experienced in where the ball shank was held. The arbor was inserted in both bores, thus bringing them in line with each other and the fixture doweled to the ways of the lathe.

The balls are next clamped in a fixture similar to the one used for turning the balls, but with a sliding V-block to locate the first trunnion, which is roughed out with a hollow mill held in the tailstock of a 25-in. lathe. The carriage of the lathe is equipped with a bridge support *A* for the hollow mill *B*, Fig. 10. This support preserves the alignment of the mill and is splined to prevent the mill from turning. The tailstock is attached to the carriage so that the power feed of the lathe may be used, the tail spindle being used only for adjustment of the mill with respect to the car-

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riage. The bridge is so constructed as to leave the cross-slide free, which carries a special tool block for facing the ends of the trunnions to length.

The mill is a Brown & Sharpe finishing mill without backrests, using two formed cutters diametrically opposite each other. These cutters rough-turn the trunnion and finish-turn the collar and fillets at the base of the trunnion. After one trunnion is turned the ball is revolved in the chucking fixture and a bushing slipped out of the center of the fixture over the trunnion just rough-turned trunnion. After the first trunnion is finished the clamps and bushings are removed and the work revolved to bring the other trunnion to cutting position. The slip bushing is changed for one with a bore fitting the finished trunnion. This bore has a very slight taper, just enough to take care of the 0.0005-in. limit. This bushing locates the trunnion first finished directly in line with the center of the hollow mill and the shank of the forging. The hollow mill is supported by a bushing in the fixture. The average time



FIGS. 16 TO 19. SPECIAL DRILLING AND MILLING FIXTURES

Fig. 16—Drill 12 holes in face of socket assembly. Fig. 17—Ream taper hole for steering arm. Fig. 18—Hollow-mill axle-shaft trunnions. Fig. 19—Mill axle-shaft squares

turned. The opposite trunnion is then roughed on a center line with the first one. The average time on this complete operation is 18.5 minutes.

The ball end is next polished to remove the tool marks, as experience has shown that on all balls broken in service the fracture originated at a tool mark.

The diameter of the trunnion, on which the tolerance is plus 0.0005 in. and minus 0.0000 in., is finished by a hollow mill with two cutters placed diametrically opposite similar to the mill used for roughing and supported as at *A*, Fig. 11. The mill is fitted to the spindle of a No. 3 horizontal milling machine and the work is clamped in the fixture shown. The first cut is located by a slip bushing, the bore of which fits the for finishing both trunnions in this operation is 7.5 minutes.

The $\frac{3}{16}$-in. oil holes through the trunnions are next drilled on a single-spindle drilling machine and the six bolt holes in the flange are drilled on a multiple-spindle drilling machine, locating the jig from one of the trunnions. This finishes the machining, the work is now ready for bench burring and final inspection.

Fig. 12 shows six of these balls in various stages of completion from the rough forging *A* to the finished ball, *B*. The rough forging weighs 65 to 70 lb. and the finished piece 22 lb.

The socket part of the joint consists of two members made from electric-furnace steel castings. They pre-

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sent several difficult machining operations on account of the close limits and the irregular shape of the castings, which make them difficult to hold without distortion. In the first operation the parts are held in a chucking fixture mounted over a three-jaw universal chuck on a 16-in. Libby lathe. The chuck jaws grip the shank and the ears for the tie bolts are held against two positive stops by setscrews. This prevents the casting springing when the intermittent cut is being taken on the concave surface. This surface is finished by means of a single-point cutting tool *A*, Fig. 3, mounted in a disk which revolves in a turret holder. The outside diameter of this disk is a worm gear which meshes with a worm on the vertical handwheel.

The two halves of the socket member are joined with a male and female fit which is roughed out in this operation. A facing tool held in a turret holder squares out the fit after it is roughed by means of a cross-slide tool. The hole through the shank is also bored and reamed to 0.002 in. less than finished size. This completes the operation which is done in 14.1 minutes.

Drilling Tie-Bolt Holes

The tie-bolt holes are next drilled in the fixture shown in Fig. 14. This fixture consists of two parts, a bushing plate and a holding fixture. The bushing plate has a male fit on one side and a female on the other, thus drilling either half of the member with the same bushings. The equalizing arms for locating the work straddle the bushing plate to locate either half being drilled so that the unfinished surfaces match each other when assembled. The time for drilling and reaming averages 4.8 min. per piece.

The halves are then chucked in a turret lathe on the male or female fit, as the case may be, with the shank end out. This end is faced, the bushing hole reamed to finish size, bored for the thread and tapped for the plug which assembles in the shank of each member. These plugs with thrust washers under them adjust against the ends of the trunnions on the axle balls, the load of the front axle being carried on the lower plug. The concave-socket member is slightly larger than the spherical surface of the axle ball, the bearing load being carried on the ball trunnions, the ball-and-socket feature of the joint serving as a housing for the universal joint in the drive shaft.

In the next operation the male and female joints are finished to gage on an engine lathe, the work being held on an arbor pressed in the reamed hole. This brings the faces true with the bushing hole after the hole is reamed to size.

The two halves are then assembled and afterward chucked in the fixture shown in Fig. 15. The assembled socket member is placed in the fixture and a special arbor *A* slipped through the bushings in the fixture and the reamed holes in the socket member. A knurled-headed screw *B* through the body of the fixture and at right angles to the arbor has two tapered surfaces which raise locating pins against the back surface of the socket assembly. This equalizes the stock so that the finished face will be parallel to the back side of the castings and at the required angle with the reamed hole through which arbor is placed. A fore-and-aft tool block replaces the cross-slide and carries two tools in both the front and back sides. These tools are set to rough and finish both the joint face and the male pilot. This male pilot fits a counterbore in the front wheel spindle, the 12 holes drilled in the socket member in the next operation being tapped to attach this spindle. This facing operation requires an average of 13.2 minutes.

The drilling of these holes is shown in Fig. 16. A channel-shaped jig carries the bushing in the web of the channel. The inside surface of this web has a counterbore which receives the male pilot of the socket assembly. The work is held in place by an arbor slipped through bushings in the flanges of the jig and the reamed holes of the socket assembly. The channel

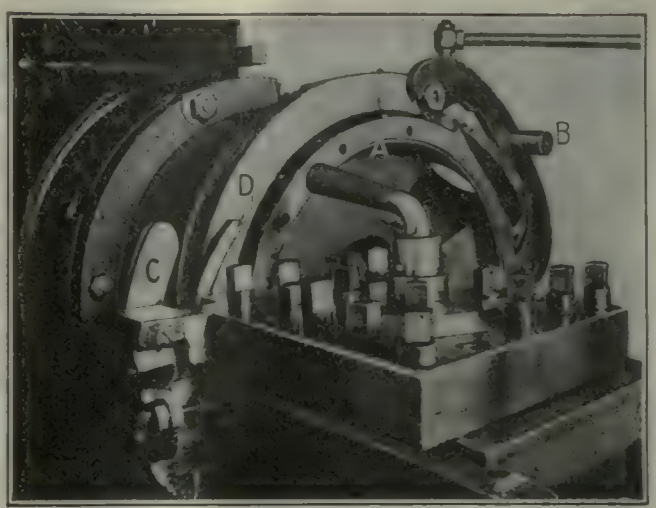


FIG. 20. HALF OF DIFFERENTIAL HOUSING WITH PINION BEARING

flanges serve as legs on which the jig stands while drilling. Two passes of the drills were used on this operation, drilling six holes at once. The average time per assembly is 8 minutes.

The boss for the steering-arm hole is straddle-milled and the taper hole is then drilled and reamed, using the tools shown in Fig. 17. The work is held with an arbor through the reamed bushing holes similar to previous jigs. The jig is made to be used either side up so as to make either right- or left-hand sockets. A three-flute drill is first run through the cored hole in the castings, being guided by a slip bushing. The taper is then roughed with a three-flute spiral reamer with notched teeth to break the chips. The hole is finished to gage with a 10-flute spiral reamer. The two reamers with Wizard chuck sleeves attached are shown in the front of the figure. The average time for this operation is 10.7 minutes.

Broaching the keyway in the taper hole, tapping the 12 holes and burring complete the operation.

As mentioned before the drive to the front wheels is through universal joints, the centers of which coincide with the centers of the ball-and-socket joint. The concave of the axle ball is for clearance over these universal joints. The shafts coupled to these joints are chrome-vanadium drop-forgings with trunnions forged

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integral on one end, the opposite end being squared for fitting into the differential or the wheel-driving end.

The axle-shaft trunnions have limits of plus 0.001 in. and minus 0.000 in. and must be concentric with the shaft bearing adjacent to the trunnions within 0.005 in. The shafts are rough-turned in a 24-swing lathe, heat-treated, finished-turned, straightened and undergo several bearings on an engine lathe. The two bearing diameters at each end of the shaft are then ground and the ends of the trunnions straddle-milled with relation to the ground bearings.

The shafts are next placed in the fixture shown in Fig. 18. They are gripped on the ground bearing diameters by hinged clamps carrying a hardened ball-mush-



THE 21 CAM-OPERATED TOOL FOR FACING AXLE SHAFTS

ing which hold the work into the other halves of the hardened bushings fitted into the body of the fixture. These clamps are opened on a vertical line so as to bring the shaft center always the same height whether the bearings are ground the high or the low limit. A stop, with a quick-action screw, locates the work for the first cut so that the trunnions will be central with the machined head of the shaft. After the first trunnion is machined the clamps are loosened and the shaft reversed end-for-end until the finished trunnion can be located by a slip bushing through the fixture. This slip bushing is directly opposite the hollow-mill support and in line with the center of the clamps which hold the shaft.

The hollow mill is a Brown & Sharpe floating mill with two cutters placed diametrically opposite. A locking sleeve pressed over the outside of the mill guides the mill in a hardened bushing in the fixture at *A*. The forging has about ⅛ in. stock for finish on the diameter, this stock being both turned and accurately with the finish due to the feed and the wear of the tool. With these tools the trunnions are finished with one cut, the limit for the diameter being plus 0.000 in. and minus 0.001 in., and plus or minus 0.001 in. in the distance from shoulder to shoulder at the base of the trunnions. The average time per shaft is 4 minutes.

The next operation squares the opposite end of the shaft, using the fixture shown in Fig. 19. This shows a shaft which has just been squared and the trunnion clamp removed. One trunnion is shown in one of the bearing V-blocks. The ground bearings which were used for holding the shafts in the previous operation are used for the same purpose in this, the clamps however, being shut in a horizontal line. After straddle-milling two sides of the square the clamps are loosened, the shaft reversed so that the trunnion used for locating is seated in the other V-block and the clamp for this V-block tightened.

The V-blocks are placed so as to bring the center line of the trunnion 90 deg. apart in the two positions, when the trunnion is correct in size. As the tolerance is plus 0.001 in. and minus 0.000 in. the center line cannot be farther apart than 90 deg. nor closer together than 0.001 in. at the radius of the trunnion shoulder from the center. The fact that this radius is more than twice the radius of the corners of the square, the squares come out of the fixture with an error of less than 0.005 in. at the corners. The two cuts, taking, etc., require 5.2 minutes.

As there are three different length shafts, both this fixture and the one for the previous operation, finishing the trunnions, are made adjustable, and the clamps which grip the squared end being movable to suit the three lengths of shafts.

Cam-Operated Facing Tool Designed

Fig. 20 is a view of one-half of a differential housing *A* mounted in a 24-in. Lodge turret lathe. This housing carries the drive-pinion shaft and its bearings as well as the flange to which the pinion-arm collar is attached. This pinion-collar flange is ⅛ in. closer to the center of the housing than the outside diameter of the joint flange. This shows a finished casting removed in the fixture, the bolt holes more clearly showing the necessity for finishing all of the joint face and the back side of the pinion-collar flange where it overhangs the joint face. In order to finish all of this joint face a cam-operated facing tool was designed. Pin *B* contacts with cams *C* and *D* and moves the tool. This tool is shown from the working side in Fig. 21.

A stationary body is clamped in the cross-slide turret. The body carries a sliding member mounted on the conventional dovetail ways *A*. On this sliding member a toolholder is gibbed with another dovetail in. This toolholder is adjustable in relation to the body of the sliding member by means of a feed screw operated by the star wheel *B* shown at the left, thus providing adjustment for wear of the cutter. The sliding member carries two profile cams *C* and *D*, which engage the other member in the yoke shown near the pinion-shaft housing in Fig. 20.

The contour of the cams is such that the tool finishes the joint face with a flat cut across its width on a radial line. When the pinion-collar flange comes in the tool the cams withdraw the tool sufficiently to make it cut along the back side of the flange on a line tangent to the plane of the pinion shaft. When the opposite side of the flange is reached the cams return the tool to its extreme cutting diameter where it is held against movement from either by means of a spring.

On account of its effect on the finish tangent face

the tool is in constant motion, first toward the center and then away from it, while passing the flange. The joint face is roughed out to the largest diameter permitted by the torsion-collar flange by means of a heavy inserted cutter tool. The remainder of the cut is finished from the rough casting by the cam-operated tool, which successfully makes an oiltight joint on these faces.

The ability of these tools to perform their duty with the maximum of accuracy in the minimum time is the result of two things, first, the use of plenty of metal in their construction, which in fixture work never costs as much as its omission; and second, accurate work in building the tools. This was obtained by a rigid inspection as the work progressed and, if necessary, corrections made before the error could cause trouble. The designs were carefully worked out and where decimal dimensions appeared on the drawing the tool inspector held the toolmakers to a 0.0002 in. plus or minus limit.

Our Duty as Employers

By J. J. Hartley

Are we as employers doing our share just at this time to reorganize our plants on a fair and square, man to man basis, or are some of us unable to break away from tradition and take advantage of the present enormous supply of unemployed, able-bodied, skilled and unskilled men, a large proportion of whom have families, and are of real necessity seeking diligently for employment? The great majority of workers in machine shops are intelligent, reasonable and honest, and should be dealt with on such a basis.

The company with which the writer is connected happened to be in need of the services of additional men during the past two months and even though the plant is located at a considerable distance from the manufacturing center of Chicago, the eligible applicants have without exaggeration numbered 75 or more for every opening we have had to offer. We have not found it necessary to remind applicants that the war is over, nor have we tried to hire them at pre-war rates. We have, on the other hand, offered and are now paying a liberal guaranteed hourly rate to all our production workers, telling them frankly when hiring them that in due course they would be given piece work on which our time allowance would permit the average man to make 50c. per hour or better. When it is explained that this arrangement applies to intelligent men of limited or no prior experience we feel that the offer is fair. This, we believe, is recognized by our men, and particularly by those who have thus far been given piece work. These men made good from the start and are in the great majority of cases averaging more than 50c. per hour. This is from 30 to 40 per cent. more than the same class of labor received in the years just preceding the wer.

The writer having personally interviewed the majority of the applicants since the middle of December, has reason to believe that some employment agents have been endeavoring to hire intelligent workers at a considerably lower hourly rate than the high cost of living would justify. The safest and fairest policy for the employer to pursue is to fix a schedule of wages and salaries that will insure the appreciation of the employee, since a fair deal will always be quickly recognized by the great majority of men employed in manufacturing industries.

The man with the important responsibilities of hiring help, to be successful, should receive an applicant in a cheerful and sympathetic manner. In fact is not the man who offers his skill and labor direct entitled at least to the same courtesy and consideration as the salesman, who also, but indirectly, offers you labor in the form of the finished product which he has to sell? It is not good business nor fair to the man who may, at great loss of time and some expense, come to our plant to offer his services, to be greeted with a shingle: "No help wanted." We owe him the courtesy of an interview and if we cannot employ him we can at least offer him an explanation why. There is a limited number of manufacturing concerns who are fortunate enough to have always recognized the hiring of and dealing with employees as of first importance. It is safe to say that the employment department records in such establishments will always show a profit resulting from the minimum help turnover which invariably prevails there.

The next big thing after hiring men is to provide them with a means of earning maximum compensation through their own individual effort. This can best be accomplished by paying them at a price per unit rather than for the hours and minutes of working time. Superintendents and foremen who have had experience with both systems will probably agree that most workmen will produce a larger output of better quality under the piece-work system than under the hourly rate method, and that once the workmen become accustomed to the greater possibilities in the way of returns from the former system they are very reluctant to return to the old one.

To be successful a piece-work system must be based on average performance and not on that of a picked expert and must take into account all the factors that may enter during a long working day. Careful analysis will divide the workers into five classes of which the middle one should be chosen as the basis of price per piece calculations of the minimum guaranteed rate and maximum possible earnings. Production records of many of the concerns operating on this basis show that the higher and lower classes usually balance each other so that the average earnings will be equal to those of the middle class man. When a man is started on piece work he should be told what the minimum returns to him will be for a fair amount of diligence and also that the price will not be reduced so long as conditions under which it was determined do not change appreciably. He should also be encouraged by being told that if he can make double the minimum rate by extra effort the company is glad to have him do it.

To Prevent Tracing Cloth From Stretching

By A. E. Kipps

I have used the simple kink as noted below for some time and have found it very handy. No doubt many readers know that when a tracing is left tacked to the drawing board for any length of time it stretches considerably. I overcome this difficulty in the following manner: Before leaving the tracing simply take out two thumb tacks from the opposite corners. The tracing may now be left as long as you please and will not stretch. It takes but a second to replace the tacks when commencing work on the tracing again.

Arrangement of Equipment in Shops

By JAMES FORREST

The principles of scientific shop layout are here taken up and reduced to the form of equations for convenience in handling. Straight-line and contract-shop layout problems are contrasted and a solution by the aid of cardboard models is described.

THE problem of planning the location of the tools and equipment in the layout of a new shop lies between the extremes of simplicity and of a complexity of requirements which can only be approximately satisfied, depending on the business to be carried on. The first point to be considered is the matter of cost in transferring the product components coincident with plant operation over a definite number of months or years between certain predetermined dates.

In all plants there exists an expectancy of gradual increase in sales to be offset by a corresponding increase in output capacity. It will be necessary in making any layout to assume a set of requirements to cover a specific output, and if the layout is based on present requirements it will become inadequate in the course of time and its various components will no longer operate at their highest efficiency. On the other hand if the layout is made to cover requirements too far in the future everything will operate at reduced efficiency until production rises to the proper volume to fully utilize the available resources. The best that can be done is to select a reasonable output standard, making provision for expansion based on past growth and future plans without introducing inordinate crippling factors during present operation.

Every layout scheme must have an entering and a leaving end and these are set to the points of the compass which will give the unit under consideration, be it a complete plant or a small department, the most efficient relation to those outside influences directly affecting it. In some instances conditions will necessitate that receiving and shipping take place at the same end of the plant or the operations may be carried out along the first floor and return along the second, and this can also be done where space is to be saved.

Laying Out a New Plant

In most plants of any size having no regard for scientific layout it will be found that convenience has compelled at least an approximate segregation of the departments such as the forge shop, machine shop, foundry, stores, etc., while in a small shop it may be that only certain corners are devoted to certain pursuits. But in old-established shops this is about as far as the subdivision goes, and the engineer called in to lay out one of a group of shops on the basis of efficiency will be fortunate if he is not forced to compromise on some seemingly indispensable points on account of its established relations with the other shops.

In laying out a new plant more freedom is possible, practically the only limits being the relation of railroad sidings to the bringing in of raw materials and the supplies for converting it, and the shipping of the finished product.

As a preliminary to any layout it will be necessary to separate the products into their component items and these again into their operation items, information being arranged in tabular form for comparative purposes. This table will show the number of pieces of each kind passing through the shops every working day and also the total time for which each machine is occupied during an operation, so that the complete machine or equipment time may be found for every item composing the product.

The total number of units will be: Number of operations on each piece; storage; repair shop; millwright; toolroom; special department, such as foreign inspection; shipping.

The size of these units of manufacture will be determined by the quantities produced, as in many cases suitable operations for combination will be performed in the same shop.

Through each shop will pass a number of pieces equal to the output per working day, and the number of machines required of any type =

$$\frac{\textit{Output} \times \textit{operation time in hours}}{\textit{working hours per day} \times 0.9} \quad \ldots\ldots (1)$$

Area of shop required =

Clearance area of machine (including operating space) × No. of machines, plus storage and handling space, plus inspecting and erecting space..... (2)

Layouts for Straight-Line Products

The simplest layout is possible when the product is a so-called straight-line product which can start at so many pieces an hour at one end of a shop or series of shops and go from one operation to another as in the manufacture of a single-piece product. This seldom occurs, but the most complicated processes of manufacture when analyzed resolve themselves into a combination of these straight-line paths.

Then there is the plant the product of which is made in such large quantities that a separate department containing certain equipment can be established for each of the various parts making up the finished product. Examples of this kind are the artillery shell and the automobile. The product is divided into its components and these again designated as parts manufactured or parts bought. The shops manufacturing some of the minor parts and the stores containing the purchased ones are located in the proper sequence and join the principal part just when needed as tributaries feed a main stream. In this way economy in handling is at a maximum, interference at a minimum and overlapping and return of the product over its own path are done away with. In a layout such as this enough machines and equipment are grouped at each station or operation shop along the path to take care of a certain predetermined number of pieces passing through in a certain time.

Such conditions can in general only be realized in the

putting down of new shops built for the express purpose in hand, but much will be accomplished by bearing the above principles in mind in the accommodating of any preëxisting shops to a new product or in the readjustment of a shop and a product that have become unbalanced.

If the product is a new one and there is not enough data to enable the engineer intelligently to balance the individual operating equipment, space should be provided in each shop to take care of the possible need for additional equipment which may develop after manufacture is under way. On the other hand, there is also the possibility that all the machines installed will not be required. These unforeseen retardants of the production stream sometimes manifest themselves in an alarming fashion after operations have been started, and for this reason the individual output of each machine or other unit should be established with extreme caution before it is embodied in any general scheme. If there is any error it will be multiplied in proportion to the number of machines employed. I have seen in one plant alone shops full of machines which, after all the expense of installing and equipping them with individual motors, never once revolved because this output factor had not been carefully established before purchasing and installing, the necessary output being obtained by machines of another type doing the same work but with 10 times the capacity. Half a million dollars did not cover the cost of this one error.

Layouts for Repair and Contract Shops

In layouts of this kind to cover straight-line products and where enough machines are installed at each point to cover the exact requirements no handling factor calculations will be necessary, as the most efficient arrangement is apparent on the surface. But there are shops, like repair and contract shops, in which the product is made up of varied items on some of which certain machines perform all the work, while others perform very litle work, and where the various items pass under the machines in mixed rotation.

In these instances it will be necessary to use what has been done in the past as a measure for the future, and after the probable requirements in machines are determined from formula 1 the best that can be done is to divide the machinery for each shop into groups depending on the work performed, as follows: Very heavy, heavy, medium, light and very light. Then starting at the entering end of the shop layout place first the very heavy machines, next the heavy, and so on, finishing with the very light at the opposite end of the shop. Machines like planers, slotters and boring machines are placed on one side and lathes, milling machines or shaping machines on the other, with the drilling machines, saws, etc., wherever convenient.

Next are those shops where large enough quantities of any one item to keep a unit of equipment busy cannot be put through, as where the product varies with local requirements of the customers, such as cranes, boilers or locomotives. In these cases it is impossible to hold the essential facts in mind at once and layouts must be made and tested by the handling factor.

In many cases the shops will be built before the equipment has been fully decided upon, and the problem will resolve itself into making the best utilization of space already provided. A plan of the shop or department in question is made to scale on the drawing board, about $\frac{3}{4}$ in. or $\frac{1}{2}$ in. = 1 ft. being suitable and showing all features in any way liable to affect the machine layout. Then for each machine an approximate shape to clearance dimensions is cut out in cardboard to the same scale as the shop layout, showing the position of the drive, the position of the operator and the extreme travel of the various working parts. At the same time cardboard cutouts are made for transfer trucks, bins, work benches, etc.

The Ideal Layout from a Handling Point of View

As all the machines cannot be placed to give straight-line motion to all the items it will be necessary to make the most efficient approximation to this. The ideal layout from a handling point of view for shops with short-run products would be to have each piece given a group of machines to itself no matter how little some of them were used in a day. But as this is not feasible from a cost standpoint the best combination must be made so that each machine is occupied all the time, the handling factor still remaining low.

A group of machines is taken from the cardboard supply to cover the total requirements for each piece as given by formula 1, taking a whole machine for each fractional machine required by the formula, as three lathes where a piece takes the equivalent time of $2\frac{1}{4}$ lathes per day by the formula, or one planing machine where 0.3 is required. On the cardboard machine that represents the fractional machine requirement this fraction is plainly marked, and for reference the same fractional part of its surface may be colored with a crayon.

A layout of all these cardboard machines to finish each piece is made on separate sheets from the shop layout, the machines being set out to scale with proper clearances for moving trucks and standard work racks in the relative positions they would occupy if each group stood alone. This is done for every piece appearing on the tabulated sheet of output operations which has already been made out as previously indicated, and when all these small layouts are made we have before us a number of groups of machines in which each group covers the work to be done on one piece or item of product. We have now to combine to the best advantage the fractional machines to make up even whole numbers so that all may be busy all the time.

The group sheet representing the heaviest piece is superimposed on the shop layout nearest to the entering end; then another group sheet is selected the fractional machine requirements of which fit in best with the first one, trying if possible to find one that will eliminate all the fractional machines. This process is gone through until all the group layouts have been used up, keeping as much as possible the heaviest parts at the entering end of the shop on both sides of the central open space. Those fractional machines nearest to each other of the same size and kind which add up to one complete machine are now removed and a whole machine laid down central to them to take their place. Slight readjustment will now close up the few gaps made by fractional machines removed and the small sheets can be taken away, one by one, pinning their machines down on the shop layout in the same places

they occupied on the small sheets. We now have the complete shop layout made, with every machine fully occupied during the working hours per day.

Each item should now be tested by the handling factor which is equal to the weight of the piece multiplied by the distance it is moved between each operation multiplied by the number of these pieces moved per day.

When the handling factor is high for one piece through its having to be moved back on its path for the purpose of utilizing a machine which otherwise would be idle, judgment must be used as to whether it will be more profitable to allow the high factor or to install another machine to perform the necessary work on the piece at the proper point on its path. For instance, it would be more economical to provide an extra drilling machine to eliminate the necessity for the return of 20 heavy pieces per day a distance of 50 ft. for a drilling operation, while it would not pay to install another large planing machine under the same conditions.

A layout in any plant will have its own peculiar conditions to be met, depending on the class of equipment to be installed, but the above indicates the procedure that will get to the required result in the shortest time.

The Use of Defective Articles

By Chesla C. Sherlock

The practice of using defective machinery without affording the manufacturer an opportunity to make good on his warranty and then trying to collect damages from him for losses due to the defects is unfortunately entirely too common. It savors of the good old army habit of "passing the buck." A knowledge of the attitude likely to be assumed by the courts would probably have saved much time and money by stopping such actions before they started.

VERY often, when manufacturers engaged in making machinery or appliances sell their product, it develops that certain machines or appliances sold are defective in workmanship or material, a possibility which is recognized by provisions in the contracts of sale which define the duties devolving upon the purchaser. It is not proposed to discuss the manufacturer's liability from the standpoint of the sale of such defective product, but rather to discuss it from the standpoint of the use of the product by the purchaser who knows that it is defective.

If a purchaser of a machine which turns out to be defective continues to use the same, such action on his part may cause serious damage to the manufacturer in any one of a number of ways. It may ruin the machine to operate it in its defective condition and thereby entail a greater loss upon the manufacturer; it may cause accidents to the purchaser's employees, the liability for which the purchaser may attempt to shoulder on the manufacturer or it may bring the manufacturer in conflict with certain state statutes relating to the machinery which he has installed, but which, for some friction of law, is often deemed to be his own property. In cases where a machine suddenly breaks down during the trial period when it is not known that it is defective, the liability of the manufacturer is generally well known. He may, in some instances, even be held liable to third parties for the negligent construction which caused the accident or injury.

When the manufacturer expressly agreed with a purchaser that in case the machine is defective he shall immediately give notice to that effect and refrain from the use of the machine for a reasonable time until the manufacturer can repair it, or substitute a new one, the persistent use of it by the purchaser is something over which the manufacturer has no control and should not be expected to bear. This is the general rule of law applicable in such cases. Sutherland, a recognized authority on the subject of damages, says: "Where property is sold with a warranty of fitness for a particular purpose, if it be of such a nature that its defects can be readily and, in fact are, ascertained, yet the purchaser persists in using it, whereby losses and expenses are incurred, they come of his own wrong, and he cannot recover damages for them as consequence of the breach of warranty."

The manufacturer's liability to the purchaser in such cases is generally predicated upon his warranty of good workmanship or material and that the machine is a good machine for the purpose for which it is intended. But the courts have said that the warranty is not confined solely to the manufacturer. He is only a party to it and he cannot be held to answer in damages for the consequences unless the agreement entered into at the time the warranty was given is fully carried out by the purchaser.

The provision as to what the purchaser shall do will be found to vary in different cases but the manufacturer generally specifies in his printed form for the contract of sale, that the purchaser shall give notice to him immediately and that if the defective machine is not repaired within ten days or some such period, the contract shall be considered void. Unless the purchaser performs his portion of the agreement by giving notice and waiting the reasonable time during which he does not operate the machine, he cannot come into court and attempt to hold the manufacturer to his warranty when he has not, in his own case, held himself blameless. "He who comes into court must come with clean hands."

An Iowa Court Decision

Such a decision was reached in an Iowa case when it was shown that the purchaser of a machine warranted free from defects used it with full knowledge that it was defective and in an extremely dangerous condition so that the operator was injured. The court said that the purchaser could not hold the seller of such a machine answerable for damages which were occasioned by his own negligence in using the machine.

In a Kansas case, an engine was sold subject to a warranty in which it was stated that the machine was manufactured of good material, of good workmanship, and, by proper management, would perform well provided the rules and directions furnished by the manufac-

turer were carefully followed. In case the machine proved defective written notice was to be given by the purchaser within ten days of its installation and a reasonable time allowed for the sellers to remedy the defect. In case the manufacturer found any defects, they were to be remedied; if the trouble was in the engine, it was to be taken back by the manufacturer and all payments made refunded. It was shown that the purchaser operated the engine for three years and then claimed damages of the manufacturer, alleging that the engine was of poor material and workmanship, and that it was unfit for the purpose intended. The court said: "Where a machine is purchased which does not meet the conditions of the contract and the defect is one that can be remedied or easily repaired, it is the duty of the injured party to take reasonable steps to have the defect repaired, and to make the liability of the other as light as possible. Damages cannot be awarded on the assumption that the defect is to continue indefinitely."

Can Purchaser Claim Damages

Very often the continued operation of a machine in a defective condition will give rise to other defects, in no way chargeable to the manufacturer, and which are directly due to the fact that the machine was operated for some time while in its original defective condition. Any competent machinist knows that it is true that the greatest injury in the operation of a defective machine is often due to the machine itself. Can the purchaser then come into court and claim damages for such additional defect? In a Kentucky case, this very proposition arose and the court held that no damages could be recovered which were due to the wrongful operation of the machine.

This matter should be reasonably apparent to all who are competent in the operation of machines and appliances. There is nothing strained or far-fetched about it, yet purchasers are continually attempting to overcome it in the courts and secure damages from the seller for things which are not his fault and which are entirely beyond his control. It is certainly just to say that no man should profit by his own wrong, but why it is attempted so often in cases involving defective machinery is a riddle which has never been solved.

A New York Case

In New York, it was shown that a party had purchased steel warranted to be first class from which, he told the seller at the time, he intended to make oil drills. Although it was found that the steel was defective and unsuitable for this purpose the purchaser continued to make it up into oil drills in spite of his knowledge of this fact. He then came into court and attempted to recover the expenses incurred or the loss of profit, but the court said that as soon as the purchaser discovered that the steel was defective he had no right to continue using it with the expectation of recovering his loss of profits from the seller. The court further said that if the vendor sells property and warrants it to be suitable for a specific purpose, and it is applied to that use and proves to be unfit, he is liable in difference in value between the article as it really is and what its value would be if as represented.

The New York case points out a very good distinction to bear in mind in instances of this kind. The court said that the warranty must apply to the particular use to which the property is to be put and that a general statement on the part of the purchaser as to what he intends to do with the property is not a sufficient agreement or linking up for the general warranty made to invoke the application of the rule announced herein.

This is a very good point to bear in mind in regard to all warranties. In order to sustain them in court and make recovery for their breach, it will generally be necessary to show that the warranty applied to the specific thing of which the purchaser claims there was a breach. If the purchaser goes to the seller and states that he wants a machine for a specific purpose and asks if the seller will warrant his machine to be a good one for that particular purpose and the seller so warrants his article, then there is a specific warranty as to the particular use. But if the purchaser casually states in the course of the sale that he thinks he will use the article for a specific purpose, there is nothing binding, especially in cases where the use intended for the article is out of the ordinary.

Making the Proposition Clearer

A homely illustration may make the proposition clearer. Suppose that a purchaser goes to a seller and wants to buy a horse. The seller makes a general warranty as to the fitness and soundness of the horse. The purchaser then states that he expects to use the horse on the race track. The general warranty made under the circumstances cannot be construed as saying that the horse is a good race horse. But if it can be shown that the horse was specifically warranted as a good race horse, very different considerations arise.

In the case of use, then, we find that where the purchaser has knowledge that the article is defective he must

1. Use every effort to lighten the liability of the seller under the warranty as much as possible.
2. Exert every reasonable effort to have the article repaired or caused to be repaired in order to perform this duty.
3. Fully perform his portion of the contract before calling upon the other party for damages.

Saving Machine Work in the Foundry

By Sandy Copeland

On page 555 of the *American Machinist*, M. E. Duggan says he saw a machinist doing a lot of work that could have been avoided by a slight change in the design of the casting, which would have made it possible to so mold it as to eliminate a large part of the machine work.

The casting was a door for a large furnace and the job was the drilling of 46 holes through which passed the anchor bolts to hold the firebrick lining. Mr. Duggan contended that if the holes had been cast in the door and the bolts cast into the anchor ribs, the whole could have been assembled with little machine work. So far so good, but his next alternative is a method of casting in the fire bricks themselves and eliminating *all* the machine work. In this case when it became necessary to replace the bricks all that would need to be done is to make a mold with new fire bricks in it, melt up the door and pour it around the bricks.

By the way, isn't 15 to 25 hours, with a few hours one way or another thrown in to cover errors is estimating, a good long time in which to drill 46 holes?

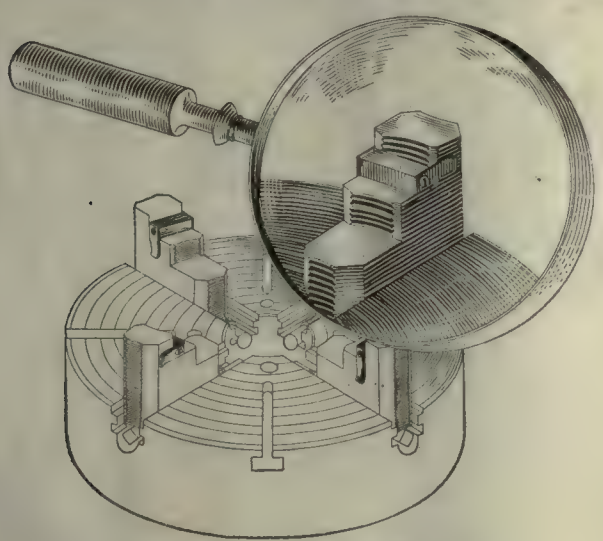


Handy Blocks for Chuck Jaws

By O. E. Charles

Many times in boring comparatively large holes in thin pieces it is desirable to block the work away from the chuck jaw in order to let the boring tool pass through without interference.

Instead of hunting up three pieces of scrap each time I have this kind of job and trying vainly to hold all



HANDY BLOCKS FOR CHUCK JAWS

three of them in position with one hand while I set the work with the other, I made two or three sets of the pieces shown in the sketch. These can be slipped on the chuck jaw and will stay in position, leaving the hands free to locate and clamp the work.

The pieces are equally serviceable for blocking a piece away from the chuck jaw or for blocking between the chuck jaw and the periphery of the work.

Instruments for Hardness Tests

By P. P. Fenaux

In his article on "Instruments for Hardness Tests" on page 93 of the *American Machinist*, Mr. Clewell mentions two modifications made in the Brinell testing machine in order to increase the speed of testing. During the war the French artillery constructors found themselves up against the same problem, and a French officer developed a portable Brinell tester that does not require a press or machinery of any description for its use. The instrument is based on the comparison between the diameter of the impression made in the specimen and the diameter of the impression made at the same time in a standardized sample of steel.

The Brinell hardness number D is defined as

$$D = \frac{P}{S}$$

where P is the pressure and S the surface of the spherical impression. If d is the diameter of this section and a the diameter of the ball

$$D = \frac{P}{\pi a\left(\frac{a - \sqrt{a^2 - d^2}}{2}\right)}$$

If the impressions on the specimen and the standard are made at the same time P is then a constant and the only variable is d. Therefore if D_1 and d_1 are respectively the hardness number and the diameter of

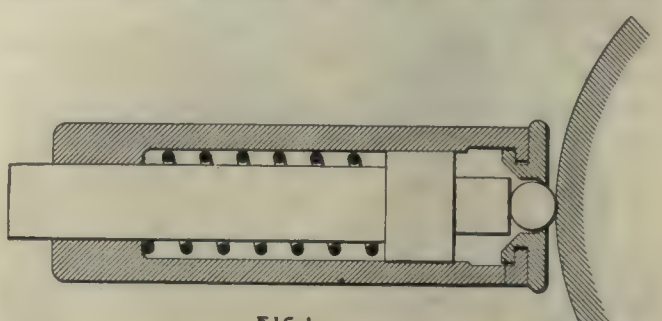


FIG. 1

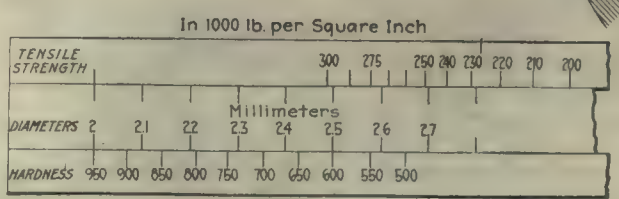


FIG. 2

FIGS. 1 AND 2. PARTS OF PORTABLE BRINELL TESTING KIT

the impression of the specimen, D_1 can be determined from D, d and d_1, where D and d are the corresponding values for the standard block.

The instrument is composed of an aluminum tube into which slides a hardened-steel plunger as shown in Fig. 1. A lower cap locked in place by half a turn retains the standardized cube and the 10-mm. ball which makes the impression. The whole thing is about four inches long.

Impressions are made by holding the instrument hard against the specimen, the spring insuring good contact between the specimen, the ball and the standard, and hitting a hard blow with a hammer on the head of the plunger.

With the aid of a small folding microscope included in the outfit the impressions are measured to within a few thousandths and a special slide rule gives the hardness number sought. The slide rule is graduated as indicated in Fig. 2. By setting the diameter of the impression on the standard above its hardness number on the lower scale either the hardness number of the specimen or its tensile strength can be found in line with the diameter of the impression.

For very accurate determinations it would be advisable to take into account the difference in hardness between faces with and across the grain, but this instrument is mostly a shop tool.

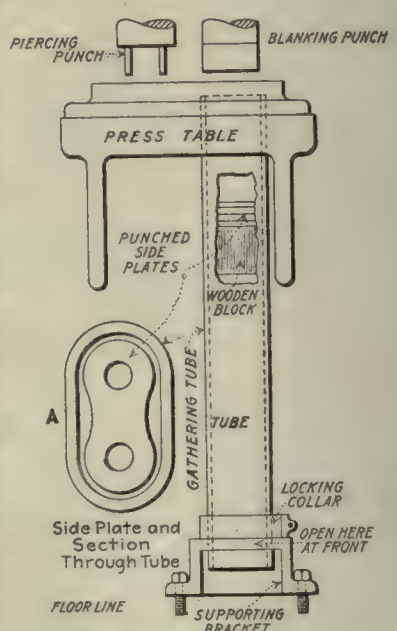
It is used by foremen for calculating from the hardness the cutting speeds allowable and by storeroom keepers for checking the carbon contents of unmarked bars of steel. It also allows of testing the hardness of parts too large to be handled under the standard Brinell tester and the result of their heat treatment.

Automatic Stacking of Chain Links

By M. E. Duggan

In an article on the manufacture of diamond transmission chain, page 1077, Vol. 49 of the *American Machinist*, J. V. Hunter says: "Some hand labor is used in gathering the parts and so arranging them that they may be properly placed in the machine magazine."

Here is a method for a similar operation in the manufacture of bicycle chains that may be of interest. The side links of the chains are pierced, blanked and gathered in a single operation on the punch press. A steel tube shaped as shown in the cut at *A* fits in a corresponding recess on the under side of the die and is held by a supporting bracket. This bracket has a split band which is adjusted tight enough to allow the tube to slip down and clear the die and press table in case of accident to the tools. A block of maple wood is shaped to fit tightly into the tube and is placed at the top end of the tube. As the side plates are punched this block recedes down the tube and at the same time the friction is sufficient to keep the blanks together and flat in the tube.



STACKER FOR BICYCLE CHAIN LINKS

When the tube is filled the operator is notified by means of an electrically connected bell. The full tube is removed and another tube, with follower set, is ready to be placed in the press.

The full tube is held in a vertical position, wires are dropped down through the holes in the links and the tube is then reversed and lifted vertically away from the links, leaving them laced on the wires ready to be transferred to the chain assembling machine, or the tumbling barrel to have the burs removed.

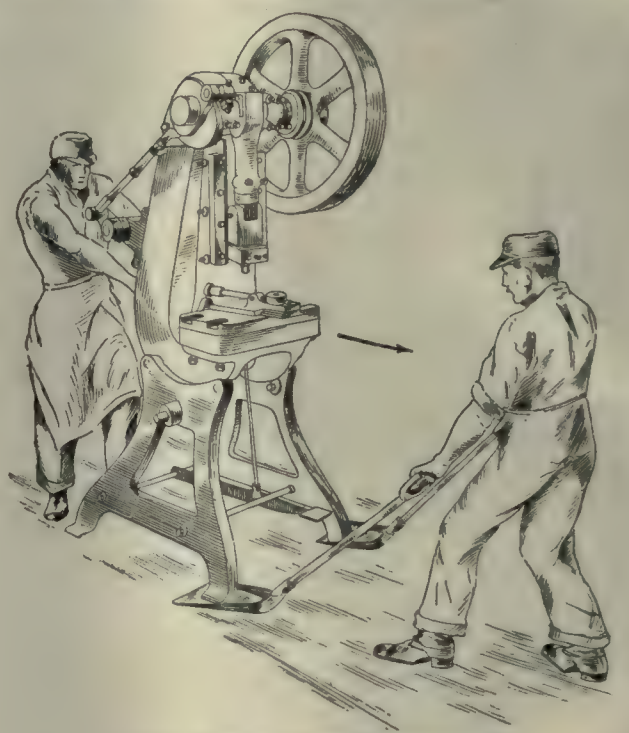
With this method of gathering the links it will be noticed that the burs are all on the same side when they come from the press.

Easy Way to Move Machinery

By S. B. Royal

When a machine, such as a punch press for instance, is to be moved over a wooden floor an easy way to do it is provided by placing ordinary shovels under the two front legs.

While a man or several men, according to the weight of the press, pushes from behind, another man walks



EASY WAY TO MOVE MACHINERY

in front of the machine guiding the shovels, and incidentally the machine, which can be done with remarkable ease by merely turning the handles in the desired direction.

The man in the lead should exert little or no pull on the shovels, as that would serve only to displace them. The effort required to move even quite heavy machinery by this means is surprisingly small.

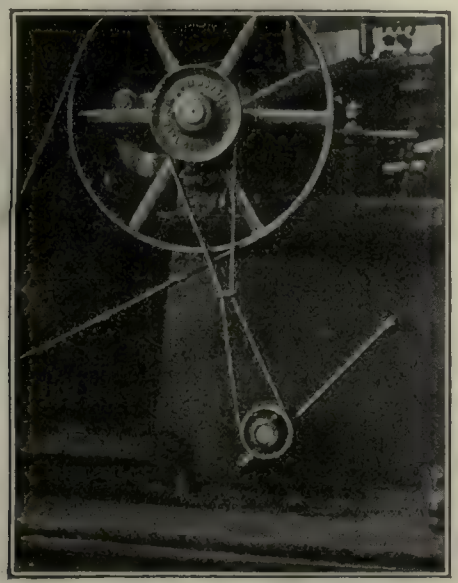
Keeping the Oil-Pump Belt On

By W. T. Delaney

On a battery of 100 metal-cutting saws much time was lost in putting on the little round belt of the oil pump drive, which was continually running off. On a batch of five of these machines in charge of a 16-year-old boy we noticed that no belt repairs were required. Upon investigation we found that the boy had taken a $\frac{3}{4}$-in. pipe and cut off sections about $\frac{3}{16}$ in. thick, slipping the rings over the belts as shown in the illustration. This ring served as a tightener, giving the belt a greater driving angle and preventing it from

slipping off the pulleys. The boy, a foreigner hardly able to speak English, had unknowingly solved a troublesome problem. No doubt a good many other firms have the same trouble.

We improved upon his idea by taking a piece of $\frac{3}{16}$-



TIGHTENER FOR OIL-PUMP BELT

in. round wire and bending it into a ring. The round wire was better than the ring of pipe in that it had no sharp corners by which the belt could be scraped or cut.

A Useful V-Block Fixture

By Herbert M. Darling

A fixture which adds considerably to the usefulness of a pair of V-blocks is shown in the sketch, Fig. 1.

A cast-iron plate planed all over has in it a shallow groove of the right width to fit the V-blocks. Fillister-

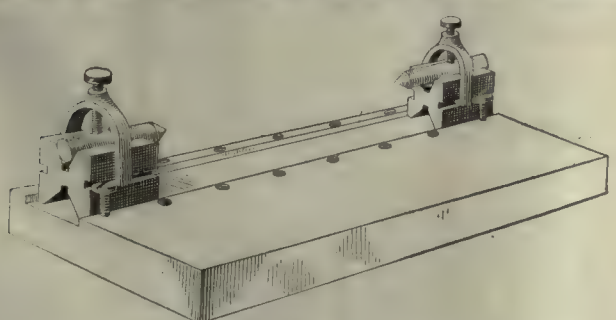


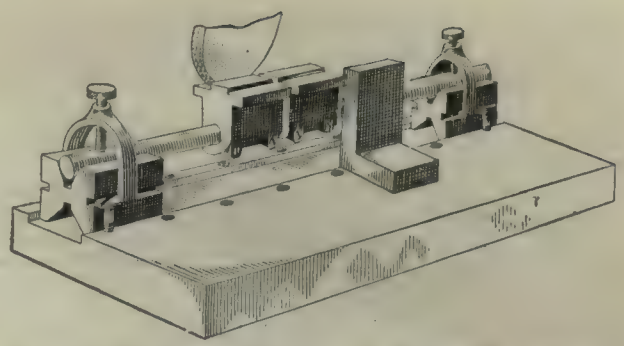
FIG. 1. BASEPLATE AND CENTER FOR V-BLOCK

head screws are used to hold the V-blocks to the plate, the screw heads fitting in the grooves of the blocks.

Centers are made of $\frac{3}{4}$-in. drill rod hardened and ground. Several pairs of screw holes are provided in the plate to hold the blocks in different positions.

Fig. 2 shows a pair of spindle heads used on a gage for aligning the front and rear sights of the Springfield rifle. The spindle holes are lapped and the bases must be ground to bring the holes in line.

I made a bar to accurately fit the holes and clamped the two heads on it, setting it in the V-blocks, as shown in Fig. 2, to grind both heads at once. The fixture is lined up on the grinding machine by placing it on the magnetic chuck against the back stop, and the



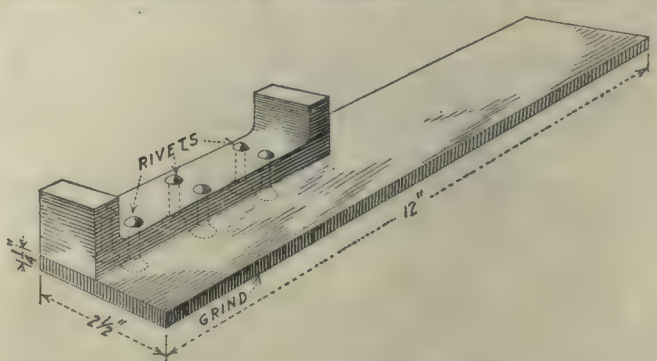
FIGS. 2. GAGE AND METHOD OF GRINDING SAME

angle iron is used as a measuring point, being placed in such a position that a micrometer may be used to measure over the bar and also over the spline, making it an easy matter to grind the spline central with the holes.

How Would You Prevent This Grinding Trouble?

By John Vernon

We have a part which is made, as shown in the illustration, of a piece of cold-rolled steel $\frac{1}{4}$ x $2\frac{1}{2}$ x 12 in. long, to one side of which is riveted a cast-iron bracket, and after the riveting is done we desire to



THE PIECE TO BE GROUND

grind the flush side to a smooth finish over its entire length, including the rivet heads.

We found upon experimentation that the cold-rolled steel would warp under this treatment by reason of the release of surface strains.

Can any reader of the *American Machinist* tell us how to accomplish the operation without incurring this trouble?

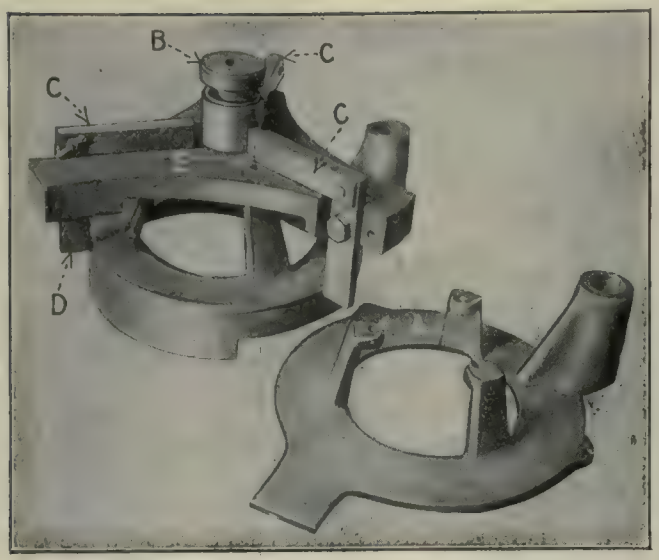
Though the piece is now made of cold-rolled steel, other steel could be used if we could get it with a fairly smooth surface and with the edges square.

Jig for Drilling Wheel-Guard Spiders

By E. V. Allen

The drilling of the holes *A* in the spider arms of the wheel guards shown in the illustration is easily accomplished by using a self-centering and clamping jig. These guards are used on the machines made by the Grand Rapids Grinder Co., Grand Rapids, Mich., and are of two forms, straight and flanged, as shown. The same jig answers equally well for both.

In using this jig it is set down over the casting, and the knurled nut *B*, operating a cone-shaped plug, is



JIG FOR DRILLING WHEEL-GUARD SPIDERS

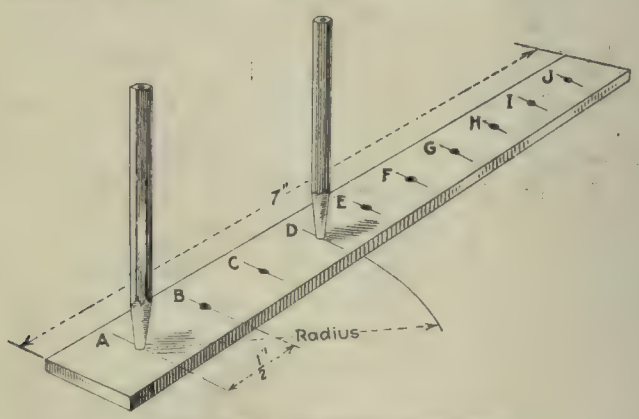
tightened. This causes the slides *C* to move outward and the jaws *D* to clamp onto the work. The holes are then drilled through bushings like *E* set into the jig plate.

Tool for Drawing Circles

By J. H. Moore

If a stout piece of cardboard or piece of thin wood about $\frac{3}{4}$ to 1 in. wide, as shown in the sketch, is carried in the vest pocket, circles will become as easy as straight lines to the sketcher.

For example, by placing one pencil at hole *A* and another in hole *D* a circle of 3 in. in diameter can be



TOOL FOR DRAWING CIRCLES

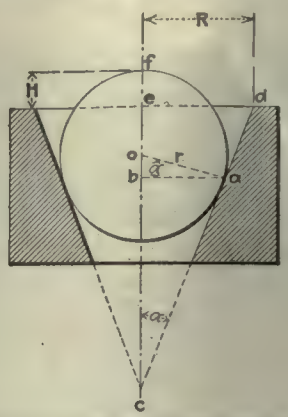
described with ease, and so on as dimensions show. It can of course be elaborated upon by making other lines of holes to draw whatever diameters of circles may be desired. No other explanation is necessary. This tool if once used will become a part of the sketcher's outfit.

Making Some Difficult Duplicate Gages

By Adolph Moses

On page 162 of the *American Machinist* the making of a master ring gage is described, which has the serious drawback of depending upon a sharp edge for its accuracy. This gage could have been made in one piece by the use of an accurate ball to measure the diameter of the base circle.

This would be done by placing the ball in the conical hole, which had been ground and lapped, and then grind-



MEASURING GAGE BY MEANS OF BALL

ing the base until it was the proper distance from the center of the ball. This distance may easily be computed by means of trigonometry.

Referring to the sketch we have given:

angle $fcd = \alpha$
radius $oa = r$
radius $ed = R$

to find, $ef = H$.

In right triangle oab

$$\angle oab = \alpha$$
$$bo = r \sin \alpha$$
$$ab = r \cos \alpha$$

In right triangle abc

$$cb = ab \cot \alpha$$
$$= r \cos \alpha \cot \alpha$$
$$of = oa = r$$
$$cf = cb + bo + of$$
$$= r \cos \alpha \cot \alpha + r \sin \alpha + r$$

In right triangle ced

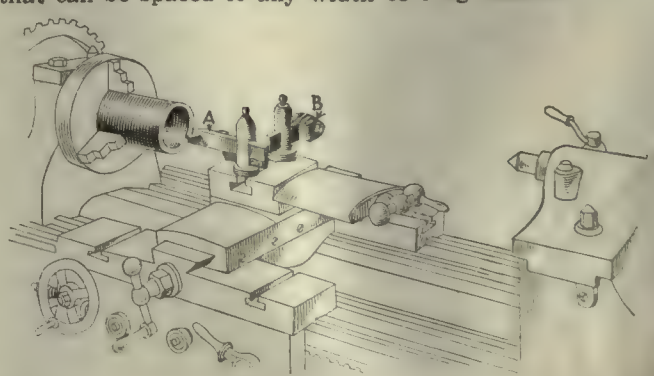
$$ce = ed \cot \alpha = R \cot \alpha$$
$$H = ef = cf - ce$$
$$= r \cos \alpha \cot \alpha + r \sin \alpha + r - R \cot \alpha$$

Parting-Off Piston Rings Accurately

By F. T. Schell

The sketch shows a method for machining piston rings which I think is superior to the one shown by W. G. Datson, on page 1047, Vol. 49.

The tool *A* is used for turning and boring and *B* is the parting tool, which consists of four disk cutters that can be spaced to any width of ring desired.



TOOL FOR CUTTING OFF PISTON RINGS



Modern Artillery Ammunition

By H. M. BRAYTON
Formerly Captain in the Ordnance Department, U. S. Army, Experimental Engineer at Frankford Arsenal

This is the first of a series of articles on the design of artillery ammunition which were written with the idea of aiding the new designer by presenting fundamental principles in as simple a form as possible and free from complicated mathematics. It is hoped that this series will help to prevent some of the natural loss of interest in ordnance topics which will normally follow the signing of the final peace terms.

THE Great War is apparently over and the world will undoubtedly settle back gradually into its old uninterested attitude toward guns, ammunition and other implements of war. Much has been said and written during the past four or five years on these subjects because a knowledge of them was very vital to our national existence. Men realized what a priceless thing a well-equipped and well-trained army really was and how difficult it was to produce up-to-date guns and ammunition on short notice. Prior to this war the general public, including the engineering societies, considered these subjects of interest only to those few officers of the regular service who were assigned to that work.

What will the public of the future know of these things? What interest will the average man or even the average engineer take in these matters in the years to come? These are vital questions now, and the whole future of our nation depends upon them. Will the engineer who is not connected with the army take sufficient interest to spend a little of his spare time in the study of ballistics and gunnery, and will he from time to time submit to the government his ideas on ammunition, or will he forget as the years roll by the great need which this country must meet in this field if it is to keep up with foreign armies?

Much was accomplished during the war in the development of new things to meet the urgent demands of the service. Some of the new things reached the western front in time to be of value to the army. Others were in the process of development. Much has been done of which nothing has as yet been written and undoubtedly much will be kept confidential to the service for some time to come. Yet regardless of all that was accomplished, much still remains to be perfected and many new things are needed before we can safely say that our army is among the best equipped in the world. We are still far behind the other great nations in this respect and it is with a view of creating an interest among the engineers of the country in these vital subjects that this article is written. The writer desires to bring before the public the true state of affairs and to point out how the technical men of the nation can best render a patriotic service by becoming interested.

Wars are not over. History will surely repeat itself. That old and very popular saying "The more we prepare for war the more certain we are to have it" has, I trust, been disproved in the last few years. When it will come next no man living can tell, but it is sure to come, and the one way to delay that day and to shorten it when it does finally come is to be thoroughly prepared for a conflict. Fully prepared here does not mean merely a well-trained army of men, although this is a prime requisite, but it means an up-to-date Ordnance Department with the latest requirements of all branches of the service fully developed and ready to put into quantity production at short notice. It is a well-known fact that it takes a much shorter time to train a man to be a good soldier than it does to design and perfect a new device. Months are required for the latter while a few weeks makes a soldier. Men available for the research and experimental work are few and as a rule must be trained for the work by years of study and practical experience.

The engineers of the country knew very little about the technical side of guns and ammunition before this war. Many were forced to become acquainted with these things during the national emergency through which we have just passed. They have done good work for their country, but they could have done much better work had they been trained or had they had even a fundamental knowledge of ordnance and gunnery. This lack of knowledge was clearly shown in the character of the many ideas submitted on ammunition and guns for the consideration of the Ordnance Department. The majority of these, although many of them came from technical men, were impractical and showed an utter lack of appreciation of the fundamental principles of the subject. Devices were produced which could not possibly function as their designers desired and intended they should, due to the high forces existing in the gun and in flight which had perhaps been entirely neglected.

Most of the forces with which the designer has to deal are simple ones which follow the ordinary laws of mechanics with a precision which is mathematically exact. They are readily calculated by one who is familiar with elementary mathematics. Of course one

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must use higher mathematics for some of the more intricate calculations, but these for the most part need not worry the ammunition designer. The inventor of new devices for ammunition is principally interested in interior ballistics or the forces and conditions existing in the gun during the travel of the projectile.

The writer wishes first to take up in this article a discussion of the fundamental forces which act upon the shell in the gun. His object in doing this is to enable the engineer who wishes to submit his ideas to the government to calculate first the stresses in his design. He may find that they are so great that the

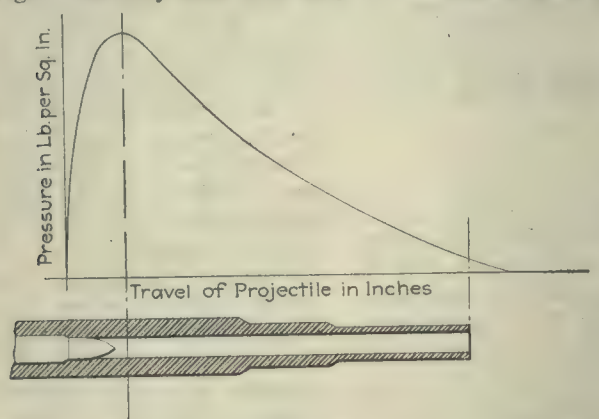


FIG. 1. PRESSURE-TRAVEL CHART FOR ARTILLERY SHELL

mechanism can not operate at all as he desires. The standard textbooks on the subject are so full of mathematics that the average man does not have time to wade through it and pick out the methods which apply to his design. It is the intention to give here in as simple a manner as possible those formulas which must be considered, and not to burden the reader with those which are of interest only in the final analysis.

Every one knows that a shell is projected forward by the action of powder gases exerting a pressure on the rear. This pressure is produced by the rapid burning of some form of powder in the bore of the gun and exists throughout the whole bore of the gun while the shell is traveling outward, although its intensity varies greatly. Fig. 1 shows the pressure curve. It will be noted that the pressure rises rapidly at first and then gradually drops off as the projectile travels forward. The exact shape of this curve will depend on several factors such as the character of the powder, the weight of the shell, and the density of loading which is the ratio between the weight of the powder charge and the weight of a volume of water equal to the powder chamber. It will be noticed that this curve does not reach zero at the muzzle of the gun but extends beyond. This means that the gases exert a pressure on the shell for about 10 ft. beyond the muzzle, an important fact which must not be lost sight of in the design.

All bodies which have mass possess inertia and a shell is no exception. We have in this case a heavy shell acted upon by the gases. The body moves with an ever-increasing speed and we say it has an acceleration. This acceleration can readily be calculated by the formula

$$F = Ma = \frac{Wa}{g} \qquad (1)$$

which is commonly known as the inertia law and in which

F = the total force acting on the base of the shell in lb. = the area of the base multiplied by the intensity of pressure in lb. per sq.in.,

M = the mass of the shell = $\frac{W}{g}$, where W = the weight of the shell in lb. and g = 32.2 ft. per sec. per sec., and

a = the acceleration of the shell in ft. per sec. per sec.

The pressure curve shown in Fig. 1 can be obtained either experimentally or by calculation and from it the value of F in the above formula can be determined. W is obtained by weighing the shell. The value of a can then be found by the formula. It is possible then to plot an acceleration-travel curve which will have the same general shape as the pressure curve. Such a curve would give the acceleration at all points along the bore. Generally however this is not needed and it is customary to consider only the maximum value, which occurs of course at the peak of the pressure curve. This maximum value of the pressure can easily be obtained by means of pressure gages. When tables of acceleration for different guns and howitzers are given, the maximum value is always implied.

The acceleration produces in the shell a condition known to the service as "set-back." This means that as the shell is accelerated, all parts having inertia tend to remain at rest, the effect being to produce severe stresses of a compressive nature in these parts. Any small part within the shell is then subjected to a very severe compressive stress when the gun is discharged, and unless the metal is strong enough to withstand this stress it will deform and fail to perform its proper function. The shell itself is not immune to this force, as all parts front of the driving band must be accelerated. The section of the shell just front of the band receives the greatest stress and this must be kept below the elastic limit of the steel, otherwise the shell will bulge in the bore and perhaps jam and blow up the gun.

The method of calculating this set-back force is very simple. Knowing the acceleration as derived from formula (1) we merely apply the inertia law again as follows

$$F' = \frac{W'a}{g} \qquad (2)$$

where F' = total force of set-back in lb.,

W' = the weight of the part under consideration in lb. and

a = acceleration of the shell in ft. per sec. per sec.

The parts upon which we desire to obtain the set-back are usually small, and it is convenient to have this formula in other units as follows

$$F' = \frac{W''a}{7000 \times 32.2} = 0.00000444\,W''a \qquad (3)$$

where W'' = the weight of the part in grains (1 lb. = 7000 grains). Tables have been worked out by the Ordnance Department giving values of F' (when W'' equals 1) for the different guns and howitzers used in our service. It is often convenient to combine formulas

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(1) and (2) and thus eliminate a and g. The following substitution will show this:

$$F = \frac{Wa}{g}. \quad \text{Therefore } a = \frac{Fg}{W} \text{ (from eq. 1)}$$

$$F' = \frac{W'a}{g}. \quad \text{Therefore } a = \frac{F'g}{W'} \text{ (from eq. 2)}$$

Combining

$$\frac{Fg}{W} = \frac{F'g}{W'}, \text{ from which } FW' = F'W$$

But $F = PA = 0.785\ D^2P$,

where P = pressure in the gun in lb. per sq.in.,
D = diameter of bore in in.

We can then substitute this value for F and obtain

$$WF' = 0.785\ D^2PW' \qquad (4)$$

Or we may prefer this formula in terms of W'', when it becomes

$$F' = \frac{0.785D^2PW''}{7000W} \qquad (5)$$

If we make $W'' = 1$ grain, this becomes a simple four variable equation of the product type,

$$F' = \frac{0.000112D^2P}{W} \qquad (6)$$

This formula is used so much and is of such great importance to the designer of ammunition that the writer has deemed it worth while to build it up in the form of a graphical chart from which any one of the four variables may be obtained very quickly and without calculation when the other three are known. Such a chart is shown in Fig. 2. It is designed to cover the usual range of the variables which enter into the formula. The values of D, P and W are the ones usually known, with F the unknown. It is then only necessary to connect the known values of D and P and by means of a straight edge marking the point of intersection with the center vertical which carries no scale. Then connect this point with the value of W found on its scale and this line prolonged will cut out the true value of the set-back, F', in lb. per grain on the outer scale. The chart illustrates by means of the dot-dash lines the method of using the chart. The case taken is that of the 4.7-in. field gun, the projectile of which weighs 60 lb., and the maximum pressure reaches a value of 35,000 lb. per sq.in. The chart shows a set-back equal to 1.44 lb. per grain. In order to get the total set-back it is of course necessary to multiply this value by the weight of the part in grains. It must be remembered that this value is the maximum and occurs only at the peak of the pressure curve. Furthermore, this stress exists for a very short interval of time. If ammunition is designed on this basis, however, it is on the safe side and no trouble will result.

Fig. 3 gives a similar chart for obtaining the set-back produced in smaller caliber guns such as the rifle and machine gun. This chart also covers the modern 11-mm. gun. The method of reading is exactly the same as described above for Fig. 2. The dash-dot lines show that it is necessary to connect the value of W in grains with P. Then through the value of D and the intersection of the first line with the diagonal a line is drawn which will cut out the proper value of F'. The cross lines here drawn show the condition in the small arms service rifle where $D = 0.30$ in., $W = 130$ grains, $P =$ 42,000 lb. per sq.in. and $F' = 22.8$ lb. per grain. This chart is built up on the formula

$$F' = \frac{0.785D^2P}{W} \qquad (7)$$

where W = weight of the bullet in grains.

It will be noted from the above discussion that the force of set-back is very much greater in small arms design than in artillery.

Such mathematical values of these various variables pertaining to the different guns as the civilian engineer may require in carrying out such calculations as the above may in most cases be obtained from the Ordnance Department in Washington. It is usually necessary, however, to show that they are desired for a legitimate

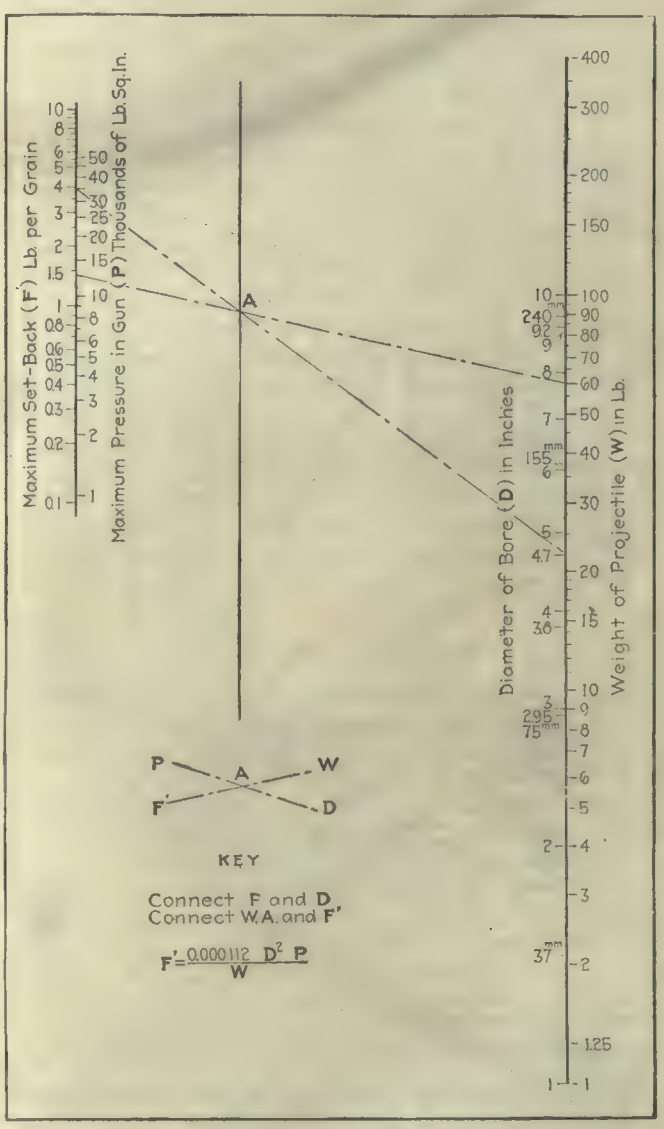


FIG. 2. INERTIA CHART FOR ARTILLERY AMMUNITION

purpose. Such values as the diameter of the bore, powder pressure and weight of the shell are usually widely known and are readily obtained.

The reader may have been led to believe from the above discussion that the force of set-back was always a hindrance to the designer and something not desired. Often this is the case, but regardless of its destructive

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properties it is much used in modern ammunition. Many fuses, especially of the smaller and less complicated designs, rely upon set-back for their operation. It is a common thing to make the set-back release safety catches and start time fuses functioning.

Set-back forces are, generally speaking, smaller in large guns than in small ones and practically always lower in howitzers and mortars than in guns of the same caliber. This is due to the higher pressures carried in the guns. Set-back is sometimes spoken of as the "shock of discharge." As such it often causes trouble

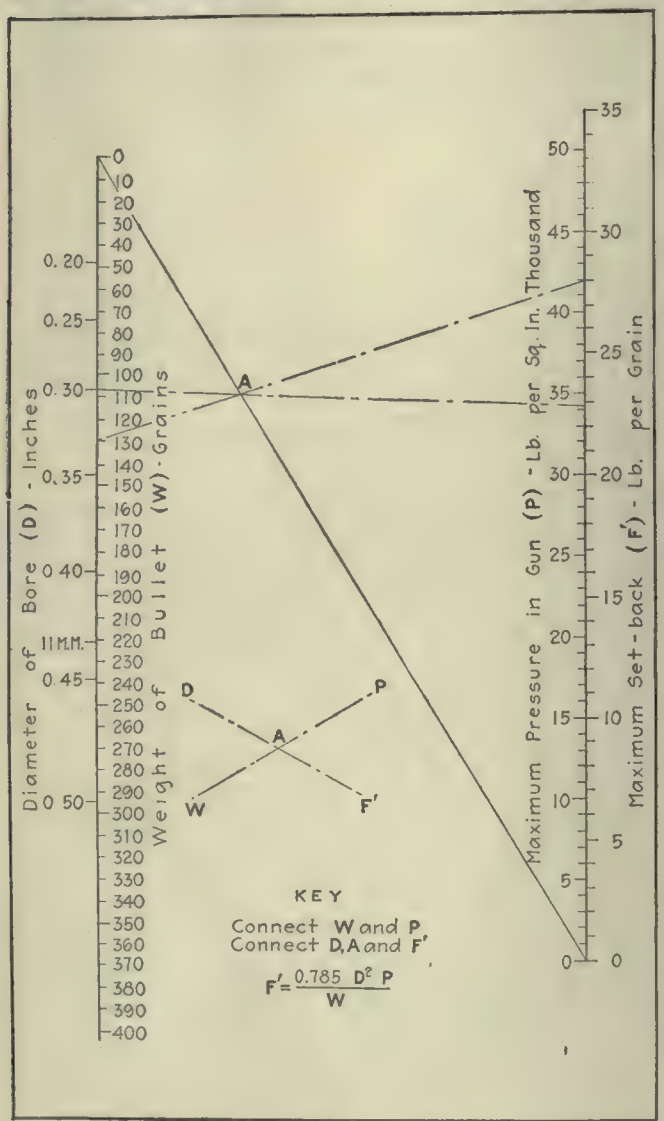


FIG. 3. INERTIA CHART FOR SMALL ARMS AMMUNITION

with the sensitive explosives such as mercury fulminate used so extensively in detonators. It is a well known fact among ammunition designers that a column of fulminate greater than ¾ in. long will explode in the 3-in. field gun upon discharge. This fact in regard to the effect of set-back must always be borne in mind when designing parts to carry the super-sensitive explosives.

It will be readily appreciated from the above discussion that all devices which are to be put on shell must be designed for the gun in which they are to be fired. This is one of the reasons why so many different types of fuses are needed in the service and why one fuse can not be obtained to fit all guns and howitzers.

In succeeding articles the writer will discuss the other forces acting on the shell in the gun and in flight, after which he will give a description of some of the new things which were developed by the experimental department at the Frankford Arsenal during the war. The reasons why these new things were needed and their manner of use will also be taken up. These articles are certified by the chief of ordnance before being published.

PERSONALS

First Lieut. D. S. Anderson, of 1720 Beacon St., Brookline, Mass., has been discharged after 13 months' service. He was formerly with the Henley-Kimball Co., Boston, Mass., and has served as inspector of ordnance.

* * *

Lieut.-Col. William Libbey, who was commissioned in February, 1918, and has acted as chief rifle demonstrator, has been discharged. He is a graduate of Princeton, and before entering the service, was a professor of modern languages at that university.

* * *

Capt. S. W. Horner, of Germantown, Penn., who was commissioned first lieutenant in February, 1918, and has been on duty in the Engineering Division, has returned to civil life. He was graduated from Dartmouth in 1907, and has been employed by the Eastern Motor Corporation, Pennsylvania.

* * *

Maj. John J. O'Connell, who was commissioned captain in 1917 and has been on duty in the Rochester district office, has left the service. He is a graduate of the University of California and a hydraulic engineer, being formerly employed by the Electric Bond and Share Co., 71 Broadway, New York.

* * *

Capt. Harry B. Johnson of Springfield, Mass., has left the service. He was commissioned in January, 1918, went to France in February, and has just returned. His work there was with the Finance Division, for which his previous experience with Harris, Forbes & Co., Investment Securities, fitted him.

* * *

First Lieut. Paul W. Engelhardt, who was commissioned in November, 1917, has returned from abroad and left the service. He acted as machine-gun instructor and was for a time attached to the 111th Mobile Ordnance Repair Shop. Lieutenant Englehardt was formerly in the employ of the Oldsmobile Co., 1806 Broadway, New York.

* * *

Maj. Malcolm S. Huey, Princeton graduate, who was recently discharged, was commissioned captain in December, 1917. His service has been entirely in personnel work, first in the Supply Division in Washington and later, overseas. Before Major Huey was commissioned, he was with William A. Read Co., Investment Securities, Philadelphia, Penn.

EDITORIALS

Never Mind Who Makes the Tonic

AN INTERESTING comment on the desire of France to do most of its own reconstruction work is found in the Paris edition of the New York *Herald* for Feb. 25. This is in the nature of a warning given by Judge Walter F. Berry, president of the American Chamber of Commerce of Paris. He quotes a typical case as follows:

"A French industrial in the north, whose textile machines were stolen and carried to Germany, recently placed an order in the United States for new machinery. These being now completed, he applied for an importation permit. It was refused on the ground that he must have his looms built in France. He replied that such looms had never been made in France; that special machinery is necessary to make them; that such special machinery is only built in the United States and in Germany, in which latter country, by the way, these old machines had been purchased. He added that if the permit were granted, his factory would be employing several thousand workmen within six months and would be producing materials for exportation."

* * *

It would be poor judgment for one who had suffered a severe sickness to refuse to take a tonic that would make him well simply because it was concocted by a druggist living outside of his block. A tonic that will make industrial Europe get on its feet quicker than anything else consists of American labor-saving machines.

Rehabilitation of the War-Maimed Returning Fighter

WE READ a great deal about the excellent work being done by the Red Cross Institute and other organizations in furnishing the maimed fighters with artificial limbs that will in part remove their disabilities; we see pictures of the maimed at work after being fitted with such aids; we read of the establishment of schools for the vocational training of the maimed in different parts of the country. All these things are excellent and are moves in the right direction but they must be followed by something more tangible—employment for the maimed—and of this we hear little or nothing.

* * *

The daily press has assured us from time to time that work was to be furnished to all our disabled fighters so that they might not want. Where are these jobs and does anyone know of a maimed soldier or sailor having been given actual employment?

A report comes from Chicago that the general superintendent of a large mail order house has completed a survey of his plant and that he has found jobs that can be satisfactorily filled by men having every kind of disability. Has he placed any of our disabled men in these jobs?

Surveys have been made without number, but surveys are preliminary and may mean much or they may mean little, but what about the actual job for the maimed.

Approximately 200,000 of our oversea forces are disabled, about half of them are suffering from wounds and half from diseases contracted in service. Of these about 196,000 had been brought back to the United States up to Mar. 1, and the small contingent now in France will soon be here.

* * *

What are we going to do with and for them? They don't want charity, they don't want pity; they want employment at a living wage that they may support themselves and those dependent on them.

How many mills, factories, stores and offices are there in these United States? If each one of these establishments would agree to furnish employment for one disabled soldier, there would not be enough disabled soldiers to fill all the positions offered.

* * *

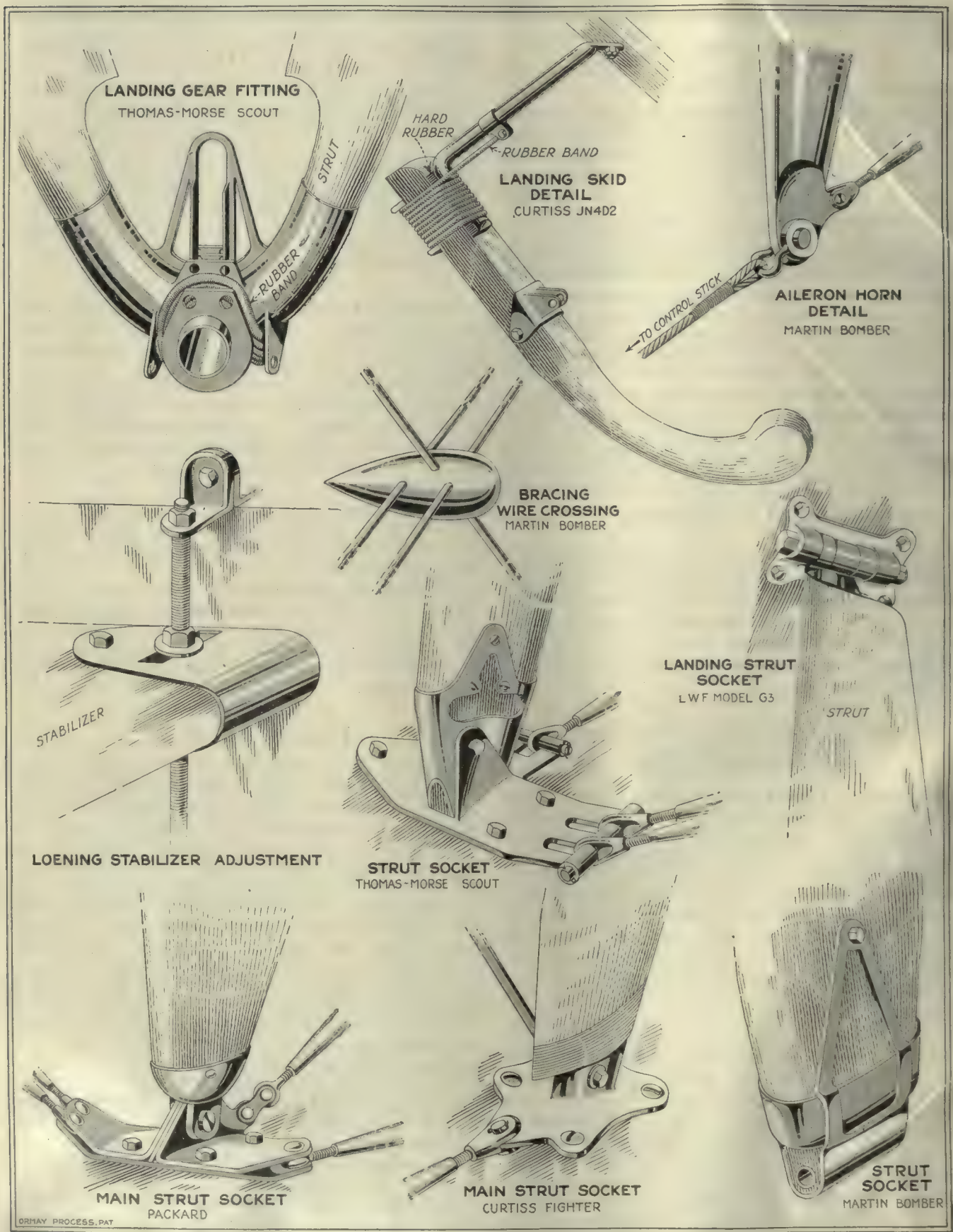
Are these men going to be given work or must we see reënacted such scenes as took place after the Civil War—maimed soldiers rattling pennies in tin cups at the street corners.

Get busy, Mr. Manufacturer, make surveys if you choose, but in Heaven's name find a job in your plant for a maimed soldier, and give it to him, not grudgingly but cheerfully, as cheerfully as he crossed the ocean to help lick the Hun and make this country safe for all of its citizens.

How to Sell Now

ONE big factor that is retarding the sale of many of the manufactured products today is the argument that price reductions are due. If salesmen can convince the buyer that prices will hold reasonably stable for the next few months, most of them will do a very good business. During the last year for which statistics are available, the total value of products manufactured in this country was $24,246,000,000. Of this total, raw materials constituted about 60 per cent.; rent and taxes 2 per cent.; depreciation, interest, and profits 16 per cent.; and labor, the important item of 22 per cent. In view of the labor difficulties facing the country at the present time, there seems little immediate chance of labor costs being cut down appreciably. Neither will rent, taxes, interest, or depreciation show radical reductions. Leaving profits out of the discussion, the remaining item is raw materials, which makes up somewhat over 50 per cent. of the total cost. This means that if the cost of the finished product is to drop 1 per cent., the average cost of the constituent raw materials must drop 2 per cent. Furthermore, it is difficult to reduce the price of a finished product as soon as raw materials go down; there is usually a time lag. These facts should be presented to the reluctant buyer.

Some Typical Metal Fittings Seen at the Aeronautical Exposition





SHOP EQUIPMENT NEWS

Schmidt-Norgren Duplex-Spindle Plain Turning Lathe

The illustrations show a duplex-geared-spindle, plain turning lathe which has been developed with the object of providing means for turning small-diameter work between centers and operating on two pieces simultaneously. The idea is particularly to provide for the turning of such pieces as cannot be turned on automatic screw machines because they are too long or must be centered for final grinding operations. A number of cutting tools for turning both straight and tapered work can be fitted and back tools can be provided for necking and undercutting operations. This machine is the product of the Schmidt-Norgren Co., 3121 South California Ave., Chicago, Ill., and is at present made in one size and type swinging 10 in. over the ways and 6 in. over the cross-slide with a capacity of 24 in. between centers.

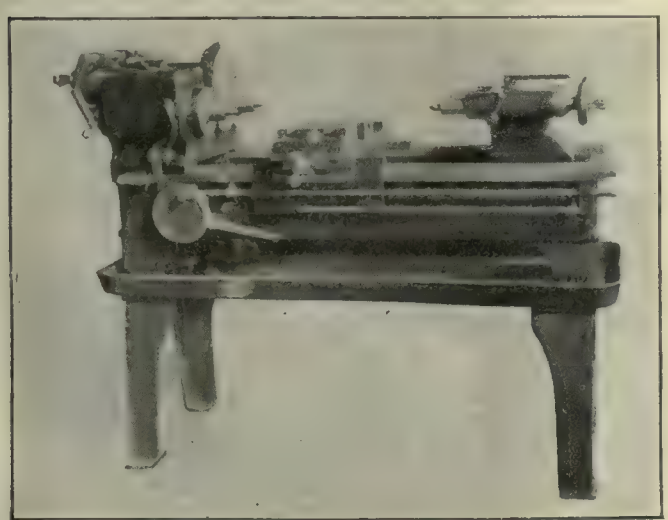


FIG. 1. THE DUPLEX-SPINDLE PLAIN TURNING LATHE
Weight, 1300 lb.; length of bed, 56 in.; floor space, length, 62 in., width, 39 in.; height, 52 in.; drive pulley diameter, 6½ in., face, 3½ in., speed, 420 r.p.m.; maximum distance between centers, 24 in.; swing over bed, 10 in.; swing over cross-rest, 6 in.

The bed is of heavy design with a double vertical wall or web on each side forming a hollow column extending the full length on each side of the center line. A cast-iron chip and oil pan is provided a short distance below the bed. Fig. 1 gives a general view of the front of the machine. Two spindles are carried in a widened headstock, and a widened single tailstock base carries two distinct tail spindles each of which is operated by an individual handwheel.

The carriage is provided with a double cross-slide with two wide toolpost surfaces, one for each spindle, these surfaces being provided with T-slots. The rear toolpost rest is carried on the main body of the cross-slide, while the front toolpost rest is a separate casting, fitted to a separate slide on the main cross-slide and operated by its individual cross-feed screw, the crank handle of which may be seen directly above the handle of the main cross-feed screw. This arrangement permits the tools for the two spindles to be adjusted separately, to the extent at least that after adjusting the rear tool carried on the portion of the main cross-slide, the front tool can be set in place. Conversely the front tool may be removed and readjusted without disturbing the rear tool. At times when one spindle is used for roughing and the other for finishing the front spindle should be used for finishing, as more frequent adjustments are of course necessary in this class

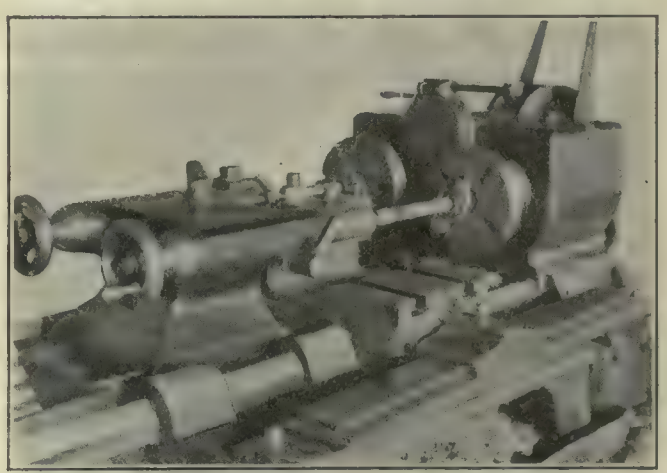


FIG. 2. TAPER-TURNING ATTACHMENT IN SERVICE

of work. The carriage is also provided with a taper-turning attachment which can be seen in service, Fig. 2.

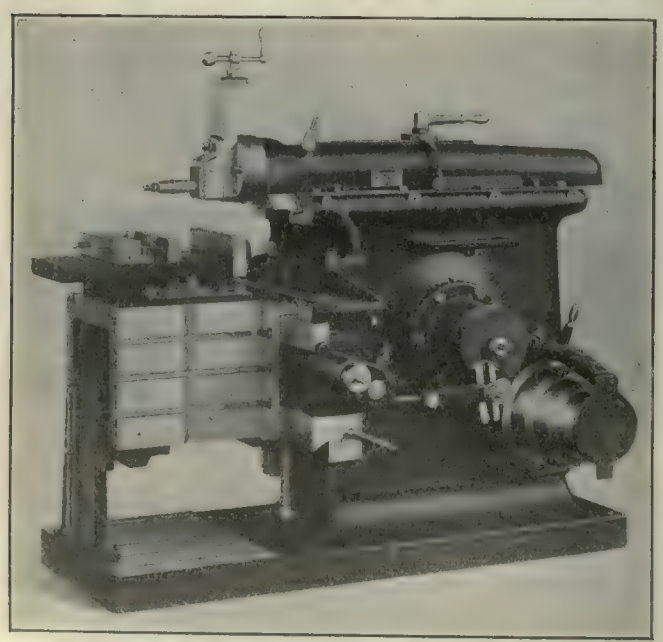
The spindles which are 10 in. apart to leave room for tooling between them, are equipped with SKF ball bearings and thrust bearings. The drive from the single-belt pulley is controlled by a friction clutch operated by the upper left lever, Fig. 1. There are four speeds, 150, 190, 230 and 280 r.p.m., when the pulley is driven at a speed of 420 r.p.m.

The ends of the spindles are designed to permit the use of pneumatic chucks. The head is constructed as an entirely inclosed casting so that the gearing may run with this chamber partially filled with oil. The gear shifting is done by means of the handle on the top of the head which operates a square-tooth clutch.

Standard screw-feed is used for the carriage and this feed is provided with an automatic knock-out rod which will be noted as the upper rod extending across the front of the tool carriage. In disconnecting the screw-feed this knock-out rod throws in the hand-feed by which the carriage can be advanced any slight distance that may be necessary to reach a positive stop carried on the lower rod when working to close limits. When the knock-out trips the feed it also operates a square-tooth clutch, and by a spring arrangement automatically engages the hand-return which operates through spiral gears.

Mattison 20-In. Shaping Machine

The 20-in. high-duty shaping machine shown in the illustration is being marketed by the Mattison Machine Works, Rockford, Ill., and is said to be of such construction that it will stand up under the heaviest type of work. The column is wide and deep and is ribbed and provided with a large base. The main bearing for the bull gear is in the form of a heavy bushing pressed into a machined recess in the column and securely locked in place, this construction eliminating dowel pins and bolts that are customarily used to secure this bearing in place. Two diameters of bearing for the bull gears are provided in this bushing, to prevent breakage at the shoulder of the gear. The table is rugged, the top surface of the table proper measuring 16 x 17 in., but by removing the dust guard, the available working space may be increased to 16 x 22 in. The T-slots are machined from the solid. The table support is another feature that is stated to be unusual. The base is extended beyond the outer edge of the table and the sliding surfaces are under the table out of the way of dirt. The construction also prevents upward vibration as well as downward.



MATTISON 20-IN. HEAVY-DUTY SHAPING MACHINE

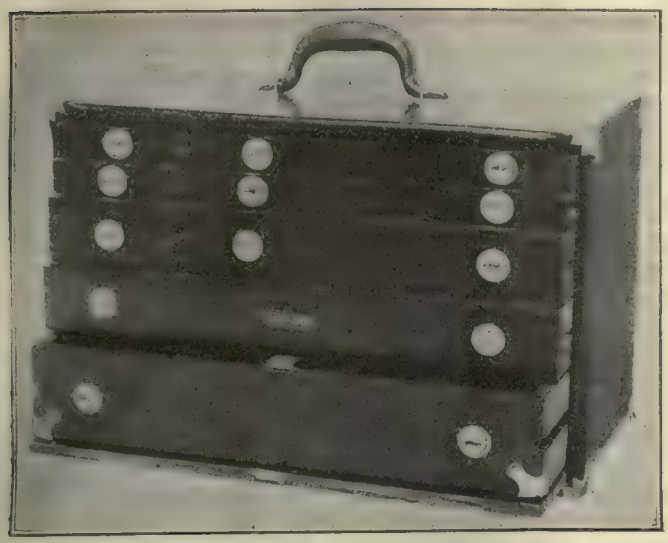
Actual length of stroke, 21 in.; horizontal travel of table, 24 in.; vertical travel of table, 15 in.; maximum distance from table to ram, 18¾ in.; maximum distance from base to ram, 38 in.; top of table, 16 x 17 in.; top of table, including apron, 16 x 22 in.; depth of table, 15¾ in.; down-feed to head, 7 in.; diameter of head, 8 in.; length of ram without head, 46 in.; ram bearing in column, 37 x 11 in.; crossrail bearing on column, 16 x 20 in.; keyseating capacity, 3⅜ in.; size of vise jaws, 2½ x 12 in.; opening of vise, 12¼ in.; size of tools, ¾ x 2 in.; cone pulley, 8 to 14 in. in diameter, 4 step, with 3¼-in. laces; tight and loose pulleys on countershaft, 14 x 4½ in.; speed of countershaft, 330 r.p.m.; speeds of ram, eight, 8 to 100 strokes per minute; single gear ratio, 7 to 1; back gear ratio, 26 to 1; size of base, 24 x 66 in.; floor space, 48 x 92 in.; weight for domestic shipment, 4800 lb.

The vise is of the planer type, and is quick-acting, the jaws being steel-faced. It can be tilted for holding tapered work and is prevented from tipping by means of clamp screws. A graduated swivel base is incorporated. The crossrail is bolted directly to the frame of machine, eliminating gibs and securing greater rigidity. Tension bolts are provided to prevent the crossrail dropping away when the locking bolts are loosened. The mechanism for regulating the cross-table-feed can be adjusted while the machine is in motion, and a friction safety device is provided to protect the feed mechanism from damage, should the cross-feed accidentally meet with any obstruction. The elevating screw is of the stationary type and operates through bevel gears on a ball thrust bearing. It is entirely contained within the machine and does not project through the floor.

The ram is long, well-ribbed and mounted on V-ways of 45-deg. angle, a feature that is said to increase the life to a considerable extent. The ram has a screw adjustment and can be positioned while the machine is in motion. A balanced construction is used for the rocker-arm enabling the use of a heavy arm without placing any undue weight or wear on the ram. It is claimed that this construction eliminates vibration to a great extent and almost entirely does away with chatter marks under heavy cuts. Another feature is the rocker-arm driving block, which is provided with an adjustment within itself, doing away with play or slap on the rocker-arm slide and insuring a smooth motion to the ram. A special oiling feature insures positive lubrication to the slide and driving pin. The cone pulley runs on a large sleeve mounted in the base, and a guard protects the operator and also prevents the belt from running off the cone when shifting.

Union Garage Tool Chest

The Union Tool Chest Co., Inc., Rochester, N. Y., has just placed on the market the tool chest illustrated, which is intended especially for mechanics and shops doing automobile repair work. The chest is made of kiln-dried oak, is lock cornered and has glued joints, the backs of the chests being rabbitted or shouldered to the frame as well as glued and nailed in place. Metal corners are used to protect against damage. The handle is covered with leather and has a heavy steel wire through the center, the weight being carried by rivets extending through the top of the chest. The drawer pulls are of the flush type set into the front of the drawer and do not detract from the drawer space. The bottom drawer or tray is fitted with a handle that drops down into the drawer when not



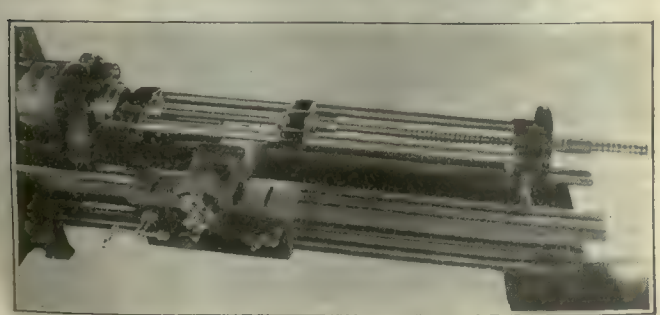
UNION GARAGE TOOL CHEST

Two drawers, 4 in. long, 7⅞ in. wide, ⅞ in. deep; one drawer 4 in. long, 7⅞ in. wide, 2⅛ in. deep; two drawers, 12⅞ in. long, 7⅞ in. wide, ⅞ in. deep; one drawer, 12⅞ in. long, 7⅞ in. wide, 2⅛ in. deep; one drawer 18¼ in. long, 7⅞ in. wide, 2⅛ in. deep; and one tray 18 in. long, 7⅞ in. wide, 3⅛ in. deep. Outside dimensions, 20½ in. long, 9¼ in. wide, 13¼ in. high. Weight, 23 lb.

in use, this serving as a handy tray to contain tools actually in use on the job. The drawers run on hardwood slides set into the ends of the frame and will carry any weight which may be put into them. The bottoms are three-ply veneer tongued to the sides and front. The two small drawers at the top are fitted with movable partitions and one of the long drawers is partitioned for a socket wrench set.

"Velco" Broaching Attachment for Lathes

The V. E. La Pointe Manufacturing Co., 17 Hungerford St., Hartford, Conn., has just placed on the market the broaching attachment shown in the illustration. This is for use in connection with an ordinary engine lathe, and is intended for use in small shops where the expense of a regular broaching machine would not be warranted. The device consists essentially of three heads, one sliding and two stationary. The latter are provided with bases that rest on the ways of the lathe and are held a fixed distance apart by means of the two cylindrical compression members shown at each side. The sliding head at a center serves as a guide for the screw and the broach, and also holds the mechanism connecting these two parts. The screw is connected to the sliding member by means of a pin which prevents the former from turning. It should be understood that the lathe spindle serves simply as a means of driving the attachment, and does not carry any of the thrust which is taken up in the two cylindrical compression members. The bronze nut which moves the screw lengthwise is carried in the head at the left. This head is held in place in a longitudinal direction, ball thrust bearings being used, and is driven from the regular lathe faceplate by a ball screw arrangement that takes care of any slight misalignment between the lathe spindle and the screw. It will be seen that the machine has as many speeds as are incorporated in the lathe, and when the lathe spindle turns, the bronze nut is turned on the screw, pulling it back to the left through the hole in the spindle of the lathe. A pulling sleeve inside of the sliding head connects the screw and broach holder, and this device and the work bushings are so constructed that the center line of the lathe spindle is in line with the cutting edge of the broach when a one-sided broach is used, this method obviating cramp. The work face has a 4½-in. hole, reducing bushings being used of any size desired. The diameter of the screw is made as large as may be conveniently passed through the hole in the lathe spindle, small screws being hardened and tempered. The standard length of stroke is 48 in., but other lengths can be made if desired. The diameter of the compression members is 1¾ in. The bases of the two stationary heads can be either furnished blank or machined to fit the ways of the lathe if templets are sent.



LA POINTE BROACHING ATTACHMENT FOR LATHES

Arnold Electric Drills

The Arnold Electric Tool Co., Inc., 902 Chapel St., New Haven, Conn., has just placed on the market the two types of electric drills shown in the illustrations. Fig. 1 shows the precision bench drill, which is of the sensitive type, and mounted on double trunnions in such a manner that the complete unit of motor and drill can be swung at any desired angle to the table. Graduations are provided on the trunnions so that the drill can be set quickly to any angle, after which it is

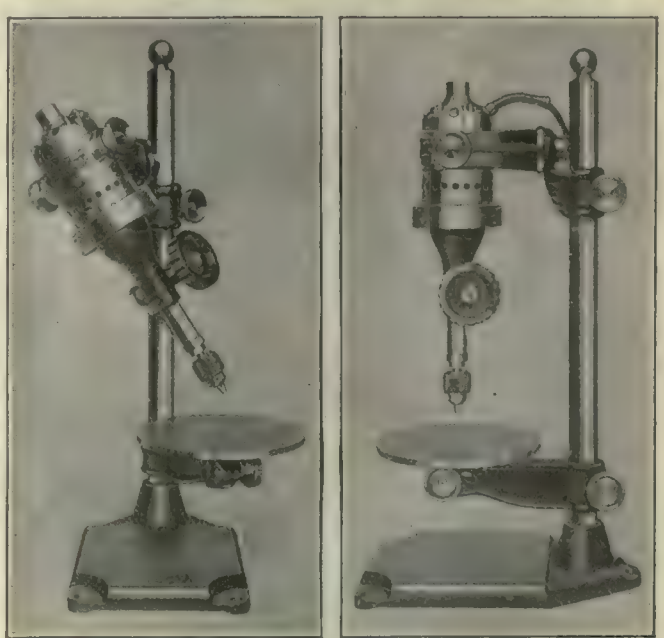


FIG. 1. THE ARNOLD PRECISION BENCH DRILL

Base, 12 x 8 in.; distance from center of table to post, 4⅝ in.; diameter of table, 6⅞ in.; total height, 23 in.; feed, rack and pinion type with 1½-in. travel; clearance from base to bottom of shaft, 11 in.; capacity, ¼ in. in steel; weight, 30 lb.; motor equipment, Hamilton Beach universal type, 110-120 volt, 25-60 cycle; chuck, Jacobs.

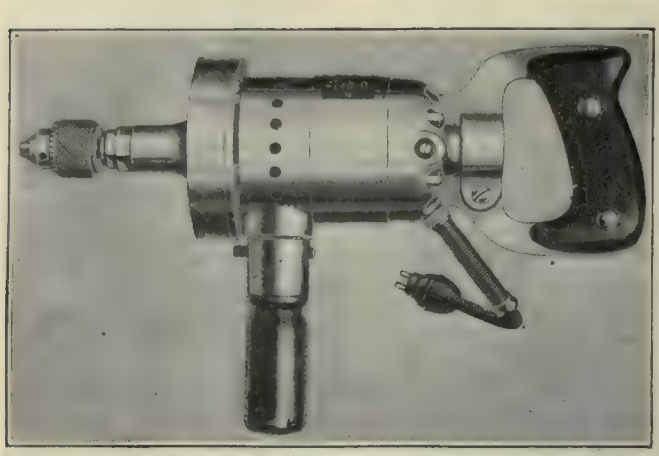


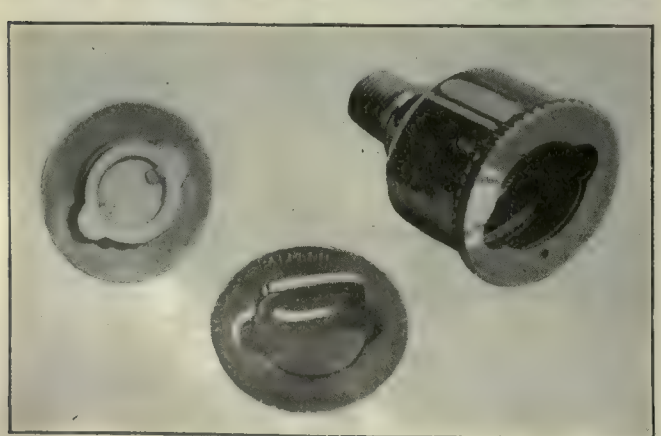
FIG. 2. TYPE-A PORTABLE HAND DRILL
Length over all, 13 in.; weight, 6 lb.; capacity, ¼ in. in steel; motor, universal type, 110-120 volt, 26-60 cycle; chuck, Jacobs.

locked in place by means of knurled hand screws. The base is machined and scraped square with the column, which is fastened to it by means of a large nut. Both the table and motor brackets slide on the column, being locked in place by means of hand screws. The table is fastened to the arm by a turned stud which fits the arm socket and is secured by a screw, allowing the table to be locked in any position desired. The feed mechanism is of the rack and pinion type, but a small lever has been substituted for the handwheel shown. A Jacobs chuck is used as regular equipment. The chuck spindle is hardened and ground and runs in bronze bearings.

Fig. 2 shows the type-A portable hand drill for use on either metal or wood. The motor runs at high speed and the reduction gearing is of the planetary type, giving a six to one reduction. The transmission is inclosed in a tight aluminum case, and either grease or heavy oil is used to insure proper lubrication. A pin-operated switch is mounted in the handle at the side of the motor. The handle at the rear can be removed in case it is desired to replace it with a taper shank, so that the drill can be used in the tail spindle of a lathe.

"Rohr" Grease Cups

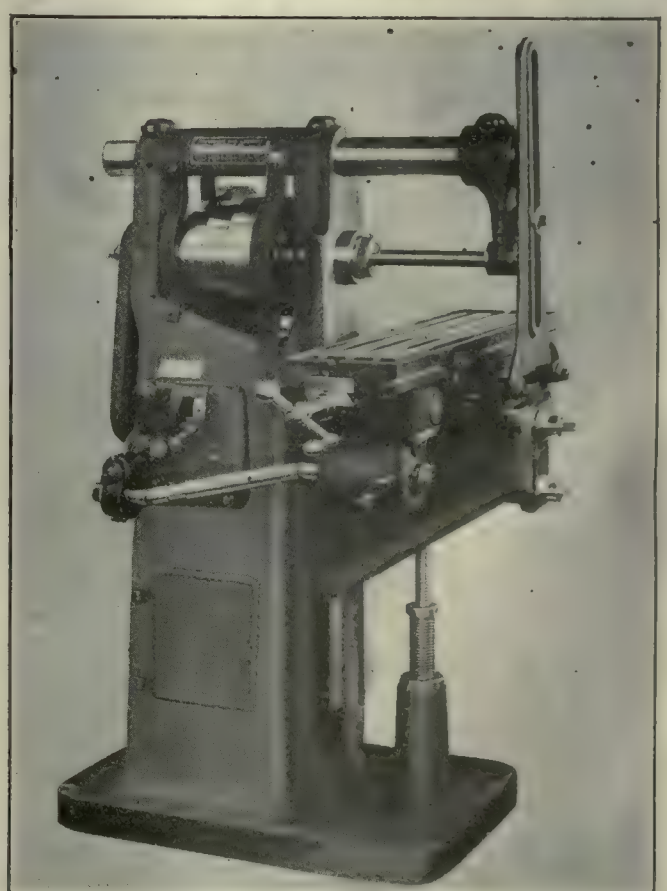
The "Rohr" grease cup shown in the illustration is being manufactured by the Tes-Tite Piston Ring Co. Freeport, L. I., and is being marketed by B. E. Carpenter, 1328 Broadway, New York. The best features of this cup are, that as the top cannot be taken off, there is no danger of losing it or crossing the thread in trying to replace it, and the fact that there are no coil springs, ratchets or other complicated parts to get out of order and cause trouble. To fill the cup it is simply necessary to turn it to the left with the thumb and finger by means of the handle until it comes to a stop, when the cover will turn in the cup-body and come off. After filling the cup with grease, the cover is simply pressed down tightly and turned to the right, the first half-turn serving to secure the cover in place while further turning places pressure on the grease. The cover is held in place by a flat spring having two ears. The handle should always be used when turning the top or body. This will insure the cover being locked when screwing down on the body, and will unlock it when being unscrewed before damage is done to the threads at the lower end. The latter is turned over slightly to prevent the body being removed. This feature prevents the top being lost.



"ROHR" GREASE CUP

Davenport No. 2-B Plain Milling Machine

A photograph is shown of the new Davenport No. 2-B plain milling machine (back-geared) built by the Davenport Manufacturing Co., Meadville, Penn. The table of the machine has three ⅝-in. T-slots and is all working surface. It is mounted on extra-wide bearings

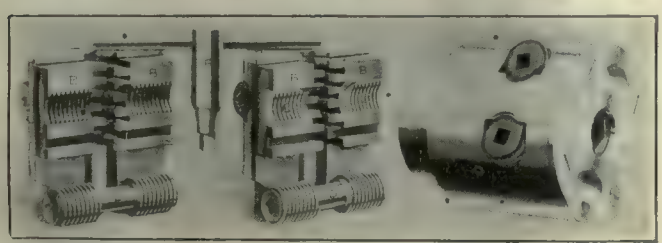


DAVENPORT NO. 2-B PLAIN MILLING MACHINE
Table, 38 x 10 in.; longitudinal movement, 23 in.; cross movement, 9 in.; vertical movement, 19 in.; spindle, 2½ in. diameter x 4⅜ in. long in ground bearing; No. 10 B. & S. taper hole; 1⅛ in. hole through; 2¼ in. diameter nose, threaded 10 per in.; three-step cone; 12 speeds; back gear ratio, 4.57 to 1; feed box, 12 changes; tripping mechanism plunger type; overhanging arm steel bar, 3½ in. diameter; countershaft, two speeds; 10 x 3½ in. pulleys; arbor, 1 x 10 in.; vise, steel jaws, 6¼ x 1½ in., 3½ in. opening; equipment—vise, 1-in. arbor, end support brace, wrenches and overhead works; weight, 1900 lb. net; 2000 lb., domestic shipping; 2250 lb., export.

and fed by a screw giving ¼ in. of movement per turn of the handle. Another crank at the end of the table gives a quick return at the rate of 1¼ in. per turn. The spindle is made of forged crucible steel and runs in adjustable phosphor-bronze boxes. Hardened and ground thrust collars are fitted and lubrication is from oil reservoirs cast in the bed. The driving cone has steps of 7.73, 8.86 and 10-in. diameter for a 2¼-in. double belt. The spindle speeds are 20, 27, 35, 45, 59, 77, 95, 123, 160, 204, 270 and 350 r.p.m., and the feeds per revolution of spindle are 0.004, 0.006, 0.009, 0.010, 0.011, 0.014, 0.018, 0.019, 0.023, 0.027 and 0.047 in. The feed-box gears are alloy steel and the drive is by roller chain from the spindle. Reversal of the feed is through a push rod on the feed box and all parts of the mechanism are oiled from one large oil pocket which is filled through an opening in the column. The tripping mechanism is of the plunger type and the under side of the overhanging arm is 6⅜ in. from the spindle center line. The countershaft speeds are 123 and 27 r.p.m. and the clutch pulleys are self-oiling. The 1 9/16-in. shaft runs in self-oiling bearings. The arbor is made of 70-point-carbon chrome-nickel steel, heat-treated, and has a ball-bearing end support. Adjustable dials graduated in thousandths of an inch are provided for longitudinal, cross and vertical movements.

Casler Twin-Screw Drill Chuck

The Marvin and Casler Co., Canastota, N. Y., has brought out the drill chuck shown, which is claimed to have a grip on a drill double that of the single-screw type, thus permitting the drill to be forced to the limit of its strength. The body is made of close-grain cast

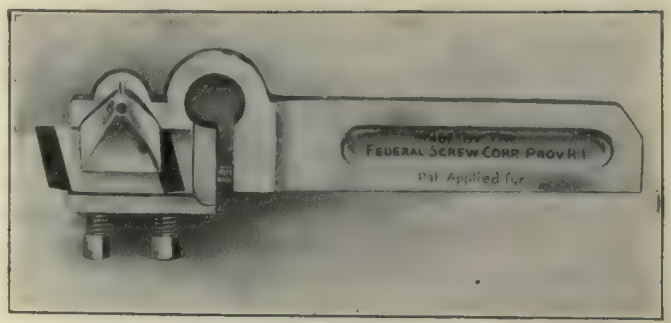


CASLER TWIN-SCREW DRILL CHUCK

iron and the jaws and screws of tempered high-carbon steel. This combination is said to give long life to the wearing surfaces. The body is reinforced by a steel cap plate to prevent it from spreading under strain. When using the chuck the primary screw *E* is first operated to grip the drill shank between the jaws *B*. The secondary screw *D* is then operated so as to bring the floating nuts *C* against the ends of the pockets in the jaws. All parts are said to be interchangeable and the chuck is relatively free from projections.

Federal Spring Toolholder

The toolholder shown in the illustration is built with a goose-neck to add flexibility to the cutter with the idea of eliminating chatter. It is marketed by the Federal Products Corporation, 393 Harris Ave., Providence, R. I., and is intended for holding thread cutters. Three cutters are furnished, one for cutting at right angles to the stock and the others for offset cutting to a shoulder, one right and the other left. One end of each cutter is ground for roughing and the other

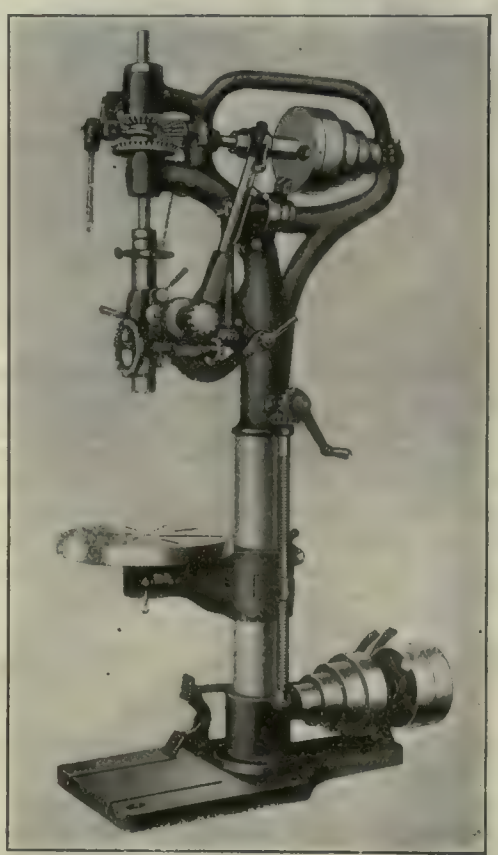


FEDERAL SPRING TOOLHOLDER

for finishing, and the sides are parallel so that the cutter can be reversed without changing the setting of the holder. A setscrew is provided to eliminate the spring feature when it is desired to use the holder as an ordinary lathe tool.

Richards 20-In. Drilling Machine

The illustration shows a new 20-in. drilling machine equipped with back gears, power feed, automatic stop and geared tapping attachment. It is now being manufactured by the Richards Machine Co., 3417-3419 Vliet St., Milwaukee, Wis. The machine has a capacity for drilling holes up to 1¼ in. in diameter and tapping holes up to ⅞ in. in diameter. The machine has eight speeds, four with open belt, and four with back gears which are inclosed in the upper cone pulley and have a ratio of 4 to 1. The power feed is secured either by means of a belt or by a direct gear drive and gives three



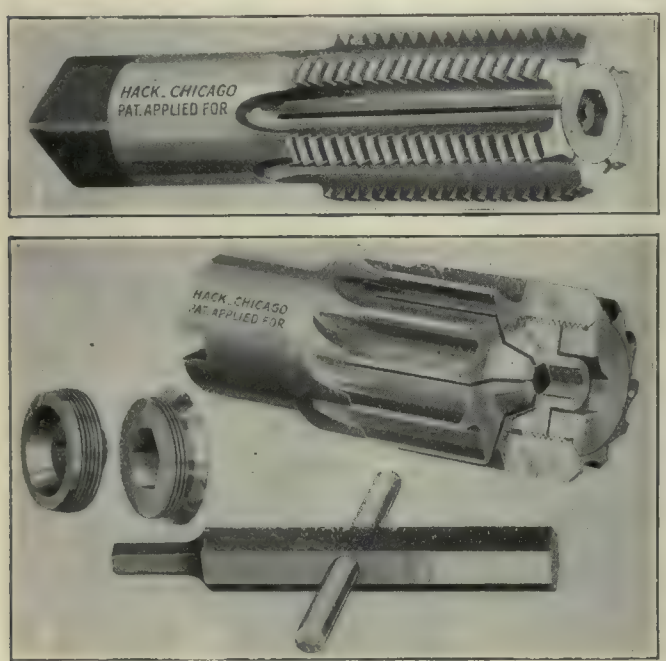
RICHARDS 20-IN. DRILLING MACHINE

Speeds, eight; four with back gears and four with open belts; holes drilled, up to 1¼ in.; holes tapped, up to ⅞ in.; belt used, 2 in.; feeds, three, 0.002, 0.005 and 0.010 per spindle revolution; ratio of back gears, 4 to 1; diameter of column, 5 3/16 in.; diameter of spindle, 1¼ in.; diameter of sleeve, 2⅜ in.

feeds. The geared-tapping attachment is supported by an arm extending from the front to the rear upper bearing and all gears are of steel. The reverse speed is about one-third faster than the tapping speed and is changed by a movement of the lever directly in front of the operator. Work can be held either on the table or on the base, the former being elevated by means of a crank-operated screw mechanism. The thrust bearings are either of fiber or of the ball type as desired.

Hack Solid Adjustable Reamers and Taps

Figs. 1 and 2 show respectively the Hack solid adjustable reamer and tap made by the American Machine Tool Engineering Works, 4854 West Kinzie St., Chicago, Ill. The adjustment is accomplished by two threaded cones, one for contracting and the other for expanding

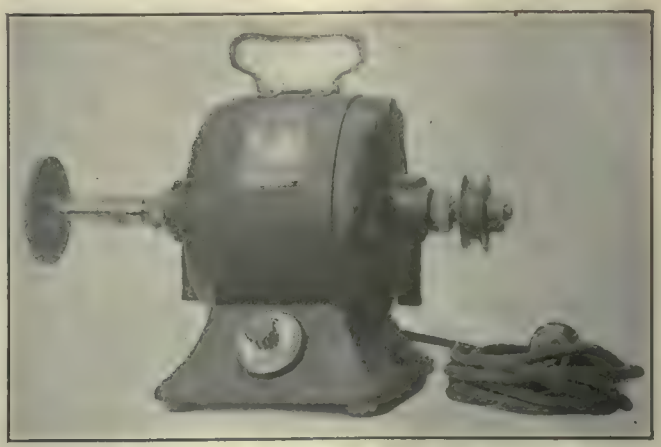


FIGS. 1 AND 2. HACK ADJUSTABLE REAMER AND ADJUSTABLE TAP

the reamer. They are operated by a solid, double-end plug wrench. When a size below standard is required the contracting cone is tightened the necessary amount and the expanding nut brought up against it to act as a locknut. For expanding the tool the procedure is reversed. It is claimed that a set of these reamers will outlast several standard solid sets on account of the possibility of regrinding. They are also valuable for oversize or undersize jobs.

Westinghouse Grinding, Polishing and Power Motors

The small grinding, polishing and power motor shown in the illustration is one of the recent products of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., and is intended especially for light grinding, polishing or power requirements. The machine is portable and is furnished with an attaching cord and snap switch, as well as a handle at the top by which it can be conveniently carried. A single-speed wholly-inclosed motor is used, with long dust-proof bearings. Rubber cushions or bumpers on the base allow the motor to be set on any surface without danger of marring and holes are also provided for fastening down if desired. The illustration shows the a.c. motor with the grinding wheel and pulley, but buffing wheels are also furnished. The machine is also furnished for direct current.



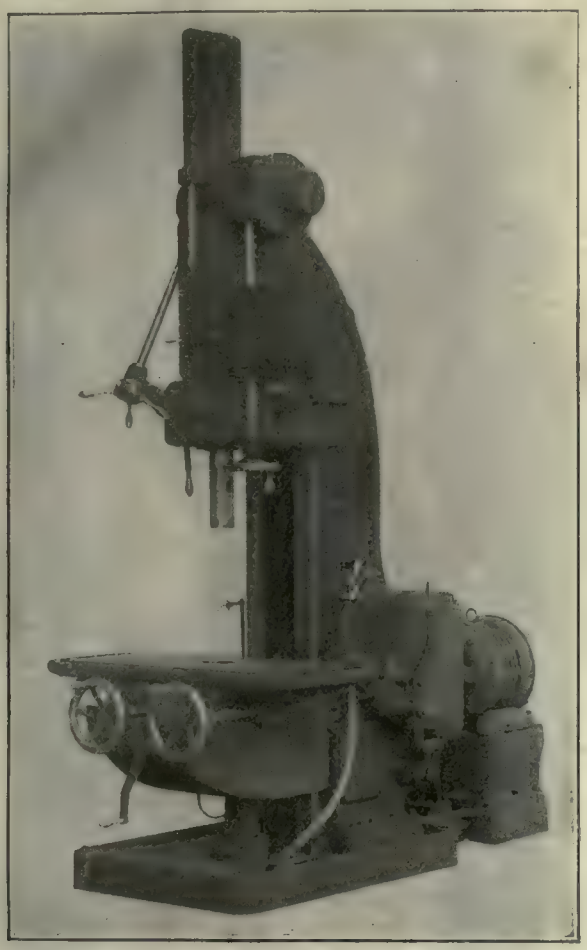
WESTINGHOUSE MOTOR WITH GRINDING WHEEL AND BELT PULLEY

Defiance No. 3 Drilling Machine With Compound Table

The Defiance Machine Works, Defiance, Ohio, is now equipping its No. 3, 24-in. heavy-service drilling machine with a compound table as shown in the illustration. The machine is entirely inclosed, with a gravity oiling system and oil reservoir placed at the bottom of the housing, from which oil is pumped to the top of the spindle, flowing to all parts of the machine and back to the reservoir. The drive is to a single pulley, the spindle speeds being obtained by means of two cones of hardened gears running idle except when one set is meshed by a roll-in gear, operated by a lever at the side of the machine. Helical gears are used on the spindle drive and two keys are used through the driving sleeve into the spindle near the nose to eliminate torsion on the spindle. The thrust is taken by a thrust bearing. Hyatt roller bearings are used on all drive bearings, while slow-feed bearings are bronze bushed. The spindle is of forged high-carbon steel and the thrust is taken on an SKF thrust bearing. The drive is a unit located in the back of the housing, and contains two cones of four gears each running idle except when one is meshed by a roll-in gear. These cones are driven by back gears operated by a friction clutch located on the pulley-drive shaft.

The table is of the box type gibbed to the column and is adjusted vertically by a telescopic screw operated by a lever at the front of the machine. This screw is located far enough from the center of the spindle towards the column to allow boring bars to pass through the table. Four changes of feed are obtained by means of two cones of gears and a power-feed stop is incorporated. The feed is transmitted to the spindle by a worm gear and quick traverse of the spindle is obtained by means of a pilot handle within reach of the operator. The tank for the cutting compound is located in the base and is part of the regular equipment. The lubricant is controlled by a single valve near the outlet, the pump being equipped with a relief valve.

The compound table, which is the new feature of the machine, is not an attachment to the regular table but consists of a special box-type bracket supporting the intermediate slide and the table. It has a working surface 17½ in. x 35 in. The table has a longitudinal adjustment of 18 in. and a crosswise adjustment of 9 in., and has three slots running lengthwise as well as an oil groove. The screw for elevating is the same as that used on the plain table. When the compound table is furnished, it is necessary to use a higher column in order to give the same maximum distance from the nose of the spindle to the table as on the plain machine. A tapping attachment can be furnished as an extra and is an all-geared fixture located directly behind the main-spindle drive gear and operated by a jaw clutch between the forward and reverse gear train.

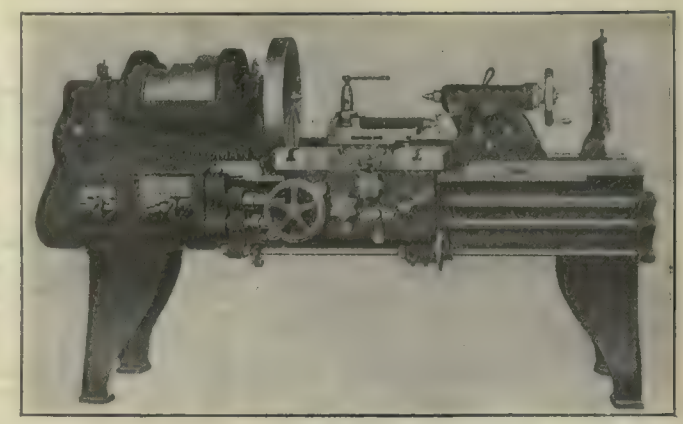


DEFIANCE 24-IN. HEAVY-SERVICE DRILLING MACHINE WITH COMPOUND TABLE

Capacity with high-speed drills in solid steel, 3 in.; length of power feed, 16 in.; diameter of spindle nose, 3½ in.; diameter of spindle drive, 3½ in.; Morse taper in spindle, No. 5; diameter of spindle sleeve, 3½ in.; width of steel rack in sleeve, 2 in.; pitch of steel rack in sleeve, 6; diameter of feed pinion shaft, 3 in.; pitch of feed pinion, 6; width of helical-drive spindle gear, 2½ in.; center of spindle to face of column, 12 in. maximum distance from nose of spindle to top of table, 32 in.; working surface of compound table, 17½ x 35 in.; vertical adjustment of table, 15 in.; feed changes, four, 0.007, 0.012, 0.018, 0.046 in. per spindle revolution; spindle speeds, eight, 51 to 408 r.p.m.; height of machine with compound table, 9 ft. 8⅝ in.; horsepower, 10; floor space, 42 x 67 in.; domestic shipping weight, 5300 lb.

Greaves-Klusman 14-in. Lathe

The Greaves-Klusman Tool Co., Cincinnati, Ohio, has just placed on the market a new 14-in. heavy, quick-change four-step-cone, single-back-geared or three-step-cone friction, double-back-geared engine lathe. The construction is said to be particularly heavy throughout, including a reinforced bed and bearing and a spindle center in back of the center line of the bed. The feed rod and lead screw are supported at both ends of the apron, which is of the double-plate box form. Longitudinal feed stops are provided for motion in both directions. Steel friction gears are used in the apron and these have cast-iron frictions bolted on. The quick-change feeds are geared and a tumbler self-locking device is incorporated for reversing the lead screw.



GREAVES-KLUSMAN HEAVY-DUTY QUICK-CHANGE LATHE

Length of bed, 6 ft. 4⅜ in.; swing over ways, 16½ in.; swing over carriage, 10⅝ in.; distance between centers, 37⅝ in.; front spindle bearing, 2⅝ x 3½ in.; rear spindle bearing, 1⅛ x 2⅜ in.; hole through spindle, 1½ in.; taper centers, Morse No. 3; spindle nose, 2½ in. in diameter and 1⅛ in. long; threads on spindle nose, U. S. S. 6; width of belt with single back gears, 2½ in.; width of belt with double back gears, 2⅝ in.; range of threads cut, 2 to 56; range of feeds, 0.0066 to 0.188 in. per spindle revolution; travel of compound rest, 2½ in.; weight crated, 1700 lb.; weight per extra ft. of bed length, 80 lb.

Beating the Safety Device

BY GEORGE F. KUEHNE

That many accidents occur through the indifference of the workmen rather than lack of adequate safeguards is emphasized by the letter of James Forrest on page 396 of *American Machinist*

The writer has had similar experiences while supervising the production of a press room in a plant where all power presses were provided with safety devices. When a workman was running a punch press that was equipped with the double lever tripping device requiring the use of both hands to operate it, he was very apt to wedge down one side so as to leave one hand free, especially if he were paid by the piece. As the court may uphold a workman in the event of an injury received under such conditions, if there is evidence to show the department foreman was cognizant of the violation and took no steps to prevent it, the foreman was obliged to inform the men that failure to use the safety devices properly would entail dismissal. After the services of a few of the offenders were dispensed with, this trouble was overcome.

Lifting Beyond the Capacity of Crane

BY R. R. SANDS

If there is a heavy flywheel, machine or other object to be lifted, that is beyond the lifting capacity of the crane, lift one end only and block it up while lifting the other end. The object may be lifted a short distance at a time until the desired height is reached.



Sparks from the

American Welding Society Organized

Permanent Organization Formed at the Engineering Societies Building for the Purpose of Supplying Information on Welding

The American Welding Society was formed into a permanent organization on Mar. 28, at the Engineering Societies Building, 33 West 39th St., New York.

The following officers were elected: President, C. A. Adams; vice president (for one year), J. M. Moorehead; vice president (for two years), G. L. Brunner; directors (for one year), W. M. Beard, M. H. Roberts, M. M. Smith, L. D. Lovekin, Alexander Churchward, W. H. Patterson, W. J. Jones, and C. A. McCune; directors (for two years), R. R. Browning, A. S. Kinsey, Victor Mauck, E. L. Hirt, J. F. Lincoln, H. M. Hobart, D. C. Alexander, and H. R. Swartley, Jr.; directors (for three years), L. H. Davis, E. L. Mills, D. B. Rushmore, James Burke, D. H. Wilson, Jr., Hermann Lemp, C. J. Nyquist, and Alexander Jenkins. A secretary, H. C. Forbes, and a treasurer, W. E. Symons, were chosen at a directors' meeting.

By unanimous consent Elihu Thomson was elected the first honorary member.

It is the purpose of the society to become a dependable source of information on welding, not only for the benefit of the manufacturers of welding apparatus and supplies, but also to aid those who use the welding in their production and those who purchase welded goods. Greater stability will be given the welding industry by the standardization of various welding processes and apparatus.

Within the society is what is known as the Bureau of Welding composed of the directors elected by the society and directors appointed by the various national engineering societies, who are entitled to one director each.

Membership Classification

It is intended that the burden of supporting the new society shall fall principally upon those whose business interests would be advanced by the work of the society. These are clearly the companies that manufacture and sell apparatus and supplies for welding, or that employ welding as a process in their output, or that purchase goods welded in whole or in part and desire to do so intelligently. Their representatives will be known as Class A sustaining members accredited to corporations, with annual dues of $100. The number of Class A members from the same corporation is not limited. On the contrary, it is expected that the larger companies at least will support the society by as many Class A members as may accord with their standing in the industry.

Class B.—The fact that a corporation is represented in the Class A sustaining membership opens the Class B membership, with full rights, to others of its employees at annual dues of $20. This class is also intended to provide for any individual not employed by a corporation—consulting engineers, college professors, etc.

Class C.—For the benefit of existing societies that become affiliated with this society through the Bureau of Welding, the Class C membership provides that their members may become associate members in the society at annual dues of $10. These members having their own director participating directly in the work under the arrangement for affiliation would not need to vote or to hold office.

Class D.—Welding artisans may join the society under Class B if they desire, but the Class D membership, with annual dues of $5, offers them the benefits of the society, other than voting and holding office, at a minimum cost.

Class E.—This membership provides for trade associations, putting them in the same category as corporations.

Class F.—This class makes provision for honorary members.

Training of Welders

Investigations thus far show that one of the most important elements in the success of an autogenous welding operation is the skill of the operator. To secure this, uniform methods of training are essential, and the society will take an active part in planning how welders should be trained and how their proficiency may be determined.

* * *

Engineering Advertisers' Association Organized in Chicago

Advertisers and sales managers representing manufacturers in various engineering lines have organized the Engineering Advertisers' Association at Chicago, with the following officers: President, H. L. Delander, advertising manager, Crane Co.; vice president, H. Colin Campbell, director of advertising, Portland Cement Association; secretary, G. H. Eddy, publicity manager, Green Engineering Co., East Chicago, Ind.; treasurer, Ed. J. Pratt, advertising manager, Kellogg Switchboard and Supply Company.

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Erratum

In the article on "Points for Spot Welding" by A. A. Karcher, on page 556, the address of the Challenge Machinery Co. was erroneously given as Grand Rapids, Mich. It should have been Grand Haven, Mich.

Catalogs Requested from the Madrid Consulate

E. E. Palmer, American consul at Madrid, Spain, reports that the consulate in Madrid desires up-to-date catalogs representative of all phases of American industry and commerce.

The following is Consul Palmer's report:

The consulate in Madrid desires up-to-date catalogs representative of all phases of American industry and commerce. The potential importance of the Spanish market in itself and its influence on the Latin-American markets have already been brought to the attention of American manufacturers and exporters. The peculiar situation of Madrid as the geographical, railway, financial and political center of this Spanish market is well known, and the advantage of having such catalogs on file in the Madrid consulate for ready consultation by local distributers to the Spanish trade and by visiting merchants from the Provinces is clearly apparent.

The consulate has recently revised its catalog files and transmitted to the Camara de Comercio (Chamber of Commerce) of Madrid all illustrated catalogs except those manifestly up to date. It is believed that they may have an interest for the members of the Camara de Comercio in so far as they picture American industrial activity, and that the stimulation of such interest at the present time will result in a demand for the most recent catalogs and price lists, which the consulate desires to be in a position to furnish.

Many possible purchasers of American merchandise in Spain have awaited the termination of the war before placing orders, so that they might benefit by the competitive conditions which during the war were practically nonexistent in the majority of lines. That the return of these conditions will necessitate an intensive activity on the part of American manufacturers and exporters who may be interested in the Spanish and Latin-American markets is beyond question, and in making the foregoing request for catalogs and price lists, the Madrid consulate is merely seeking that coöperative assistance from American business interests which it is prepared to offer in the promotion of American foreign trade.

* * *

Pratt & Whitney To Make Hoke Precision Gages

Those who read the article in last week's issue relating to the manufacture of Hoke precision gages at the Bureau of Standards will be interested in the information that the Pratt & Whitney Co. have acquired the manufacturing rights for these gages and will put them on the market. Major Hoke is now associated with the Pratt & Whitney Co. in supervising the manufacture of these gage blocks.

World's Industrial Forge

By E.C.Porter, News Editor

War Contract Claims Should Be Entered at Once

All claims for settlement under the War Contract Validating Bill signed by the President on Mar. 3 must be filed on or before June 30, 1919. Hence clients should lose no time in preparing their papers. All claims are to be separated into two classes. Class A includes those agreements the nature, terms, and conditions of which have been reduced to a contract form or are otherwise established by written evidence. Class B includes all other claims. Claims falling under Class A shall be prepared in quadruplicate on standard forms and forwarded to one of the following boards of the War Department at Washington, depending of course upon who purchased the material: Ordnance Claims Board; Claims Board, Air Service; Claims Board, Chemical Warfare Service; Claims Board, Construction Division; Claims Board, Director of Purchase; Claims Board, Signal Corps; Claims Board, Office Chief of Engineers. Claims based on agreements with the Quartermaster Corps should be addressed to the Claims Board, Director of Purchase, War Department, Washington. Claims coming under Class B shall be prepared in sextuplicate, on standard forms, and forwarded to the Board of Contract Adjustment, Munitions Building, Washington. Standard forms for contract claims, together with further information, can be secured from the respective boards mentioned.

* * *

Training Foremen To Improve Production

The Bullard Machine Tool Co., Bridgeport, Conn., has inaugurated a special course of training for its foremen in order to improve production and labor relations in its plant. A study group has been organized under John E. Calder, M. E., of the Business Training Corporation, New York, and S. H. Bullard, vice president, at the factory, to take up a course in modern production methods. Mr. Bullard is of the opinion that increased efficiency in the plant and more harmonious relations with employees depends ultimately on the foremen, and that foremen trained in the principles of management and production, and having a broader vision of the company as a whole, can get better results. An additional object is to develop competent understudies for the foremen among the more ambitious employees of the plant.

The foremen's class is studying such subjects as plant layout and routing; purchasing, stockkeeping and storeskeeping; reduction of waste; production records; cost accounting; labor turnover; selection, training and supervision of employees; handling different classes of labor; discipline; safety and sanitation. The course consists of the study of text books, problems and conferences, and lasts three months.

* * *

Gear Manufacturers Will Meet in Cleveland

President F. W. Sinram of the American Gear Manufacturers' Association announces that its annual convention will be held at the Hotel Statler, Cleveland, Ohio, Apr. 14, 15 and 16.

The organization includes in its membership representative companies engaged in making gears in the United



E. W. SINRAM

States and Canada, and promises to be of unusual interest to the manufacturing world. For some years past the American Gear Manufacturers' Association has been striving earnestly to effect an organization that would develop definite means for standardizing its products.

Papers will be presented as follows: (1) "Gear Steels," by Dr. Parker of the Carpenter Steel Co.; (2) "Proper Sizes and Materials for Gears;" (3) "Worms and Wormwheels," by a representative of Timken-Detroit Axle Co.

Officers of the association are: President, F. W. Sinram, of the Van Dorn and Dutton Co., Cleveland, Ohio; vice president, H. E. Eberhardt, of the Newark Gear Cutting Machine Co., Newark, N. J.; secretary, Frank D. Hamlin, of the Earle Gear and Machine Co., Philadelphia, Penn.; treasurer, Frank Horsburgh, of the Horsburgh and Scott Co., Cleveland, Ohio.

* * *

Installs New Machinery

The Union Switch and Signal Co., Swissvale, Penn., has purchased machinery for finishing crankshafts and camshafts, and will be ready to make deliveries in the near future. This company manufactures its own forgings, and the centralization of the operations required to make finished forgings will be of great advantage.

British Machine Tool Situation

Question of Tariff, Prices and Unemployment, Which May Effect Business in This Country as Well as in England

In a recent paper before the Northeast Coast Institution of Engineers and Shipbuilders, Sir Alfred Herbert, the well-known British machine-tool builder, brought out many interesting points, both as to the early shop practices in Great Britain and as to the later developments during the war. He also took up the question of trade, both present and future, and gave as his belief that the large accumulation of machine tools in Great Britain at the present time need give no particular anxiety to the machine-tool builders. He felt sure the machinery could be satisfactorily employed and that the country would find abundant occupation in supplementing and balancing existing plants and in meeting the demands of new manufacturing industries.

He admits the indebtedness of Great Britain to the United States for much progress in machine-tool production and in workshop methods, and he believes that "taxation on imported machine tools would be a grave disadvantage to the British machine-tool maker as well as to the user. A policy of taxation on imported machine tools might temporarily please those British makers who are either inefficient or who wish to rest on their laurels without constant and renewed efforts, but in the long run it would result in a serious check to progress, both in engineering generally, and in machine-tool manufacture in particular. It must be remembered, too, that the immediate effect of protective tariff is to increase cost of production, and this handicaps the British toolmaker and the British tool user alike in the neutral markets of the world."

He says further: "The introduction of American machine tools, developed under the special conditions obtaining in that country of mass production of output and dear labor, has, in the author's opinion, been of the greatest service to this country in preparing it gradually to meet similar conditions. Any policy which would tend to make it difficult or unduly costly for British machine-tool users to obtain the best machine tools, wherever produced, would be as shortsighted as the restriction of raw materials."

The Scotch Situation

A recent report from England says: "Labor conditions in Scotland are said to continue relatively satisfactory, but the outputs are not sufficient to maintain exports to any degree. All avail-

able blast furnaces are in operation, with most of the output absorbed locally. The pressure of local orders, however, seems to be easing off, but the orders from France and Belgium are becoming increasingly greater. Everything seems to tend to higher prices, and even at the present rate more or less of American material is finding its way into the local markets.

"In the Falkirk district over 2000 women who were engaged on munition work have been displaced by male workers. Efforts are being made, however, to introduce new industries to absorb this labor.

"The fact that structural engineers are keeping busy indicates that enlargements are to be expected. The motor-truck industry seems to be in good condition, and another large airship, 670 ft. long x 79 ft. diameter, has been completed at Inchinnan. It has a capacity of 2,000,000 cu.ft. and a lifting power of about 50 tons.

"Machine-tool makers report a falling off of definite orders, although there is a large inquiry, mostly foreign. The shops are, however, keeping fairly busy at the present time, but fear that it will be necessary to decrease the output unless new orders are received. M'Gregor, Swinburne, Ltd., are filled up with orders for drill chucks and special tools and fixtures, so that the completion of their war contract is not a serious matter.

MANCHESTER

"In the Lancashire district unemployment seems to be on the increase, due largely to the cotton trade. The engineering trade, however, is being affected to some extent. The hopeful sign is that there is a demand for patternmakers and blacksmiths, which would seem to indicate an increase in other lines in the near future.

"Major Frank Gilbreth, of motion-picture study fame, has been lecturing at the Technical College and attracting considerable attention to his methods. E. G. Herbert, Ltd., reports a very good demand for their hacksaws and shop accessories. They are now building a number of hacksaws to cut bars up to 26 in. in diameter, which makes quite a sizeable machine. The Petrie & Co. branch of J. Holroyd & Co., Ltd., are building special lathes for turning railway ties and also some 48-in. lathes of standard design. They are also building a special planer for cutting spiral grooves in chilled rolls. The Manchester Association of Engineers has been discussing the use of automatic machines, which may have a bearing on their more extensive use in this district in the future.

BIRMINGHAM

"The question of no overtime work threatens to develop a discouraging situation in the Birmingham district. Its object, of course, was to distribute the available employment among as large a number of men as possible. The trade unions, however, have recognized the necessity of increasing pivotal or key work, or work on which other industries depend, in order to secure employment in other lines as rapidly as possible. The agreement was reached before any serious damage had been done, which is a good indication of the tendency for both sides to get together.

The lifting of the embargo on overtime applies only to patternmakers, jigmakers, toolmakers, etc., who are engaged on work necessary to speed up reconstruction work in various lines. On production work, the limit of 47 hours per week remains, and there is a common agreement between the operatives and the employers as to the undesirability of systematic overtime work.

Electric heating and electric welding are being very widely discussed in the Birmingham district. A furnace for heat treatment has been invented by C. M. Walter, chief of the Birmingham Municipal Laboratory, with the collaboration of the firm of Kynoch. In addition to this, H. W. Wolton is advocating the use of electric welding and predicting that great savings are possible by its adoption in locomotive work. He holds that both arc and resistance welding have abundantly proved themselves in practice during the war, both in Great Britain and in the United States. Should this be taken up seriously, it would probably provide for the use of increased labor in many districts for the manufacture of the necessary apparatus and its installation.

* * *

Disposition of Surplus Motor Vehicles

Many rumors have been circulated throughout the country as to the disposition of the surplus motor-driven vehicles now owned by the War Department. The following outline of the proposed method of handling this matter is given by the Director of Sales, War Department:

1.—The different branches of the government will be consulted to see whether the surplus in the War Department of automobiles and motor trucks can be used to fill their requirements.

2.—Various manufacturers of vehicles will then be approached to see if they will take over the vehicles of their own make to market them with their own machines, thus giving the government fair market price and at the same time disturbing the market conditions as little as possible.

3.—The net surplus remaining, after the above methods have been followed out, will be disposed of to the public, either through auction or by sealed bids. Full publicity will be given to these sales in order that the government may realize the best results of the sale.

* * *

Bill Introduced To Remove Taxes on Machinery and Tools

Assemblyman John E. Gill, of Trenton, N. J., has introduced a bill in the New Jersey Legislature which would remove all taxes on tools, implements, engines and machinery used or designated to be used in manufacturing, except as are parts of real estate. The measure in effect carries out the idea of the single tax. Advocates of the bill claim that Pennsylvania is rapidly acquiring all manufacturing interests of New Jersey because of having lifted the restrictions of taxation from such property and that Maryland is competing for the location of New Jersey and New York manufacturing industries. William L. McDonald, of Jersey City, representing the iron manufacturers of North Jersey, spoke in favor of the bill at the hearing at the state house. New Jersey manufacturers are in favor of the bill.

Coal Production Decreases

Less bituminous coal was mined during the week ended Mar. 22 than during any week since Christmas, the amount being 7,477,000 net tons, according to estimates furnished to the United States Fuel Administration by the Geological Survey.

Last year the output recorded for the corresponding week was 11,121,000 net tons, or nearly 50 per cent. more. While the chief cause of the heavy drop in the record was the lack or orders, there was also considerable time lost on St. Patrick's Day.

The loss from full-time production because of "no market" during the week ended Mar. 15 was 42.8 per cent. compared with 41.8, 41.9 and 43.0 per cent. respectively for the three weeks next preceding. Total losses from full time during the week ended Mar. 15 amounted to 48.0 per cent.

Anthracite production during the week ended Mar. 22 is estimated at 1,171,000 net tons as against 1,206,000 net tons the previous week and 2,099,000 net tons for the corresponding week of last year

* * *

Literature for the Foreman

The U. S. Training Service of the Department of Labor has announced that it has in preparation a series of monographs dealing with the special training of foremen.

The material in these discussions is being assembled from all parts of the country and from a great number of different industries. The pamphlets will endeavor to set forth in concise and yet sufficiently detailed form, the approved practices for foremen in the performance of their various duties. The monographs promise to be a valuable addition to the literature dealing with industrial efficiency as it will take up in a practical way each of many problems that the foremen must face.

When the literature now being prepared is ready for free distribution further announcement will be made in the various trade papers. The training service with offices in Washington has already completed several other pamphlets dealing with other phases of industrial training which are free for the asking.

Sale of Surplus Material Progressing

The office of the Director of Sales of the War Department announces that good progress is being made with the disposal of surplus materials and equipment. During the period between Mar. 8 to Mar. 14 total sales of $42,499,827 were made, in accordance with the following list. It will be noted that there has been no sale of passenger automobiles or trucks, notwithstanding frequent reports that the War Department would have many of these vehicles for sale. It is possible that a few trucks will be sold later on. The amount of $450 in the following list under the item of "trucks and trailers" was a sale of kitchen trailers:

Airplanes	$319,000.00
Airplane equipment	679,887.00
Animals	984,018.32
Artillery and artillery ammunition	.....
Building utilities	25,098.52
Miscellaneous building material	95,035.39
Chemicals and acids	25,000.00
Clothing and equipage	1,773,098.10
Ferrous metal, including scrap	71,977.96
Nonferrous metals, including scrap	234,581.83
Fuels	314,728.40
Hardware	7,876.08
Lumber	32,218.10
Machinery, machine tools and engineering equipment	224,824.85
Masonry material	6,269.00
Medical and hospital supplies	2,122.65
Motors and vehicle equipment	666.44
Motor-vehicle accessories	281.66
Office equipment	64,981.57
Oils, greases, etc	35,228.48
Passenger cars	.....
Railway material	1,835.54
Real estate	49,283.00
Small arms and small-arms ammunition	.....
Subsistence	2,895,240.11
Textiles, including wool	26,324,697.90
Trench warfare materials	.....
Trucks and trailers	450.00
Miscellaneous	25,426.10
Total	$42,499,827.00

Business Items

Williams & Wilson, Ltd., Montreal, have moved to their new machinery warerooms at 84 Inspector St., Montreal.

The Firth-Sterling Steel Co., McKeesport, Penn., has moved its warehouse in New York to 310-312-314 Hudson St.; the Boston warehouse has also moved back to 35 Oliver Street.

The Carpenter Steel Co. has moved its office in Chicago to 1101 West Lake St., where a new branch warehouse has been opened. John B. Guthrie, district sales manager, is in charge.

The Chicago Pneumatic Tool Co. has opened offices and warehouses at 313 Richards Building, Tulsa, Okla., and at El Dorado, Kan. Stocks of repair parts and the company's products will be maintained at both of these points.

The Philadelphia Chapter of the American Steel Treaters' Society was organized on Mar. 17, 1919. The following officers were elected: George W. Pressell, chairman, and Arthur L. Collins, secretary and treasurer.

The Hawkridge Bros. Co., Boston, Mass., has been appointed the New England distributer for the Pressed Metal Radiator Co., Pittsburgh, Penn., for the marketing of their gas-welded, cold-drawn tubing.

The Wallace Barnes Co., Bristol, Conn., has opened branch sales offices at 50 East 42nd St., New York, in charge of district sales manager Lisle K. Lasher, and also at 618 Book Building, Detroit, Mich., with Brown Joyce in charge.

At the regular quarterly meeting of the directors of the Hendey Machine Co., Torrington, Conn., held on Mar. 29, F. F. Fuessenich tendered his resignation as president and treasurer of the company. The directors voted that Mr. Fuessenich be elected chairman of the board of directors for the ensuing year. Charles H. Alvord, who has been vice president and general manager since the death of Mr. Hendey in 1906, was elected president and treasurer, and Robert C. Swayze was elected vice president.

Obituary

FRANK W. HASKELL, president of the Carborundum Co. and its allied companies, died on Apr. 2, 1919. Further particulars of Mr. Haskell's death will be published in the issue of Apr. 17.

* * *

Estimate of 1918 Lumber Cut

A total lumber production of 32,760,000,000 ft. is the estimated cut for the year 1918, on the basis of partial returns received by the Forest Service of the United States Department of Agriculture, from 731 sawmills, each one of which cut about 5,000,000 ft. in the years 1917 or 1918.

In 1917 the total production amounted to 36,000,000,000 ft. The decrease in 1918 is not confined to any one region but is general. It is largest in the southern and eastern states and least in the western states.

* * *

Government Planning Credit Ratings on Foreign Firms

The American Manufacturers' Export Association, New York, has been advised to the effect that the government is planning to give credit ratings on foreign firms. It is understood that, with certain records which have been secured by the Bureau of War Trade Intelligence as a nucleus for the service, it is proposed to build up a new and distinct bureau of the Government, the sole duty of which will be to furnish American exporters with credit ratings on firms in foreign countries who purchase American goods.

This service is as yet in its infancy and is therefore not complete in its scope. It can be used however, and any interested persons may inquire at the Washington office of the association for ratings on firms whose financial responsibility they are anxious to ascertain. While it is unquestionably true that for a short time yet the system will not be complete enough to furnish satisfactory ratings in all cases, yet the number of firms which are listed is sufficient to warrant the statement that there is service there.

Zionist Engineering Organization Wants Machinery and Tools

The Zionist Society of Engineers and Agriculturists, 127 East 37th St., New York, is interested in any and all kinds of machinery, tools, equipment and building materials. This organization is composed of architects, engineers and agriculturists in all branches and specializations, who are engaged in the planning and budgeting Mass-Colonization of Palestine to be undertaken in the near future by the Zionist Organization of America and Europe in behalf of the future Jewish commonwealth.

To facilitate its studies and the agricultural, commercial and industrial planning of Palestine, it desires the coöperation of American manufacturers so that it may be placed in an advantageous position to select and recommend the subsequent purchase of the proper kinds of materials, tools, machinery and equipment to be used in the reclamation work of Palestine.

This organization is at present planning to send an engineering commission to Palestine for the purpose of making a survey of the natural resources.

Personals

CHARLES A. HEIL has been made district sales manager of the Carpenter Steel Co., 400 Lakeside Ave., N. W., Cleveland, Ohio. He succeeds James W. Sederquist, who resigned.

W. L. ROMAINE, secretary of the Badger-Packard Machinery Co., Milwaukee, Wis., has resigned to become special representative of several machine-tool lines in the northern Illinois and Wisconsin territory.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A man in France desires to secure an agency for the sale of printing machines, paper, ink, hardware, machine tools, and sewing machines. Quotations should be given f.o.b. New York. Correspondence should be in French. Reference. 28939.

An engineer in Wales desires to secure an agency for the sale of all kinds of engineering tools, supplies, and metals. Terms of payment, cash against documents at bank. 28873.

A man in Italy desires to receive an exclusive agency for the sale of electrical machinery, magnetic sheet steel, batteries, frequency meters, phasometers, current compters, instruments of precision, electric apparatus for mines, for chemical industries, and for electric railways; also, insulating material, mica paper, varnish, fiber and cable insulators, medical applications, marine installations, magnetos, telephone apparatus, and telephone switchboards. Correspondence may be in English. References. 28897.

A company in Italy desires to secure an agency for the sale of agricultural machinery of various kinds. Correspondence should be in Italian. References. 28899.

New Publications

Screw Threads Bibliography.—By Henry E. Haferkorn, librarian Engineer School Library, Washington, D. C. Sixty-two 6 x 9-in. pages; bound in paper: Published by the Press of the Engineer School, Washington, D. C.

This work is a bibliography of available material on the systems and classifications of screw threads, including tolerances, allowances and symbols of nomenclature, and on gages, methods of testing and specifications. The book was prepared by Mr. Haferkorn at the request of the United States Screw Thread Commission, and is arranged in alphabetical order according to authors and titles, and is also supplied with an index of subjects. The aim of the work is to furnish accounts as complete as possible of the various domestic and foreign forms and systems of screw threads, together with reports from professional men relating to their actual experience and study along these lines.

Works Committees and Joint Industrial Councils. A. B. Wolfe, Industrial Relations Division, U. S. Shipping Board, Emergency Fleet Corporation, Philadelphia. Paper binding.

A branch of the Industrial Relations Division was organized for the purpose of analyzing and making available to American manufacturers both English and American experience in industrial relations under war time conditions. Many lines of inquiry were started but only a few of these inquiries had been completed at the time of the signing of the armistice. One of these which was concluded is here presented as a report on Works Committees and Joint Councils. It is divided into five chapters with an introduction and seven appendices. The headings of the chapters are as follows: The Human Factor in Industry; Psychology, Democracy and Efficiency; The Whitley Committee Recommendations; Works Commitees; Works Committees in the United States.

Manual of Inspection and Information for Weights and Measures Officials.—By F. S. Holbrook, inspector of works and measures, United States Bureau of Standards. Two hundred and forty-six 4½ x 7 in. pages; illustrated; bound in cardboard. Published by the Department of Commerce, Bureau of Standards, Washington, D. C., for free distribution.

This book has been published primarily for the use of official sealers and inspectors appointed to enforce weights and measures laws and ordinances, but it is of value to anyone who has occasion to inspect and test weights and measures and weighing and measuring devices of the types ordinarily found in commercial use. It contains complete instructions, together with specifications and tolerances for the testing of all kinds of scales, length measures, etc.; general instructions concerning the enforcement of law; lists of standards in apparatus; method of keeping office records, etc. Appendices are included containing the federal weights and measures laws with rules and regulations, a model state law in relation to weights and measures, a description of the metric system, general tables, conversion tables, and tables of equivalents. Copies of this book may be obtained by addressing the Bureau of Standards, Washington, D. C.

Applied Mechanics—Vol. II, Strength of Materials.—By Charles E. Fuller and William A. Johnson. First Edition. John Wiley & Sons, Inc., New York. Five hundred and thirty-eight pages, with numerous problems and illustrations. Price, $3.75.

This is a rather comprehensive treatment of the subject generally known as "Strength of Materials," and follows the conventional lines of development, beginning with the physical properties of materials and taking up in order the analysis of stress and strain, beams, combined stresses, the theory of flexure, columns, shafting and springs, curved bars, arches and catenaries, cylinders and plates, and reinforced concrete. It is essentially a textbook and requires of the student a knowledge of differential and integral calculus and theoretical mechanics. The methods of the calculus have been freely employed throughout and there is also a generous use of graphical methods of solution and representation of results. The book will recommend itself to teachers on account of the many problems introduced, solutions being included where their use would be an aid in clearing up obscure points. As a reference book for graduate engineers it should be of considerable value on account of its completeness and also because all the steps in the derivation of the more intricate formulas have been included, particularly where differential equations are employed—a great help to the man who has not time to keep his hand in at this sort of exercise. The work has been so arranged that parts of some of the earlier chapters and all of some of the later and more difficult ones may be omitted for a shorter course in the subject. Although the treatment is decidedly theoretical attention is called to the limitations of the theory and the divergence of actual conditions from those assumed.

Compressed Air Plant.—By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. Four hundred and eighty-five 6 x 9 pages; with many diagrams, illustrations and tables; bound in cloth. Third edition. Published by John Wiley and Sons, Inc., New York. Price, $4.25.

This work is an effort to combine the rather scattered information on the subject. It offers to the practicing mining engineer a reference book which is encouragingly free from mathematical formulas. A chapter is devoted to the general theory of the compression of air, and in it the deductions of the more important formulas are given, such as those used for finding the horsepower for single- and multiple-stage compression. The first part deals with the construction and operation of air compressors, but many of the details of design are omitted as not being of particular value to the users of such apparatus. The second part is devoted to applications of compressed-air transmission of power to machine drills, pumps, locomotives, rock-channeling machines, etc. The following list of chapter headings will give a good idea of the comprehensive nature of the text: Structure and operation of air compressors; the compression of air; wet compressors; dry compressors; compound or stage compressors; air-inlet valves; discharge or delivery valves; mechanically-controlled valves; performance of air compressors; air receivers; speed and pressure regulators; air compression at attitude above sea level; explosions in compressors and receivers; air compression by action of falling water; conveyance of compressed air in pipes; compressed air engines; freezing of moisture; reheating compressed air; compressed air rock-drills, hammer drills; coal-cutting machinery; channeling machines; operation of mine pumps by compressed air; pumping by direct action of compressed air; compressed air haulage.

Starrett Data Book for Machinists.—Vol. II of Starrett books. One hundred and seventy-nine 4½ x 7-in. pages; bound in flexible red leather. Published by the L. S. Starrett Co., Athol, Mass. Price, 50 cents.

For the convenience of the expert machinist who often wants certain shop information and data not easily remembered and seldom easy to find when needed the L. S. Starrett Co. of Athol, Mass., has just published the Starrett Data Book for Machinists. To insure its covering the field thoroughly the Starrett company secured as editors Prof. H. P. Fairfield of Worcester Polytechnic Institute; N. J. Bethel, production manager of the Taft-Peirce Co.; N. H. Edge, factory manager of the Locomobile Co., and J. C. Spence, superintendent of the Norton Co., and through their coöperation the company has been able to include practically all of the information, formulas, etc., essential to good shop practice as found in the different classes of work produced in the several plants under the direction of the collaborating editors and has avoided the elementary and theoretical matter which is of little or no value to a practical man.

The book contains tables, rules, data, etc., is freely illustrated with line drawings, carefully indexed, and presents in a convenient form the information that the practical expert machinist so frequently requires. The volume under review is divided into 21 general heads, the page references in the index showing over 500 subjects treated, the information being given in the form of tables, formulas and charts and is confined wholly to the practical phases of every-day machine-shop practice on the assumption that the men who will use the book are experienced, familiar with their tools and shop methods and beyond the need of explanatory and elementary advice. Among the general subjects treated are Laying Out; Screw Machines; Heat Treatment of Steel; Threads and Screws; Gears and Gearing; Lubricants; Grinding, Belting and Shafting; Milling; Tapers; Taps; Turning and Boring, etc.

Trade Catalogs

Maxim Products. Maxim Silencer Co., Hartford, Conn. A single sheet folder showing the various steel tubings by the Maxilent Process.

Electric Butt Welding. The Ready Tool Co., Bridgeport, Conn. Circular, pp. 4, 8½ x 11 in. Examples are given to show economies effected in high-speed carbon and tool steel.

Electrical Supplies. The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has issued a catalog in which all of its electrical supplies are listed.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials. The 22nd annual meeting of the society will be held at Atlantic City, N. J. on June 24-27, 1919, with headquarters at the Hotel Traymore. Alfred D. Flinn, secretary, 29 West 39th St., New York.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, April 15, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, N. Y.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. Other meetings on Apr. 24, when Allen S. Crocker will speak; also on May 29 with Maurice A. Wilder as the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis Apr. 28, 29 and 30.

Western Society of Engineers, Chicago Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

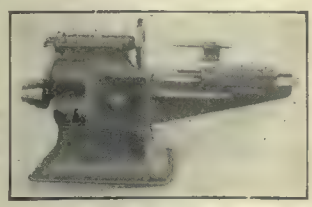
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Oil Grooving Machine

Fischer Machine Co., 310-316 North 14th St., Philadelphia, Penn.

"American Machinist," March 20, 1919

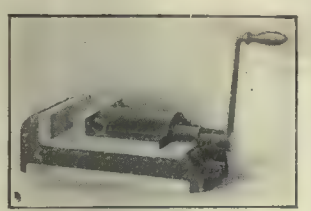


Hole in spindle, No. 4 Morse taper; thread on spindle, 2⅜ in.; pitch of thread on spindle, 6; length of groove cut, 15 in.; swing over bed, 19 in.; diameter of faceplate, 18 in.; length of machine, 8 ft. 3 in.; diameter of cone steps, 11, 13 and 15 in.; width of belt, 2½ in.; speed of countershaft, 300 r.p.m.; hp. required, 2; height of spindle above floor, 3 ft. 8 in.; height of ways above floor, 2 ft. 10½ in.; floor space, 8 ft. 3 in. by 2 ft. 8 in.; size of base, 2 ft. 7¾ in. by 4 ft.

Vise, Heavy-Duty Milling

Edlund Machinery Co., Cortland, N. Y.

"American Machinist," March 20, 1919

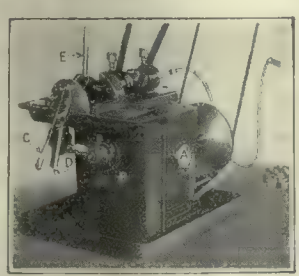


A milling vise for heavy work. The solid jaw is reinforced to prevent breakage and the screw is protected so that chips cannot accumulate around the working parts of the vise. The crank is said to be extra long to give a greater purchase for gripping. The jaws are hardened, ground and drilled to fit the standard vises. Made in three sizes, 6, 7 and 8 in.

Milling Machine, Automatic

Automatic Engraving and Manufacturing Co., 2033 Fifth Ave., New York.

"American Machinist," March 27, 1919

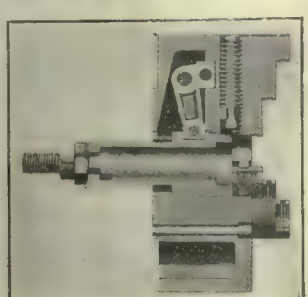


A new adaptation of the small special purpose milling machine built by this company. A two-position holding fixture is attached to the reciprocating table and the work for which it is adapted is the routing of a peculiar-shaped slot in a locknut. The spindle is provided with a spring collet to hold an end mill ¾ in. in diameter. Both spindle and cutter are hollow and lubricant is supplied through the spindle directly to the cutting point by means of a small pump and flexible tube connection. The spindle runs 3500 r.p.m. The machine is very compact, occupying a space about 14 x 18 in. square and 12 in. high. The weight is approximately 200 lb. The time of each cycle on this work is 28 seconds.

Chucks, Air Operated, "Logan"

Frank G. Payson Co., 9 So. Clinton St., Chicago, Selling Agents. Logansport Machine Co., manufacturers.

"American Machinist," March 27, 1919

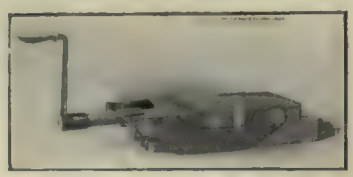


A three-jaw, air-operated, combination chuck, said to combine maximum power with minimum weight and simplicity of operation. The body is a one-piece casting, eliminating all bolts, screws, or other parts, and it is said that the jaw-operating mechanism is new to air-chuck construction. A special heat-treated lever is used, to which are pivoted hardened and ground steel blocks which engage in hardened and ground ways in both the draw tube and chuck draw slide, thus eliminating wear and friction to a great extent. The mechanical advantage obtained by the lever used is three to one.

Vise, Milling With Side Bars

Edlund Machinery Co., Cortland, N. Y.

"American Machinist," March 20, 1919

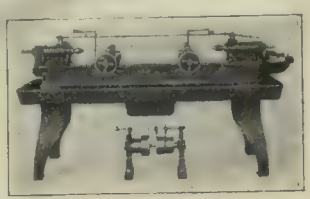


Made in 6-, 7- and 8-in. sizes and equipped with side bars which take the clamping strain, these bars being dropped under the opening of the vise jaws in order that long work may be held. It will be noticed that the sliding jaw is on the opposite end from the clamping handle. The jaw faces are removable and replaceable and the advantage claimed for the type of construction used is that the pieces of work are gripped in such a manner that there is no tendency for the jaws to spring upward, allowing the work to loosen.

Centering and Drilling Machine, Double-End

Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich.

"American Machinist," March 27, 1919



Although primarily intended for centering both ends of a shaft simultaneously, it may be adapted to a wide range of work where it is desired to drill from opposite directions. The machine is of such construction that two ⅝-in. drills can be used simultaneously and the bed lengths are such as to take 12, 24, 36, 48, or 60 in. between centers, as desired. The belt-driven machine is shown, but motor drive can be furnished, the motor being mounted under the pan at the right end of the machine and driving through a Link-Belt silent chain running in a bath of oil. The machine can be so arranged that the left-hand head is removable, enabling longer shafts to be centered, or if desired can be furnished with one drilling head. The drive from the pulley shaft to the spindle shafts is through Link-Belt silent chains running in oil baths, the end thrust being carried on ball thrust bearings. The vise jaws have a capacity for round stock up to 4 in. in diameter and can be set to drill off center if desired.

Furnace, Three-Purpose Heat-Treating, "Triad"

W. R. Bennett Co., Elmwood, Conn.

"American Machinist," March 27, 1919



Three heating operations can be carried on at one time by three men without interference; namely, heating for hardening in a lead or cyanide bath, heating for hardening in a semi-muffle furnace, and heating for forging in the combustion compartment. The pot is suspended from the split iron covers forming the top of the furnace, a feature that is said to give a uniformity of temperature from the bottom to the top that is not possible when the pot rests upon a supporting base. The flame itself does not come into contact with the lead pot. Floor space, 2 sq. ft.; height, 31 in.; weight, 550 lb.; burner for oil, ¾ in.; burner for gas, 1 in.; size of pot, either 6 or 7 in. in diameter and 11 in. deep.

Tailstock and Center

Porter-Cable Machine Co., 1708 N. Salina St., Syracuse, N. Y.

"American Machinist," March 27, 1919



Replaces the ordinary center by dovetailed slide with a center point on one end. It is so designed that no part projects farther from the center line toward the operator than ⅝ in. This permits the cross slide to be moved to the right of the tail center for measuring or filing the work, without backing out the slide, provided the diameter of the work exceeds ⅞ in. Convenient for turret toolpost and gang-tool set-ups for the same reason. Center may be ground back ¾ in., for which purpose a special fixture is provided. The device can be applied to Porter-Cable lathes now in use on account of the adjustable nature of the grinding fixture. A setting gage and complete information is supplied with each outfit.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$34.00
Northern Basic	27.55	31.80
Southern Ohio No. 2	28.55	32.80
NEW YORK, Tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	36.15
Southern No. 2 (silicon 2.25 to 2.75)	34.70	39.95
BIRMINGHAM		
No. 2 Foundry	26.75	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	31.90*	36.15*
Virginia No. 2	33.25†	38.10†
Basic	29.65*	33.90*
Grey Forge	29.65*	33.90*
CHICAGO		
No. 2 Foundry Local	26.75	31.00
No. 2 Foundry Southern	33.00	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.25	31.00
Basic	25.75	30.00
Bessemer	29.35	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.04	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.04	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.14	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.39	3.67	4.45

* For ¼-in. plates the extra is 30c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	3.98½
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.62	6.22	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.52	6.12	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.47	6.07	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.42	6.02	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	5.37	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	5.27	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	5.17	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	7.42	7.57	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	7.12	7.27	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.97	7.12	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	30%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire: 5/16, 1/4, 3/16, 5/32, 1/8, No. 8, 7/64 and No. 10, 3/32, No. 12, 1/16, No. 14 and 1/32, No. 18, No. 20 — 25.50 to 33.00

Domestic 20c. for 1/16, 15c. for 1/8 to 5/16.

Cast-Iron Welding Rods

5/16 by 12 in. long	14.00
1/4 by 19 in. long	12.00
5/16 by 19 in. long	10.00
1/2 by 21 in. long	10.00

Special Welding Wire, Coated

1/4	33.00
5/32	30.00
1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.02	8.25	8.10
Floor plates	5.67	6.00	5.92

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4, and 3/8	50½%	24%	1/8 to 1¼	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	3/4 to 1¼	39½%	24½%
1/2	51½%	39%			
3/4 to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
3/8 to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.37½	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.25	5.10	7.25
Spelter	6.55	6.85	7.50

ST. LOUIS

Lead	5.00	4.80	7.10
Spelter	6.20	6.50	7.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	24.50	35.00	26.00	35.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	34.00	22.00	34.00
Brass sheets	18.75	23.75–28	30.75	25.00	30.00	21.50	35.00
Brass pipe	28.00	34.00–37	36.50	33.00	41.00	31.00	41.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	41.50	41.50	39.00	48.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

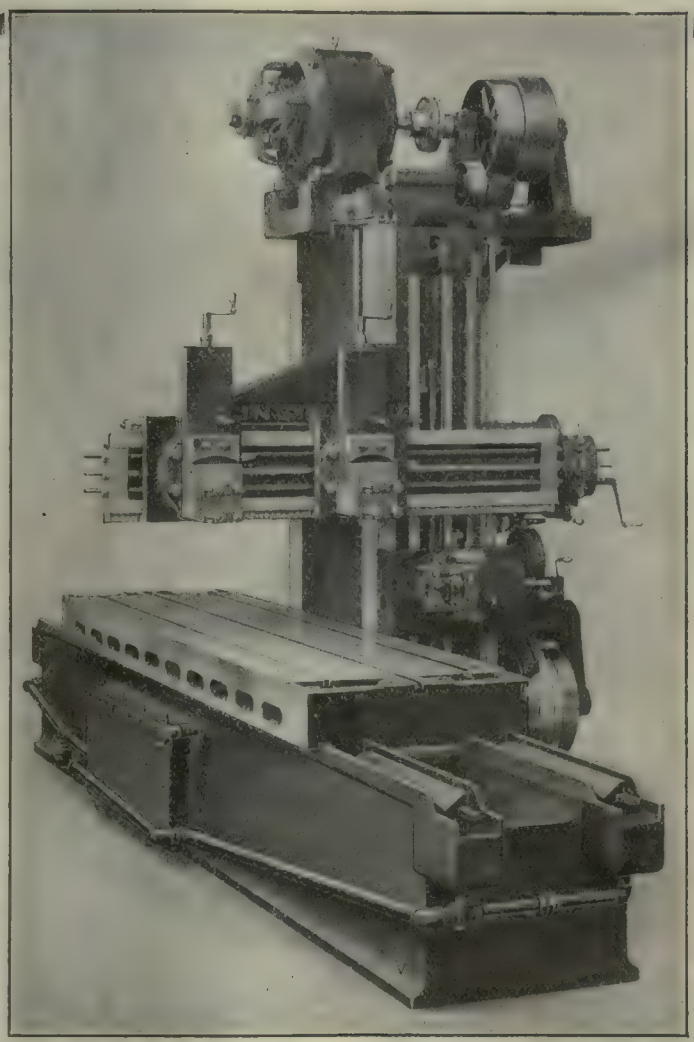
BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	35.00

April 17, 1919 American Machinist Vol. 50, No. 16

Cincinnati Open-Side Planing Machines

Up to the present time the Cincinnati Planer Co. has confined itself to the manufacture of planing machines of the double-housing type. The open-side machine described in this article is a new product for this concern and should be of much interest to any one having work to do that could be handled on a machine of this kind.



THE Cincinnati Planer Co., Cincinnati, Ohio, has just placed on the market a new and complete line of open-side planing machines. This is a new line for this concern, and it is stated that care has been exercised in the design so the features embodied in the double-housing type planing machines manufactured are now incorporated in the open-side type of machine.

The machines are manufactured in three sizes, 36 x 36 in., 48 x 48 in., and 72 x 72 in. The points of superiority cited are power rapid traverse for the rail heads, a box-type table, forced lubrication of the Vs, a patent "tu-speed" drive on the 36-in. and 48-in. machines, quick-reverse aluminum pulleys, an extra capacity table, a box-type bed closed on top, a bed bored for shaft bearings by means of jigs, a bull wheel revolving with the shaft in bearings at the side, bronze bushed self-oiling loose pulleys, a self-releasing combination friction, patent gear-shaped tumbler and dogs, a safety locking device, a down-feed screw and collar of one-piece construction, ball bearings on the down-feed screws, down-feed screws in tension at all times, adjustable taper gibs throughout, a vertical slide maintaining a full bearing on the harp at all times, micrometer collars for horizontal and vertical feeds, simplex feed gears, a patent power-elevating device, and all gearing completely covered. The side head has a long narrow guide for the saddle on the column; an independent adjustable-feed gear, and a handle for the vertical movement; a self-contained counterbalance system, and a releasing latch handle for the tool block.

The headpiece and Figs. 1 and 2 illustrate one of the machines from various points of view. The rail heads are provided with a rapid power traverse mechanism, this feature enabling the operator to quickly adjust the heads to any desired position by power. The Vs of the bed and table are oiled by forced lubrication from a pump which delivers the oil into the Vs directly under the tool point, and from this point it is distributed over the entire length of the bed to either end, from where it returns to the tank, the oil passing through two strainers before it is again used. It is stated that this feature is especially desirable where heavy loads are carried by the table. For planing work that is wider than the table, the use of an auxiliary rolling table is recommended, this being supplied at extra cost if desired. The 36-in. and 48-in. machines are regularly furnished with a "tu-speed" drive, giving two cutting speeds and a constant speed return, but where a greater number of speeds are needed either reversible or non-reversible motor drive is furnished, these requiring direct current.

The bed is of heavy-box section, and is especially strengthened where the gearing and column are mounted. Heavy T-shaped girths at short intervals tie the walls together, and further strength is added by closing in the top between the Vs with an integral part of the casting. This feature also serves as a safeguard against accidents to the operator. The column seat is deep and wide, providing a large surface for the column fastening, and is entirely inclosed on all sides. The length of the bed has very little overhang of the table when planing at full stroke.

The column is of box-type construction and is fastened to the bed by tongues and grooves in addition to the regular bolts and dowel pins. It is made with considerable taper toward the bottom, this design being

said to resist the combined bending and twisting stresses and to prevent springing under a heavy cut when the heads are working at the extreme position on the cross rail.

The table is of the box type, the bottom being entirely closed. Heavy ribs at short intervals tie the top and bottom securely together, and prevent springing either when clamping work upon it or while it is at the limit of its travel. The T-slots are planed from the solid (not cored), the center slot extending the full length of the table. Stop holes are drilled and reamed throughout the entire surface of the table. By drilling extra holes at each corner of the table and by carrying the center T-slot the entire length, it is possible to plane from 6 to 10 in. longer than the rated capacity of the machine. Making the under side of the table solid also prevents dirt and chips from falling through the holes into the ways. Each section of the rack is bolted and doweled to the table. A view of the bottom of one of the tables is shown in Fig. 3.

The gearing and rack are cut from the solid by a system of special cutters for each gear, this method giving a smooth-running machine, and insuring strength and long life. All the large gears and racks are made from semi-steel castings, and the pinions from steel forgings. All gearing is completely covered for protection against accidents.

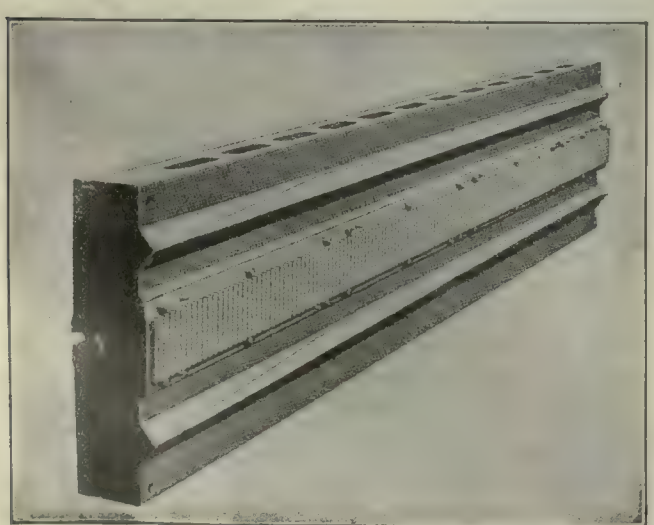


FIG. 3. A BOTTOM VIEW OF THE TABLE

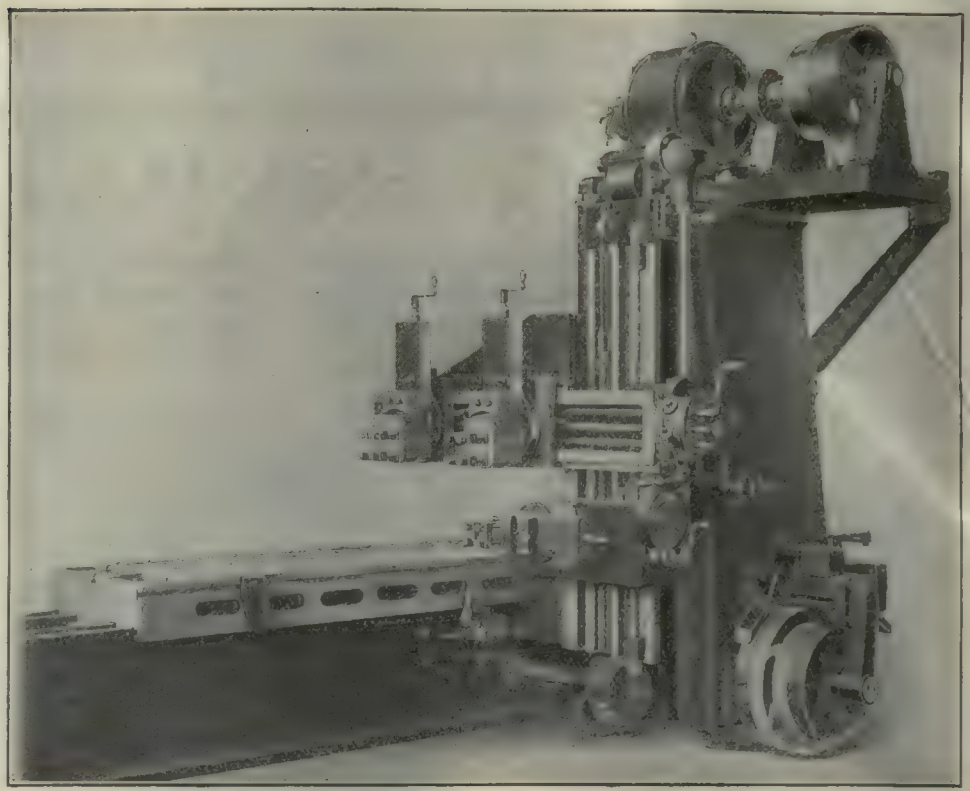


FIG. 1. A SIDE VIEW OF THE CINCINNATI OPEN-SIDE PLANING MACHINE

Specifications for 36 x 36 in. planing machine: Length of table, 8 ft.; capacity under knee, 37 in.; will square down in width, 44 in.; if tool is swivelled will plane about 54 in.; length of bed, 13 ft. 4¾ in.; depth of bed, 24 in.; depth of table, 9¾ in.; width of table, 32 in.; depth of rail, 13¾ in.; length of down-feed, 15 in.; height of rail bearing on column, 28 in.; width of knee bearing on column, 45 in.; width of cutting belt, 2½ in.; face width of bull wheel and rack, 7¼ in.; size of motor, 15 hp.; maximum speed of motor, 700 r.p.m.; total height without motor, 107 in.; total width without motor, 105 in.; weight, 22,000 lb.; weight per extra foot of bed, 1100 lb.

Specifications for 48 x 48 in. planing machine: Length of table, 10 ft.; capaciy under knee, 49 in.; will square down in width, 52 in.; if tool is swivelled with plane about 62 in.; length of bed, 16 ft. 9 in.; depth of bed, 23 in.; depth of table, 10 in.; width of table, 40 in.; depth of rail, 15¾ in.; length of down-feed, 18 in.; height of rail bearing on column, 30 in.; width of knee bearing on column, 54 in.; width of cutting belt, 3 in.; face width of bull wheel and rack, 8½ in.; size of motor, 25 hp.; maximum speed of motor, 700 r.p.m.; total height without motor, 122 in.; total width without motor, 135 in.; weight, 34,000 lb.; weight per extra foot of bed, 1500 lb.

Specifications for 72 x 72 in. planing machine: Length of table, 12 ft.; capacity under knee, 73 in.; will square down in width, 76 in.; if tool is swivelled will plane about 91 in.; length of bed, 19 ft. 11 in.; depth of bed, 23 in.; depth of table, 11½ in.; width of table, 62 in.; depth of rail, 20¾ in.; length of down-feed, 25 in.; height of rail bearing on column, 40 in.; width of knee bearing on column, 75 in.; width of cutting belt, two, 3 in.; face width of bull wheel and rack, 12 in.; size of motor, 40 hp.; speed of motor, 700 r.p.m.; height without motor, 156 in.; width without motor, 170 in.; weight, 65,000 lb.; weight per extra foot of bed, 2100 lb.

The driving shafts are made of 75-point carbon steel, and are ground, after the splining and all work has been done, to insure accuracy. Large reservoirs with self-oiling wicks furnish continuous lubrication to the shaft bearings. Each bearing is provided with a small reservoir, and an oil groove is cut on the inside at the top and bottom. The bearings for the driving shafts are ground internally and are fitted into the bed, the holes in the bed being bored out to a jig. No bushing is less than 7 in. long. The entire construction is shown clearly in Fig. 4.

Knee and Crossrail

The crossrail is bolted and doweled to the knee and is raised and lowered by means of a power-elevating device operated through frictions by the lever on the right side of the column. The knee is formed at the top to provide a long bearing on the face of the column; it is also provided with a narrow guide arrangement with taper gibs and clamps.

The heads are distinctive, the end of the tool block and slide being made round to avoid projecting corners on angular work. They are scraped to the rail, and are graduated for swiveling up to 90 deg. They have automatic feeds in all directions, and can be operated from

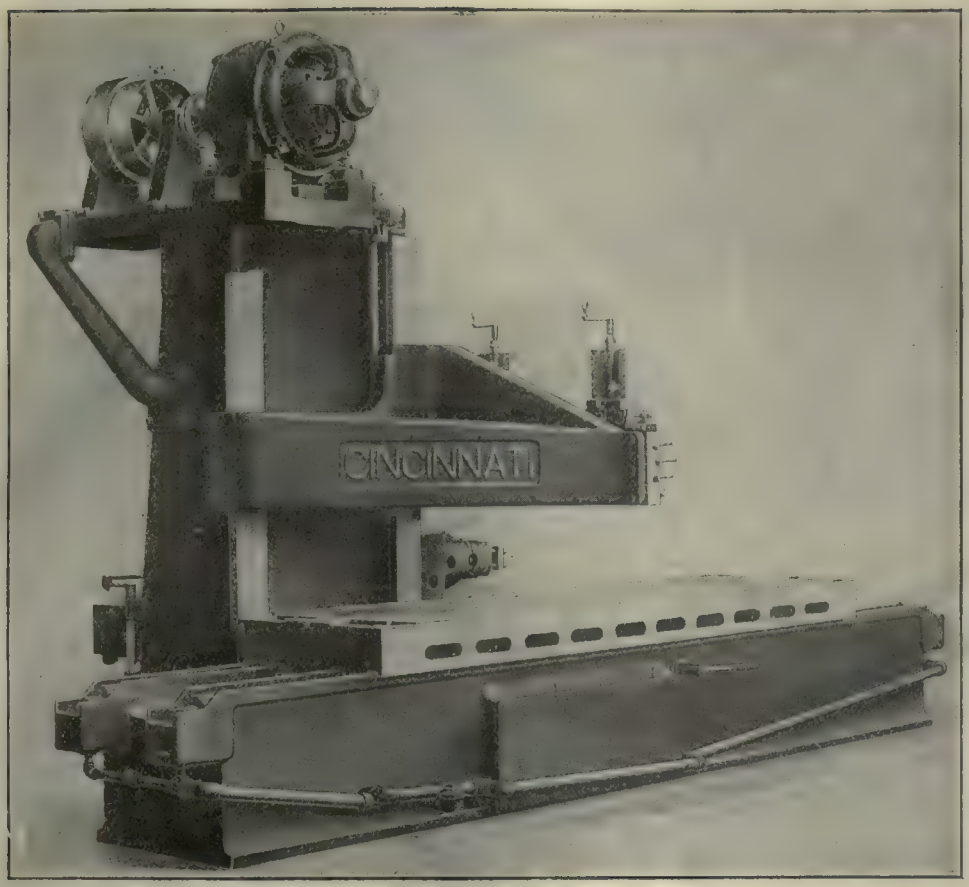


FIG. 2. A BACK VIEW SHOWING THE METHOD OF BRACING THE CROSSRAIL

either side of the machine. The saddles being right and left, the heads can be run very close together. The tool block swings on a tool-steel taper pin, and carries four steel bolts for clamping the tool. Tool-lifting devices can be furnished at a slight additional cost when desired.

Adjustable taper gibs, as shown in Fig. 5, are incorporated in all heads. The slides are also hung on ball bearings, which allow them to work freely.

Side heads can be furnished on all sizes. These are provided with independent power and hand vertical feed, and can be run below the top of the table when not in use. The handle which controls the side head travels up and down with the head, and is convenient to the hand of the operator. Weights and wire cables are furnished for counterbalancing, without extra charge.

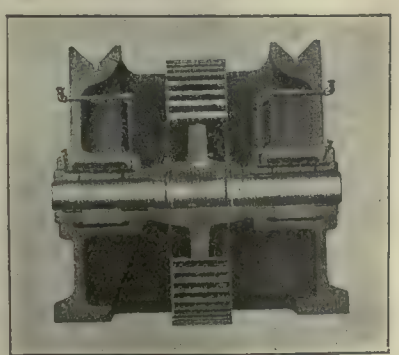


FIG. 4. METHOD OF CONSTRUCTING THE BOXES FOR THE DRIVING SHAFT

Micrometer dials are furnished on all down- and cross-feed screws, and consist of collars graduated in thousandths. The feed racks are cut from bar steel, and the pinions, which mesh with them are also made of steel, insuring long life.

The feeding device, shown in Fig. 6, is of new design and is said to have many improvements over the old style, in that it has all the trigger and spring mechanism inclosed, there being only the handle for operating the pawl on the outside. Every detail of this device is made by jigs and all parts are interchangeable. The construction is such that in removing the gear from the rod or screw all parts remain in place.

The shifting mechanism is said to transfer the belts quickly and noiselessly when running at the highest speeds. The belt arms are provided with an adjustment that keeps them in proper position at all times, and are provided with an extra support on the bracket which relieves the fulcrum stud from undue strain, doing away with the usual wear at this point. The studs are hardened and ground. The cam and rollers are protected from dirt by a cover, which entirely incloses the mechanism. A drip pan is provided under the shifting mechanism for catching the oil, preventing it from getting on the belts. By means of shifting levers at both the front and rear the operator can control the motion of the table without walking around the machine. The safety locking device permanently locks the entire shifting mechanism, preventing the table from starting, except at the will of the operator. This is a valuable attachment, being a safeguard against accident and spoiled work. It consists of a spring plunger, which enters a seat in the bed, and holds the shifting lever in a fixed position.

Aluminum quick-reverse pulleys greatly reduce the power required at the moment of reverse and also increase the efficiency of the machine to a marked degree. Owing to the lightness of the metal used the greater part of the inertia at the moment of reverse is elimi-

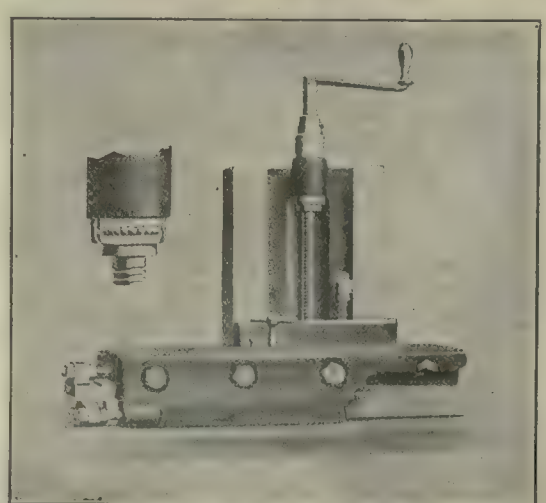


FIG. 5. THE TYPE OF ADJUSTABLE TAPER GIBS AND BALL BEARINGS

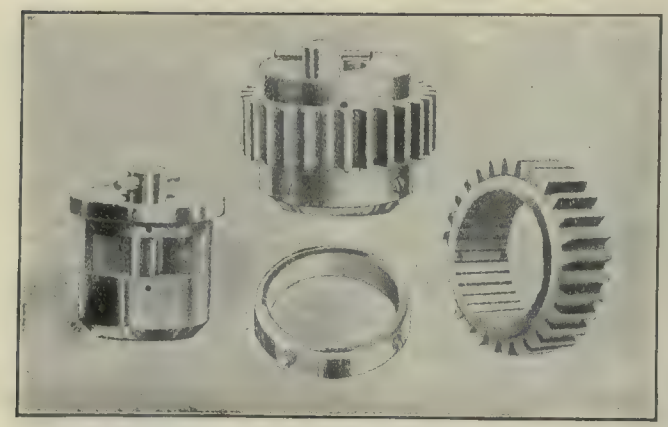


FIG. 6. THE IMPROVED FEEDING DEVICE

nated. Loose pulleys are provided with a new and improved self-oiling bronze bushing. The hubs are bored straight and the bushing driven into them. These bushings are cast so as to provide a large oil chamber, which holds sufficient oil to properly lubricate this part of the machine for at least one month. The bushings are provided with two grooves, into which are inserted strips of felt; the oil passes through the felt and lubricates the shaft.

Centralized Compressor Plant Versus Independent Compressors

By Frank Richards

I was very much interested in the article in the *American Machinist*, Feb. 27, page 395, giving an account of the employment of compressed air for various operations in the manufacture of 155-mm. shells at the works of Winslow Brothers Co., Chicago, Ill. Many establishments were rushed last year in the production of munitions, and the plant among them which did not use compressed air for some of its work would have been a curiosity. In the example above referred to, the special uses of the air were for the chucks on lathes and boring machines, for varnishing and for sandblasting the shells. I was especially interested in the following portion of the detailed description which I here reproduce verbatim:

"An interesting feature of the air-compressing installation is that, instead of being grouped centrally in a power house, it is distributed about the plant at convenient points where the air is most used. This saves long lines of piping and makes for efficiency, as it obviates to the greatest possible extent drop in pressure, due to friction in the transmission line caused by elbows and turns."

Now, I feel compelled to say at once without hesitation and without apology, that while the feature to which attention is thus called is certainly "interesting," it is also to me most surprising. It is at variance with all experience and practice, and the claimed advantage is absurd. A single compressor could have been installed in the power house of the works, or anywhere most convenient, the air could have been distributed throughout the establishment, and the pressure maintained so that there would not have been more than 1 lb. of pressure drop at the remotest point. This may be substantiated by the records of hundreds of compressed-air installations where the pressures carried are anywhere up to 80 or 90 lb. gage, and the distribution areas very much larger than in this case. Here there were four similar compressors, two-stage, with air cylinders 14 in. and 8¾ in. respectively, with a common stroke of 10 in.—quite small machines as compressors go today. A single machine, the exact equivalent of these in theoretical capacity, would have had at the same piston speed, air cylinders 28 in. and 17½ in. in diameter; but, with the greater piston speed permitted to the larger machine, air cylinders 24 in. and 14 in. in diameter would have fully equalled the air output.

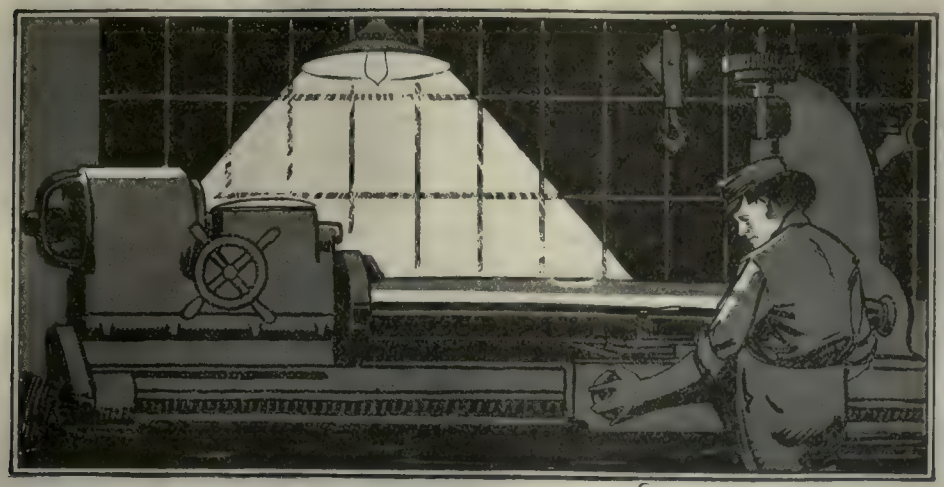
Under the conditions which rule wherever compressed air is employed, and especially was it so in this case, the air is used intermittently, and the demand for the air at the source of supply is irregular. The consumption of air in operating the various chucks spoken of must have been very small, since they are worked by static pressure and not by flow or loss of air. By far the larger volume of the air, we must assume, was used for the varnishing and the sandblasting, and especially the latter, since for these, when actually operating, there would be a continuous discharge of air; but here too the work was not continuous for any machine, and the machines would seldom, if ever, be operating all at once. The demand for air from each of the four compressors was of course never coincident with that of either of the others. The air demand would have been much better averaged and equalized if all the air had been drawn from a single compressor, and a single air receiver, approximately equal in capacity to that of the four smaller ones would have been better to meet the demand.

Having regard to the fluctuating and unequal air consumption, it would seem, from all that appears, and from all that may be legitimately inferred, that a single central compressor with cylinders 20 in. and 12½ in. in diameter would have afforded a sufficient supply of air in this case. The cost of such a machine might be about one-half of that of the four smaller ones. The single line of distributing pipe would probably cost less than the extra shafting, pulleys and belts, and the piping for cooling water for the four isolated machines. The extra cost of attending the four separate machines, the multiplicity of the lubrication, the fourfold liability of stoppage for repairs, need not be spoken of.

The article which we have been considering calls attention to the special air-drying arrangement provided for the air to be used for the sandblasting. With a single air compressor, an effective aftercooler and a separator, the latter operating upon the air when at its highest pressure and at its lowest temperature, or when its moisture carrying capacity would have been at the minimum, would have provided the advantage of dry air for all the purposes for which it was used, instead of for the sandblasting alone.

The Useful Life of a File

A French investigator states that the useful life of a file is on an average 25,000 strokes, which is equivalent to two full working days of 10 hours each. Files should be discarded as soon as they have passed through the period of useful life, because worn files are expensive to use. It has been estimated that counting the workman's time and overhead charges a new file would be capable of turning out an amount of work valued at $4.60, which when using an old file would cost $10.60.—*Brass World.*



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Old and New Shop Circuits

This article discusses the question of electric circuits for shop motors and lamps. A comparison is made between the conditions in the small shop and those in the larger industries or where additions are made to what was originally a small plant. Notes are included concerning some of the operating features of motors and lamps. Standard practice in the matter of voltages, frequencies and phases for alternating-current shop work is referred to, with a statement of the allowable variations of these elements on the operation of shop power appliances.

IN EARLIER shop practice there was a more or less general tendency to employ direct current for distributing electric power. With the natural growth of such shops and the accompanying expansion into new buildings, the question is faced regarding the policy to adopt in the matter of extensions of electric-power circuits. It is well to keep in mind two principal points. One relates to the question of which of the two methods known as direct-current and alternating-current distribution is the better and the more economical to use, and the other is concerned with which type of motor will be better suited to the needs of machine tools and machinery in general.

From the standpoint of the distribution of power without any regard to the apparatus to be operated, either direct or alternating current may be employed economically, provided the distances over which the power is to be transmitted are small. When the size of the plant is large, as where a number of buildings must be supplied and where the yard area over which the buildings are distributed is great, it is not usually economical to use direct current.

The reason for this is that there is no convenient and inexpensive way by which to transform direct current from one voltage or pressure to another as is the case with alternating current. The direct current must usually be generated in the power house, distributed over the circuits and utilized at the motors and lamps at essentially the same voltage, the value of this voltage being dictated in part at least by the requirements of the machinery it is to operate, its value in the average shop usually being quite low; that is, 110 or 220 volts except in special cases.

For the distribution of power by direct current the power is determined by the product of the voltage and the current, and hence if the voltage is low the current must necessarily be high. This means large and expensive wire conductors, and this feature is further emphasized if the distances become great. Thus the cost of the circuits becomes excessive and the interest

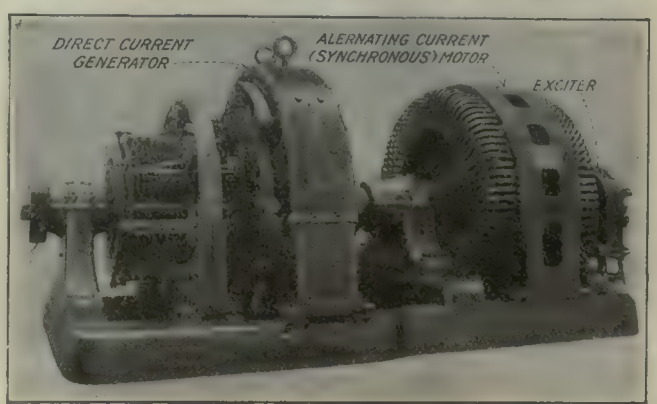


FIG. 1. MOTOR-GENERATOR SET FOR CONVERTING FROM ALTERNATING TO DIRECT CURRENT

and depreciation on the distribution system large. On the other hand, if the wires are not large enough the current fed through them means a large power loss in the distribution system.

In marked contrast the alternating system possesses the flexible characteristic which makes it possible to transform conveniently and economically from high to low voltage and the reverse by the so called transformer. The scheme adopted in this system is to use a fairly high voltage (often 2300 volts) for the transmitting circuits between the power house and remote buildings. This higher voltage means a low current for a given amount of power, and hence the cost of the circuits is reduced and the loss of power in the transmission and distribution can be kept down to a very small value.

The foregoing notes will show, therefore, why there is a very general tendency to use alternating current in the large central stations for the purpose of trans-

mitting and distributing power over large areas, and it is also readily seen that even where an industry has its own power house there is a marked tendency from the purely distribution side of the question to employ alternating current, particularly where the size of the shops is large and the areas involved are extensive.

Turning to the question of the motors and lamps used in the average shop we find that this apparatus as well as the matter of economy of electric-power distribution must also be considered in deciding between the two methods of electrical supply. Very little attention need be given to the question of electric lamps, since modern lamps for shop purposes in nearly all cases are available for operation on both kinds of circuits.

The adjustable-speed machine-shop motor, which has become so widely used for machine-tool work, is a direct-current motor with a ratio of maximum to minimum speed of 2, 3 or 4 to 1 as the case may be, and in which the speed remains practically constant at all loads when set for a given value.

Numerous types of alternating-current motors are available for shop work, but these are mainly of the constant-speed type, or they possess such marked limitations in the matter of speed control as to be removed from the class known as the adjustable-speed type. By constant speed is meant one fixed operating speed which stays practically constant at all loads. It is apparent, therefore, that the machine-shop field presents an advantage in the use of alternating-current circuits from the standpoint of the circuits themselves both in low first cost and in low operating expense, but that in a good deal of shop machinery the distinct advantages of the direct-current adjustable-speed motor makes the use of direct current a necessary part of the supply system.

There are, of course, numerous cases of shop machinery where the constant-speed alternating-current motor is well suited to the requirements. In such cases it is also equally possible to use a constant-speed direct-current motor if it happens that the supply of power has been limited to direct current for the benefit of those machine tools which call for adjustable-speed operation. In many cases both classes of circuits are available in the same shop plant.

Let us suppose that it has been decided to adopt an alternating-current system in the shop power house and that the use of alternating current has been found to be satisfactory for a great deal of the power equipment and for all of the shop-lighting load. It is possible that those machine tools which require an adjustable speed scheme of driving may make it desirable to have a certain proportion of the total power supply in the form of direct current.



FIG. 2. ARRANGEMENT OF LIGHTING AND POWER CIRCUITS IN CONDUIT WIRING

Again, it may happen that the shop plant is to be supplied entirely from outside service such as that from a central power station and that the only available service is in the form of alternating current. In the first instance a direct-current generator may be installed in the shop power house for supplying the special needs of those machine tools which require adjustable speed drive; or in case it is found best to produce all of the electric power in the form of alternating current some form of conversion equipment to change the alternating to direct current may be employed, typified, for example, by the motor-generator

set shown in Fig. 1, which may be used for converting from an alternating-current to a direct-current supply.

This latter scheme may also be employed where central-station power is purchased and only alternating current is available, a motor-generator set being installed in the shop for changing over any necessary proportion of the total purchased power into direct current.

By the term voltage of a circuit or of a motor is meant the electric pressure at which it is operated. The voltage of the supply circuits is governed partly by the voltages of the apparatus to be supplied and to some extent by conditions of safety around the plant.

To the items of voltage and frequency we may add that of phase. Motors for operation on alternating-current circuits in power work are usually either of the two- or the three-phase type, three-phase usually being preferable.

From the standpoint of circuit-operating conditions it is important to note the characteristics of motors at starting. Direct-current motors are usually provided with one of the well-known forms of starting controller with which the amount of starting current may be kept within certain prescribed values.

The squirrel-cage induction motor tends to take an unduly large current at starting unless the voltage ap-

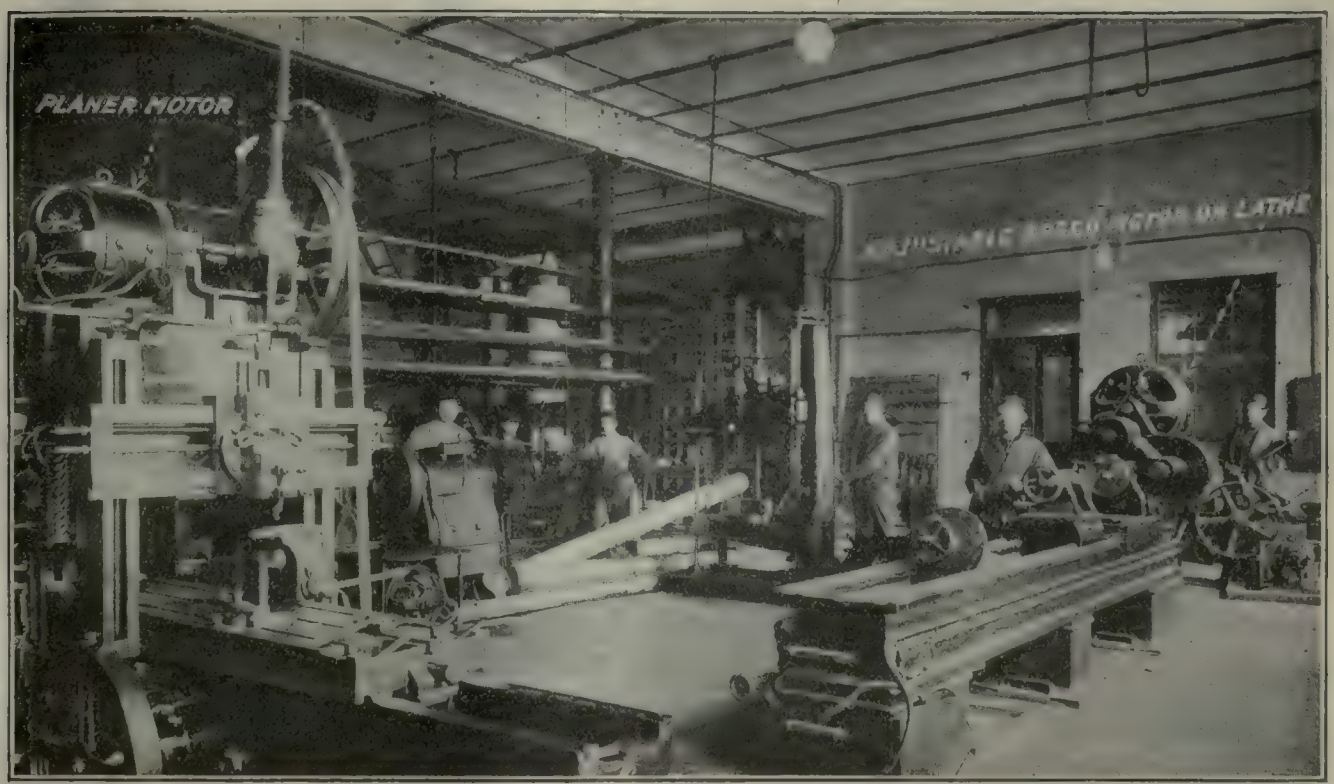


FIG. 3. GENERAL APPEARANCE OF A SMALL SHOP EQUIPPED WITH DIRECT-CURRENT MOTORS

According to broad lines of standardization of voltages as governed by the sizes of the motors, A. M. Dudley gives the following figures:[1] For motors up to 5 hp., 110 volts; up to 75 hp., 220 volts, which is probably the most generally used pressure in shop power work; voltages of 440 and 550 may be used for motors ranging from 7½ to 200 hp.; 2200 volts, from 20 to 1500 hp.; 3800 and 4000 for motors of 50 hp. and over, and so on. These higher voltages may be looked upon as special from the shop viewpoint. The voltage of supply circuits should not vary more than 10 per cent. either up or down from the rated value of the motor for highly successful operation.

The most widely used frequencies for alternating-current circuits (the term not applying to direct-current circuits) are 25 and 60 cycles per second. Dudley classes 60 cycles as the choice for general all-round work, the advantages of 25 cycles applying to heavy slow-speed motors, a variation of as much as 10 per cent. in frequency not greatly impairing the motor operation.

[1]Transactions of the American Institute of Electrical Engineers, Vol. XXXIV, 1915, page 740.

plied to the motor is reduced during the interval of starting. Too large a current at the starting point of such motors may cause an excessive voltage drop in the supply circuits and may consequently affect other apparatus on the same circuits. The well-known "auto-starter" is used in such cases to cut down the voltage at the motor terminals just at starting and then to raise it to its normal value a little after the moment of starting.

Auto-starters, according to the practice of one motor manufacturer, are arranged to reduce the applied voltage to 50, 65 or 85 per cent. of the full line voltage, 65 per cent. being the usual value employed. If the starting voltage is reduced too much the starting torque of the motor is greatly reduced. Hence a good rule to follow is to reduce the applied voltage low enough to keep the first inrush of current down to a reasonably low value, but to have the voltage high enough to insure a sufficient starting torque for the load requirements on the motor.

In the slip-ring induction motor provision is made for inserting an adjustable resistance in the circuit of the rotating member. This is inserted at starting very

much like the auxiliary armature resistance used for starting an ordinary direct-current motor. By its use the starting current may be kept down and good starting torque is provided. As the motor speeds up, this auxiliary resistance is cut out of the circuit. Some degree of speed control may be effected by means of this adjustable resistance, but to produce a change of speed by inserting resistance in the rotating member means that the speed change is increased with changes in load, and in this respect there is a great difference between the slip-ring induction motor and the adjustable-speed direct-current motor.

From the standpoint of keeping down excessive peaks of current when purchasing power from a central

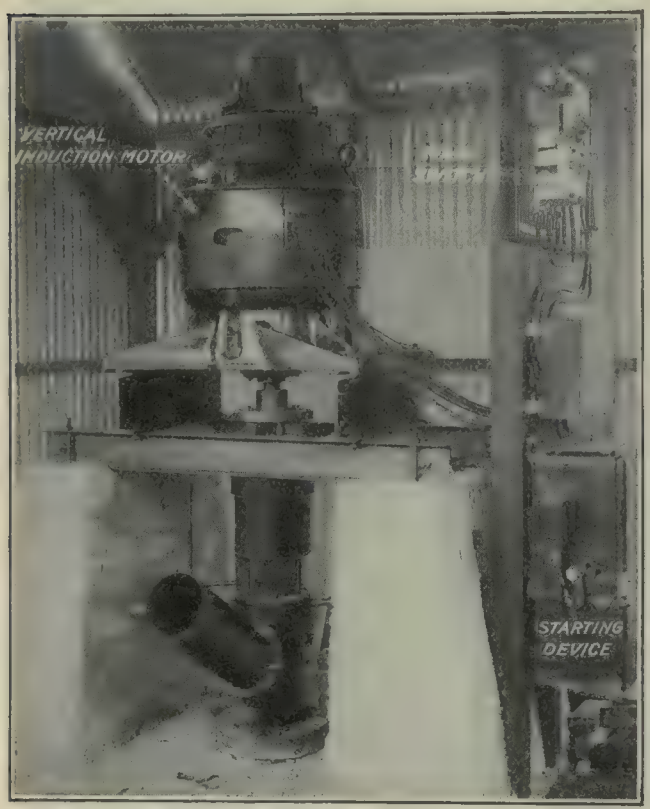


FIG. 4. APPLICATION OF A VERTICAL ALTERNATING-CURRENT MOTOR TO A LAYNE & BOWLER PUMP. NOTE THE WIRING ARRANGEMENTS TO THE RIGHT

station so as to obtain the advantage of a lower rate for power than otherwise, the foregoing notes on how to keep down the current at starting are very important. This is made more evident by a consideration of the following table of current in the line and starting torque in percentage of the normal full-load values for various values of voltage applied to the motor in terms of normal, from which it will be seen that to apply too high a voltage, that is a value not sufficiently below normal, to the terminals of a squirrel-cage induction motor, means usually a very excessive current.

This table also brings out the fact that too great a reduction of applied voltage may mean such a low starting torque as to prevent the motor from starting.[2]

In Fig. 2 a good idea of the form taken by well-arranged shop circuits is given. In the upper part of the illustration conduit wiring for lamps may be seen, and below in the foreground the neat appearance of concealed conduit power circuits is evident.

Fig. 3 gives some idea of the motor applications from direct-current circuits in a small shop space. In this view may be found a motor-driven planing machine and lathe, two motor-driven pipe-threading machines, a motor-driven drilling machine and a motor-driven sawing machine

TABLE OF CURRENT USED IN STARTING SQUIRREL CAGE MOTORS IN TERMS OF FULL LOAD TORQUE AND NORMAL VOLTAGE PERCENTAGES

Voltages on Motor, in Percentage	Current in Line, in Percentage	Starting Torque, in Percentage
33	75	22
50	175	50
66	300	88
100	700	200

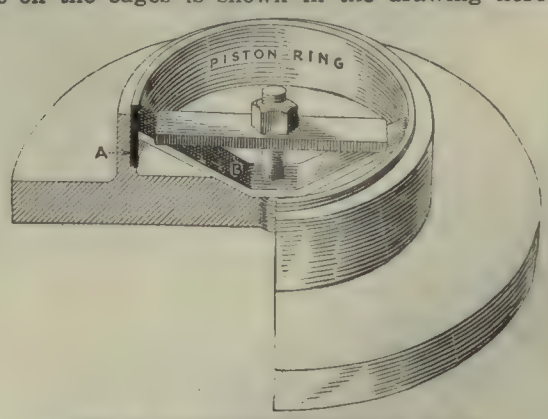
Fig. 4 shows an interesting application of a vertical alternating-current motor for driving a pump. Attention is directed to the main switch at the upper right-hand part of the illustration and the starting device at the lower right-hand corner.

Mention should be made that the electric circuits between the shop power house and the motors take the place of just that much line shafting. The successful operation of the lamps and motors supplied from such circuits depends to a large extent on the excellence with which the distribution system is planned. The obscurity of an electric circuit after its installation tends to its neglect as changes occur in the shop and the original loads on the circuits become modified. As a suggestion, therefore, a fairly close record should be kept of all the shop circuits and of the loading on each as well as the changes of load as motors are shifted from place to place to accommodate changes in the routing of materials and consequent rearrangements of machine tools and other machinery.

Chuck for Holding Piston Rings

BY A. P. M. WILKING

A simple and effective form of chuck for holding piston rings for grinding or other machining operations on the edges is shown in the drawing herewith.



CHUCK FOR HOLDING PISTON RINGS

It is not of course expected to compete with a magnetic chuck but to be used as a substitute when the latter is not available.

The construction is adequately shown by the drawing. The seat *A* for the ring should be recessed to a diameter slightly larger than the inside diameter of the ring to facilitate removal of the latter, and the clamp *B* should be spring tempered to insure its releasing the work when the pressure of the nut is removed.

[2]This table is taken from the "Handbook for Electrical Engineers," John Wiley & Sons, Inc., page 1008.



IX. Oxygen and Hydrogen by the Electrolytic Method

Without oxygen, gas-torch welding or cutting would be impossible. The electrolytic process not only produces oxygen of great purity, but also produces hydrogen which is valuable for numerous purposes. This article shows how both oxygen and hydrogen may be obtained in commercial quantities from water by the use of very simple apparatus.

THE electrolytic process for the production of oxygen is more adapted to private installations than the liquid-air process. An electrolytic installation is flexible, and may be expanded so as to produce any commercial quantity of gas desired with very little attention. One big advantage of this process is that hydrogen is produced at the same time as the oxygen, and in many cases this hydrogen can be used to advantage for welding, cutting, or other purposes.

As a rule, oxy-hydrogen for welding is less desirable than oxy-acetylene, but for some purposes, especially when there is an abundance of hydrogen available, it is very satisfactory. The heat produced by the oxy-hydrogen flame (about 3632 deg. F.) is considerably less than that of the oxy-acetylene flame (about 6300 deg. F.), consequently it is commonly employed for welding thin metals, lead burning or other work within its heat range. As a general rule, oxy-hydrogen is good for welding 16-gage steel, or thinner, but should not be used on steel over $\frac{1}{4}$ in. thick. As hydrogen contains no carbon, the weld is softer than with acetylene. Cast iron up to $\frac{3}{4}$ in. in thickness may be successfully welded, as may also aluminum crankcases or alloyed metals. For cutting, however, oxy-hydrogen has a wide field, especially for heavy work.

General Principles of the Electrolytic Method

In an elementary form, decomposition of water may be effected by passing an electrical current between two metallic poles, or electrodes, immersed in water. By the admixture of acid or alkali, forming an electrolyte, the resistance of the water is lowered to allow a large current of electricity to pass, proportionately raising gas production. Simultaneously with the passage of current, decomposition of water into its components, oxygen and hydrogen, begins. Oxygen, exhibiting positive electrical properties, is formed on the positive pole or "anode"; double quantity of hydrogen is formed at the same time on the negative pole or "cathode." The gases are immediately available, and by interposition of a suitable diaphragm between the poles, are kept separate and led to their proper receivers.

The rapidity of decomposition, and consequently the amount of gases evolved being in direct measure of the electrical current passing, there is afforded convenient and economical means of producing commercial oxygen and hydrogen. The electrolytic solution increases in density as the action continues. The volume of water dissociated is therefore replaced at regular intervals.

Complete separation of the gases is desirable in order to insure their availability at high purity. This involves the use of a diaphragm, which, immersed in the solution, will allow passage of current between the poles and at the same time prevent mixing of gases.

The production of oxygen and hydrogen being in respect to the amount of current passing, it is apparent that the voltage required to send the specified amount of electricity through the electrolyzer is a measure of the efficiency of the apparatus, since, if the kilowatt-

*For the author's forthcoming book, "Modern Welding and Cutting." All rights reserved.

hour consumption is known, the gas production may be compared with it. Thus, there has been evolved the commonly accepted performance rating of any electrolyzer given in terms of cubic feet of gas produced per kilowatt-hour operation.

The production of pure gases is very important. In the earlier types of water electrolyzers the require-

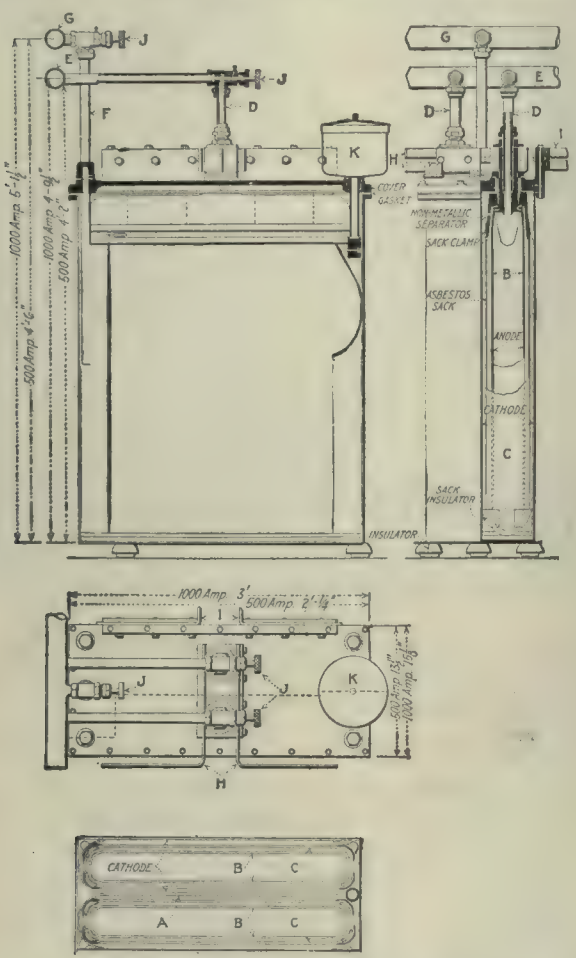


FIG. 88. DETAILS OF THE DAVIS ELECTROLYZER CELL

ments for producing gases of high purity were not understood, with the result that means of purification of the gases after generation were necessary. Devices of this character have been found expensive to maintain and inefficient in action. Modern designs of electrolyzers are capable of delivering oxygen of about 99 per cent., and hydrogen of equal or greater purity, so that the need for external purifying means no longer exists.

On delivery from the electrolyzers the gases are conducted separately to a pressure regulating device which imposes equal pressures on both oxygen and hydrogen, thus equalizing the pressures on each side of the separating diaphragm. The gases are then passed to their respective gas holders, in which they are collected and stored at a few ounces pressure. Upon the nature of service of the gases will depend the size of the gas holders, and the method of compressor control.

If it is desired to compress the gases into cylinders for shipment, as in the case of a commercial plant, large gas holders are employed having capacity for, at least, a continuous day's run of the electrolyzers. High-pressure compressors draw from these holders and discharge to a manifold to which the portable cylinders are connected. The pressure carried in the cylinders is usually 1600 to 1800 lb. per sq.in. Cylinders of 100 and 200 cu.ft. capacity will weigh about 85 and 150 lb. respectively.

There are many oxy-hydrogen producing equipments installed in industrial establishments, the gases being utilized in various portions of the works. In the Davis-Bournonville installations, gas holders of moderate size are employed, their rise and fall starting and stopping the compressor motors through automatic electrical control devices.

The gases may be stored in stationary pressure tanks to a moderate amount, these being fitted with automatic regulators, so that when they are filled to capacity, the entire plant will be shut down. The gases are piped, where desired, through pressure lines, thus avoiding the replacement of empty cylinders. This method of installation is particularly desirable for continuous welding and cutting operations, either by hand or



FIG. 89. CELL MADE BY THE INTERNATIONAL OXYGEN CO.

mechanical means. Provision may also be made for charging portable cylinders for use in operations carried on at isolated points.

Through the automatic control mentioned, the flexibility of an oxy-hydrogen generating and compressing equipment may be appreciated. The required amount of attendance being small, and needed only at regular intervals, continuous 24-hour operation of the equipment or intermittent service, if desired, is quite feasible and practicable. If maximum production is not desired,

reducing the current passing through the electrolyzers will proportionately lower the volume of gas that is being generated.

Details of the Davis Electrolyzer Cell

For various reasons, electrolytic installations are made up of small units or cells, which may be combined in such a way as to produce any required amount of gas. Details of an electrolyzer cell are shown in Fig. 88. This type of cell is made by the Davis-Bournonville Co., Jersey City, N. J. The type illustrated provides current conducting areas and gas generating surfaces amply proportioned to their requirements. There is

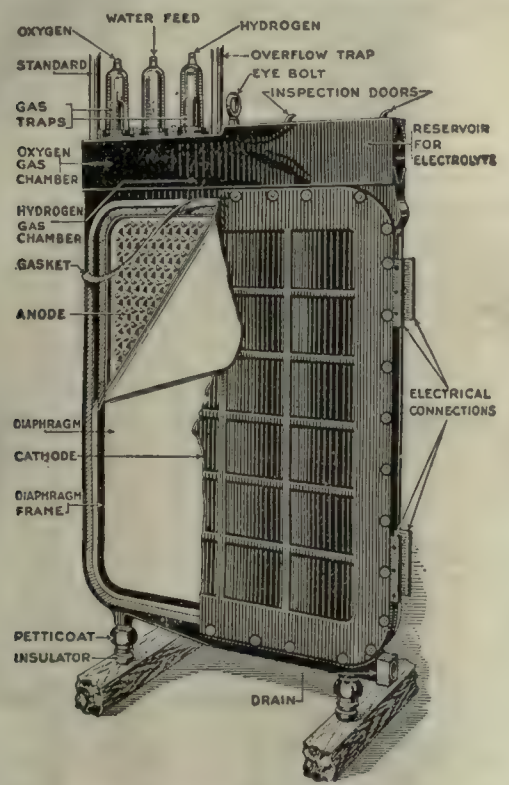


FIG. 90. SOME DETAILS OF THE CELL CONSTRUCTION

sufficient over-capacity to minimize electrical resistance and afford high working efficiency. Long life of the vital parts is also insured. Research has shown that a nickel-iron-alkali combination of elements employed for electrolytic dissociation of water is a very efficient selection from an electrical input and gas producing standpoint. Parts subject to deteriorating action of any character are constructed of special material and protected by processes especially adapted to service requirements. Care has been exercised in the design so as to avoid complication of electrical and mechanical connections of small cross-section. Thus studs, bolts, busbars and their contacts are amply large for all purposes.

These electrolyzers are manufactured in two sizes, operating on specified currents of 500 and 1000 amp. respectively. The dimensions of the respective cells are 54 and 61½ in. high, 13½ and 15⅛ in. thick and 24¼ and 36 in. wide. The height given is from the bottom of the cell to the center of the highest horizontal tube, through which the hydrogen passes into the service pipe.

In stating the production of gases evolved by dissociation of water the commonly accepted formula employed specifies production of 7.93 cu.ft. of oxygen with double quantity of hydrogen per kilo-ampere-hours at normal temperature and pressure. The normal production of Davis-Bournonville electrolyzers may therefore, according to their booklet, be stated as follows:

Type	Normal Amperage	Hourly Gas Production Oxygen	Hydrogen
5	500	3.96 cu.ft.	7.92 cu.ft.
6	1000	7.92 "	15.84 "

at 20 deg. C. and 760 mm. barometer.

The closed-cell type of construction adopted eliminates the absorption of carbon dioxide (CO_2) by the solution exposed to the atmosphere in the open type of electrolyzer, and its consequent deteriorating effect upon the electrolyte and purity of gases. Electrical current passing through the electrolyzer is converted almost entirely into chemical energy for producing oxygen and hydrogen. There being practically no action on the electrolyte employed as a conducting medium between the poles other than the dissociation of water, it is evident that the electrical pressure or voltage required to send the specified amount of electrical energy through the apparatus is a measure of its efficiency.

Referring now to the illustration, it should be kept in mind that the solution used is water with certain

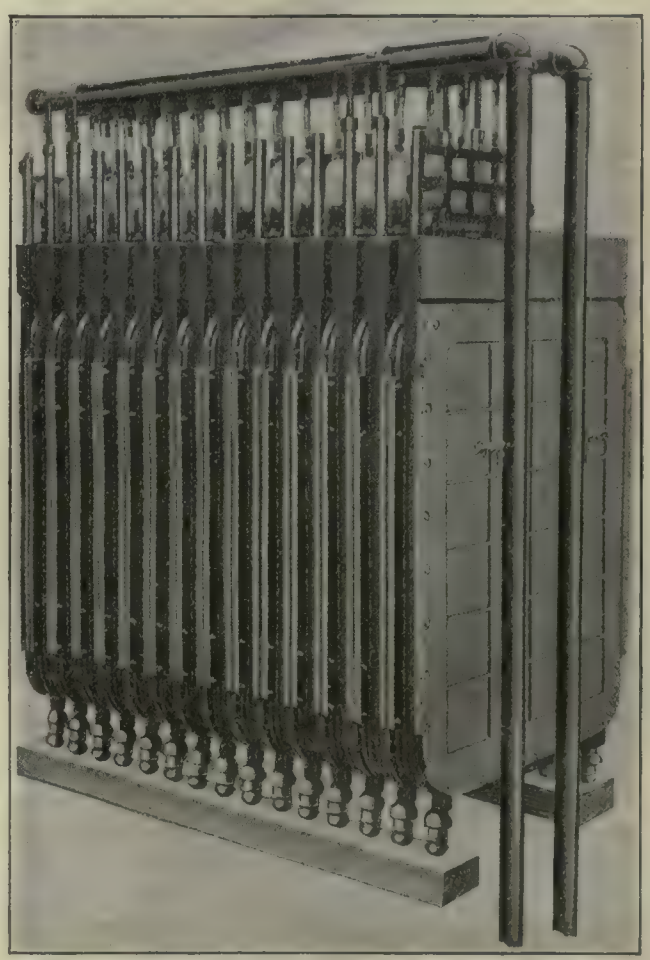


FIG. 91. A GROUP OF I. O. C. CELLS

chemicals, such as sodium hydroxide (caustic soda) or potassium hydroxide (caustic potash), added to increase the conductivity. The reservoir in which the solution is placed, is divided by a metal plate *A*. Anodes *B* are suspended on each side of this plate, and on these the oxygen forms. The cell itself is made of metal, and the walls of this, as well as the sides of the metal plate *A*, form the cathode or negative pole from which the hydrogen gas rises. To keep the oxygen and hydrogen separated, asbestos sacks *C* are so placed as to surround

each of the two anodes. The oxygen generated passes up through the hard rubber tubes *D* connected to the pipe *E*. The hydrogen passes up tube *F* into pipe *G*. The current to the anodes is conducted through the positive busbar assembly *H*. The negative busbar assembly, shown at *I*, is attached to and forms part of the cast-iron cover of the cell and connects with the center plate and the tank walls. Valves for the three

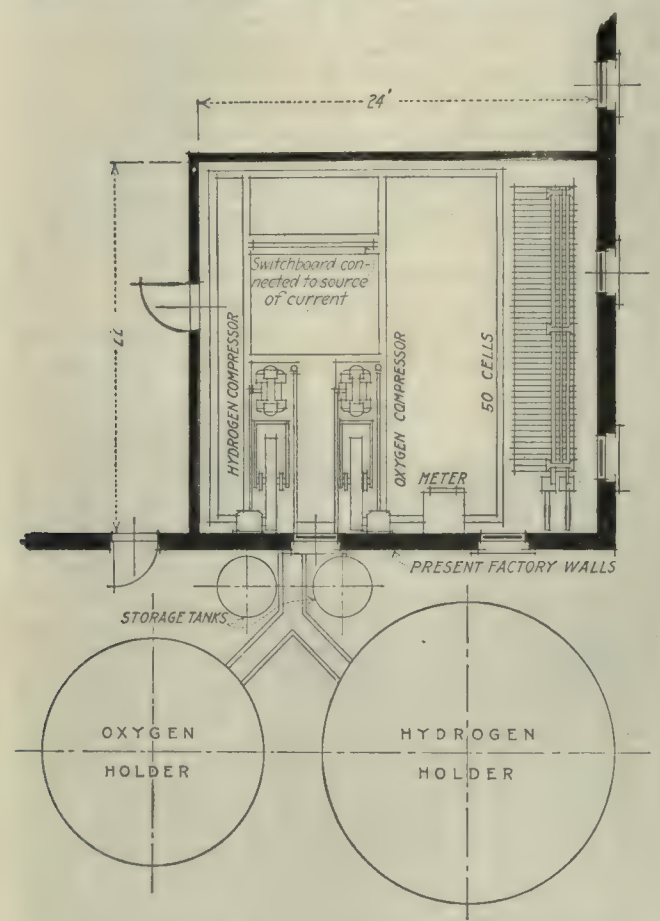


FIG. 92. SUGGESTED LAYOUT OF A 50-CELL PLANT

gas tubes are indicated by *J*. As the current passes through the cell the entire solution is charged and this results in the freeing of oxygen at the anodes and hydrogen at the cathodes. Since these gases have no tendency to pass off anywhere except at the respective terminals in the cell, the asbestos curtain effectively keeps them separated. The pressure of the two gases, however, must be kept the same or the one having the higher pressure will be forced through the fabric of the asbestos sacks and mix with the other gas. This is taken care of by having the gases from the pipes *E* and *G* pass through a combined flash-back and pressure regulator. The function of this device is to receive the gases; regulate their pressure through a simple water seal which equalizes the gas pressures inside the electrolyzer; separate and return to the cell any alkali carried over; provide means of replacement of water to the cell; bypass gases to the air if the delivery lines become obstructed, and to prevent admission of the flame to the electrolyzer.

The replacement of distilled water, as needed, is made through the reservoir *K*, which combines the replacement function with that of a hydraulic governor automatically adjusting the inner level of the solution. Under operating conditions, the usual replacement of distilled water amounts to approximately one gallon per 100 cu.ft. of oxygen and 200 cu.ft. of hydrogen. This replacement and the ordinary inspection usually given to electrical apparatus is practically all the attention required for a battery of cells.

The International Oxy-Hydrogen Generator

The electrolytic cell shown in Fig. 89 and in further detail in Fig. 90, is made by the International Oxygen Co., New York. Each cell unit requires a floor space 4 x 40 in., and with the necessary pipe connections, a head room of about 6 ft. These cells are intended to be run on a normal amperage of 600 and a voltage of 2.2 each, using a caustic soda solution. The possible range above and below the normal amperage is considerable, without injury to the cells. An equipment of their type 4-1000 cells can be operated with good economy over a current range of less than 200 up to 1000 amp., representing a production range of more than one to five. In actual figures this means that an installation giving 600 cu.ft. of oxygen and 1200 cu.ft. of hydrogen per 24 hours, at 600 amp., can by varying the current and without any alteration in the plant, be made

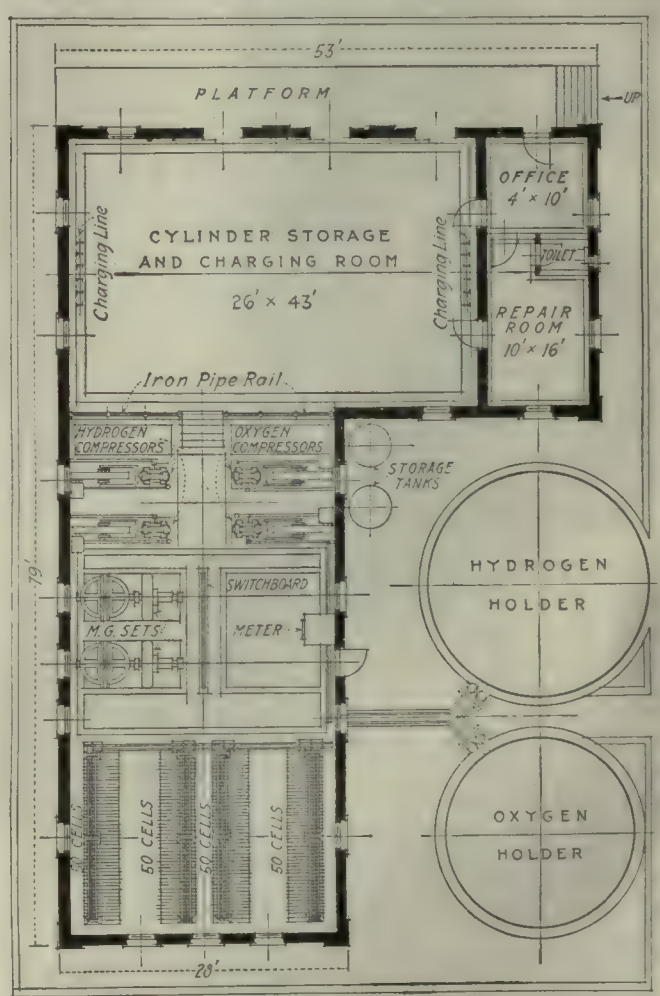


FIG. 93. SUGGESTED LAYOUT OF A 200-CELL PLANT

to deliver from less than 200 cu.ft. of oxygen and 400 cu.ft. of hydrogen, to more than 1000 cu.ft. of oxygen and 2000 cu.ft. of hydrogen per 24 hours. Operating at 200 amp., the power consumption per unit of gas generated is 16 per cent. less than the normal 600-amp. operation. When operating at 1000 amp., the power consumption per unit of gas is 15 per cent. more than at 600 amp.

Local rates will largely govern the number of cells required for a given output of the gases. Where the cost of current is low, the plant can be economically run on current above 600 amp., the increased production per hour giving the required amount with fewer cells, since the lower current cost justifies the slightly lower electrical efficiency. Where the price of current is high, it will be advantageous to use current less than 600 amp., thus taking advantage of the higher electrical efficiency, but more cells will be needed.

In general principles, this make of cell resembles the one previously described, though different in form. By referring to the illustration, it will be seen that a cell is made up of a thin rectangular-shaped box

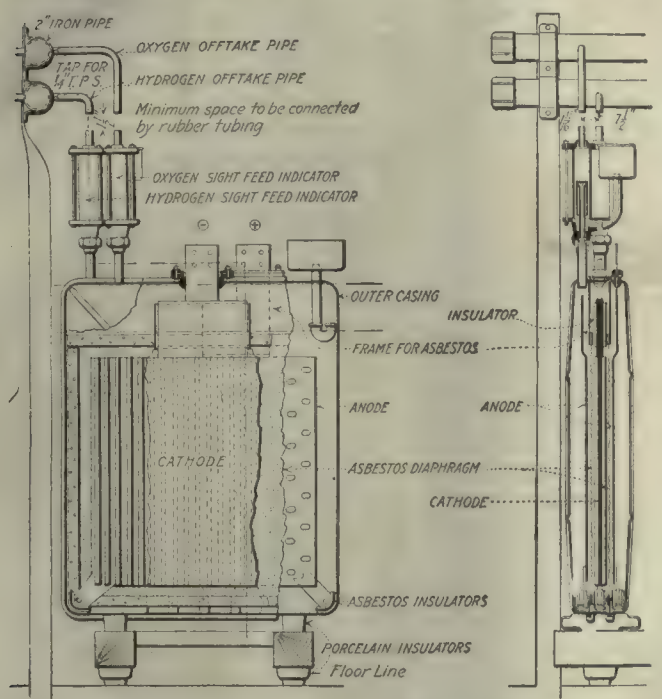


FIG. 94. CROSS-SECTION OF THE LEVIN GENERATOR CELL

frame to the sides of which are bolted two cast-iron plates or electrodes. The cavities formed between the center and side plates are divided by asbestos fabric diaphragms, forming two chambers. The asbestos diaphragms are clamped directly by metal and are not held in place by either rubber or cement. In the upper part of the cast-iron frame are reservoirs for the electrolyte, from which it is fed to the two sides of the diaphragms. There are also two gas chambers at the top of the frame, which serve as gas traps and gas take-offs, as well as an automatic pressure-controlling device. At the bottom of the frame are communicating passages which permit the equalization of densities in the electrolyte. The cells are constructed of material which make them practically indestructible. Each cell is provided with an eye-bolt to facilitate handling. The electrodes are provided with a large number of pyramidal projections which greatly increase the area of contact with the electrolyte and facilitate the release of the gases at the generating surfaces. At 600 amp. the production of a plant per 24 hours is 105 cu.ft. of oxygen and 210 cu.ft. of hydrogen per square foot of floor space. A group of cells is shown in Fig. 91.

Two typical plant layouts are shown in Figs. 92 and 93. Fig. 92 is a layout for a 50-cell plant, with a normal capacity of 5760 cu.ft. of oxygen and twice as much hydrogen. This plant may be put in a corner of an existing building, and requires a space 22 x 24 ft. It is complete with all accessories except gas holders and storage tanks. Fig. 93 is a separate plant of 200 cells, with all necessary accessories—such a plant as might be installed for public service in cylinders for gas users. Its main dimensions are 53 x 79 ft. and it has a normal capacity of 23,040 cu.ft. of oxygen and 46,080 cu.ft. of hydrogen per 24 hours.

The Levin Type of Generator

The generator made by the Electrolytic Oxy-Hydrogen Laboratories, Inc., Dayton, Ohio, and also of New York, is the design of I. H. Levin, after whom it is named. It is of the unit type, and is made up of a few standardized parts which can be easily assembled. Details of one of the cells are shown in Fig. 94. From this it will be seen that in the main the general construction is the same as others on the market. One noticeable difference from those described, however, is that the electrodes are made independent of the casing, being separated from and securely fixed within the casing by specially designed blocks of asbestos.

Each compartment has an independent water feed which also serves as a blow-off device to vent the gases under abnormal conditions. The surfaces of both the anode and cathode are plated with cobalt, which is said to lower the over-voltage or voltage in excess of what the gas electrodes require. The cells are sent out entirely welded, and completely and rigidly assembled, so that they may be filled with electrolyte, connected up, and put into service immediately. Each cell is 6¼ in. thick, 25 in. wide and 30 in. high, and weighs 185 lb. With the ground supports, porcelain insulators and the piping system above, the total height is 4 ft. 8 in., which brings all the parts within the range of normal reach and vision. Even a minimum aisle space of 30 in. will leave ample room for the removal or replacement of any cell. Each cell is intended to operate at a normal amperage of 250, requiring a little over $\frac{4}{10}$ kw. per hour. A battery of 1000 cells will occupy a space 4½ x 31 ft. and is claimed to produce 200 cu.ft. of oxygen and 400 cu.ft. of hydrogen per hour.

Hand Versus Power Feeds

By Harry Senior

On page 356 of the *American Machinist* Arthur W. Suiter upholds the writer of a previous article who advocated the removal of power feeds from surface grinding machines. He also charges me with having reviewed the article in question with "thinly veiled sarcasm with some rather irrelevant remarks thrown in for good measure."

I had not intended sarcasm, veiled or otherwise, in reference to the removal of the feeds. That is a matter of individual convenience. If a foreman chooses to remove the mechanism so that no one can use power feeds either rightly or wrongly it is strictly his funeral, though it does seem a pity to put a useful and valuable accessory out of business simply because there are some jobs that can be handled to better advantage without it. It is perfectly easy both to feed and to traverse a grinding machine by hand and still leave the automatic feature instantly available.

My criticism was directed against the implied statement in the original article (page 901, Vol. 49) that

the feeds and power traverse (though this latter was not specifically mentioned) were removed because *the workmen did not know enough to use them properly.*

The point made by Mr. Suiter that a heavy cut slowly fed across the work is not good practice is not to be questioned, but the implication that this condition is the fault of the power feed and table drive is not warranted, as it is quite as easy to feed rapidly by power as by hand and much less fatiguing. On the other hand the depth of cut is quite independent of the method of feeding and traversing. If the operator is going to do it wrong anyway he can accomplish the latter result by hand as well as by power, and the incentive is much greater (in the estimation of a lazy or incompetent operator), as thereby he can save several miles of table travel in course of a year.

I do not dispute the statement that for grinding light, intricate parts hand feed (and traverse) is desirable, but I contend that this does not constitute a reason for dismantling the automatic feature any more than the fact that we frequently use hand tools or hand feeds on the lathe warrants the removal of the feed works from the latter. And when a foreman deliberately imposes an entirely unnecessary hardship upon all hands all the time simply because a part of his force for a part of the time misuses the conveniences provided to increase its efficiency there is something wrong with the foreman.

The toolmaker who through ignorance wrongly performs an operation so simple in principle as surface grinding is not yet a toolmaker, and a foreman who allows a toolmaker to do the same wilfully through carelessness or laziness is not a foreman.

I will advance as a "single legitimate reason" why power feeds and traverse should not be removed from grinding machines the fact that on jobs of any size the hand operation is tedious and fatiguing, resulting in prompt and noticeable depreciation of the operator's sense of touch and consequent ability to make fine measurements. It also—perhaps this is a separate reason—occupies *all* the operator's attention and both of his hands *all* the time, and good toolmakers do not spend all of the time that they have an automatic machine running in sucking their thumbs and cooling their heels.

There is still another reason against the proposition: Sandow himself could not maintain over long periods the absolute unvarying precision of movement that is characteristic of the automatic feature. Short and narrow pieces do not by any means constitute the major portion of tool work, and uniformity of feed and traverse is quite essential to good results.

Nothing can be done on the surface grinding machine stripped of its automatic movements that cannot be performed with equal advantage (without using them) with the latter in their proper place; nothing can be done without their use that cannot be done with it if desirable. If they are there they may be used or not at the discretion of the operator or his foreman; if they are not there they obviously cannot be used no matter how badly they are needed. We might as well discuss the abolishment of the railroads because some fellows get too fat riding around in Pullman cars.

Mr. Suiter suggests that omitting the automatic features of surface grinding machines would accomplish a saving in cost of construction. The cost of such a machine is slight in comparison with the value of its product and even a very minor reduction in its efficiency would soon swamp any saving in this direction, but if he wants them I think they may be obtained. I do not know who, if anybody, makes them now, but I have seen, operated and cursed them 30 years ago.

Specifications for Shop Oils

By M. H. Potter

The specifications given herewith are worthy of note from the standpoint of practical use. Many shops would do well to specify that the oils which they purchase come within certain limits. Simple tests which will enable the user to determine as to whether or not the purchased oils are within the specifications are here given.

This substitute may be used with satisfactory results for all purposes where neatsfoot oil has been used. The great scarcity of neatsfoot oil has made it quite difficult to obtain and the price is correspondingly high.

This mixture should be composed of 50 per cent. animal oil, the balance to be well-filtered mineral oil of approximately the same viscosity. The animal oil should be a good grade of lard or neatsfoot oil and should have a cold test not higher than 45 deg. F. which test may be carried out in the following manner:

A four-ounce sample bottle is half filled with the oil, a thermometer inserted in the neck of the bottle with the bulb in the oil, and the bottle placed in a freezing mixture. It is allowed to remain in this freezing mixture for one hour after the oil has solidified. The bottle is then removed and the frozen mass of oil carefully worked with the thermometer until the oil will flow from one end of the bottle to the other, the reading of the thermometer at this point is the cold test.

It is also important that the animal oil should not contain more than 4 per cent. of acid. The viscosity of the mineral oil used should be at least 300 at 70 deg. F. using a standard viscosimeter. The mineral oil should have a cold test below 25 deg. F.; oils having a lower cold test are more desirable. The flash point of the mineral oil (under open cup test) should not be less than 335 deg. F.

Lard oil should be free from all other oils and foreign matter and should contain less than 3 per cent. acid. It should have a specific gravity of 0.916 to 0.920 at a temperature of 60 deg. F.; it should show no discoloration under the regular laboratory test, and when heated should be free from offensive odors.

Good grades of tempering oils will pass the following prescribed specifications and tests:

Light Tempering Oil.—This oil should be free from acid; the flash test should not be less than 375 deg. F.; the oil should not congeal when cooled in a vial to 25 deg. F.; and should show a viscosity of not less than 130 at 100 deg. F., under the standard viscosimeter test.

Medium Tempering Oil.—Specifications and tests are the same as prescribed above with the following variations: The flash test (open cup) should not be less than 400 deg. F.; and the viscosity should show 270 at 100 deg. F. under the standard test.

Heavy Tempering Oil.—Specifications and tests are the same as prescribed for light tempering oils with the following variations: The flash test (open cup) should not be less than 590 deg. F.; the viscosity should show 170 to 190 at 212 deg. F.; and the oil should not congeal above 30 deg. F. when cooled.

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Hardness Tests of Gun-Barrel Steel

By WILLIAM KENT SHEPARD
Assistant Professor, Sheffield Scientific School, Yale University.

Confirmation of previous investigations into the relations between tensile and hardness tests on steel is furnished in this article. The results suggest a saving in the time required for making physical tests on gun barrels which might well be useful along other lines. The advantages of physical tests made on the actual product without resorting to the use of separate test specimens are obvious.

THIS paper is the report of a number of tests made in the Mason Laboratory of Mechanical Engineering at the Sheffield Scientific School of Yale University to see if the Brinell and scleroscope hardness tests on a certain grade of gun-barrel steel would give reliable indications of the physical properties of the steel as found by the ordinary tensile test.

Investigations by Robert R. Abbott on treated and untreated alloy and plain steels and by Shepard and Porter on cold-rolled steel have shown that an approximate straight-line relation exists between the ultimate tensile strength and the Brinell hardness number and the ultimate tensile strength and the scleroscope hardness number. The steels under investigation by the above authors varied greatly in ultimate strength, due to varying chemical composition, heat treatments and cold working.

It was believed by the author of the present article that with specimens of steel of practically the same chemical composition and differing in physical properties due only to variations in the heat treatment the hardness tests might give quite satisfactory indications of these physical properties.

A large number of tensile tests of gun-barrel steel were being made during the winter of 1917-18 at the Mason Laboratory for the Marlin-Rockwell Corporation of New Haven, Conn. This steel, which was being used in the Marlin aircraft and the light Browning rapid-fire guns, is commonly known as "smokeless-barrel steel" and has a chemical analysis of 0.50 to 0.60 per cent. carbon, 1.15 to 1.30 per cent. manganese, 0.18 to 0.25 per cent. silicon, 0.08 per cent. (maximum) phosphorus and 0.06 per cent. (maximum) sulphur. The physical specifications for this steel were 110,000 lb. per square inch (minimum) tensile strength, 75,000 lb. per square inch (minimum) yield point, 40 per cent. (minimum) reduction in area and 20 per cent. (minimum) elongation in 2 in. The opportunity thus pre-

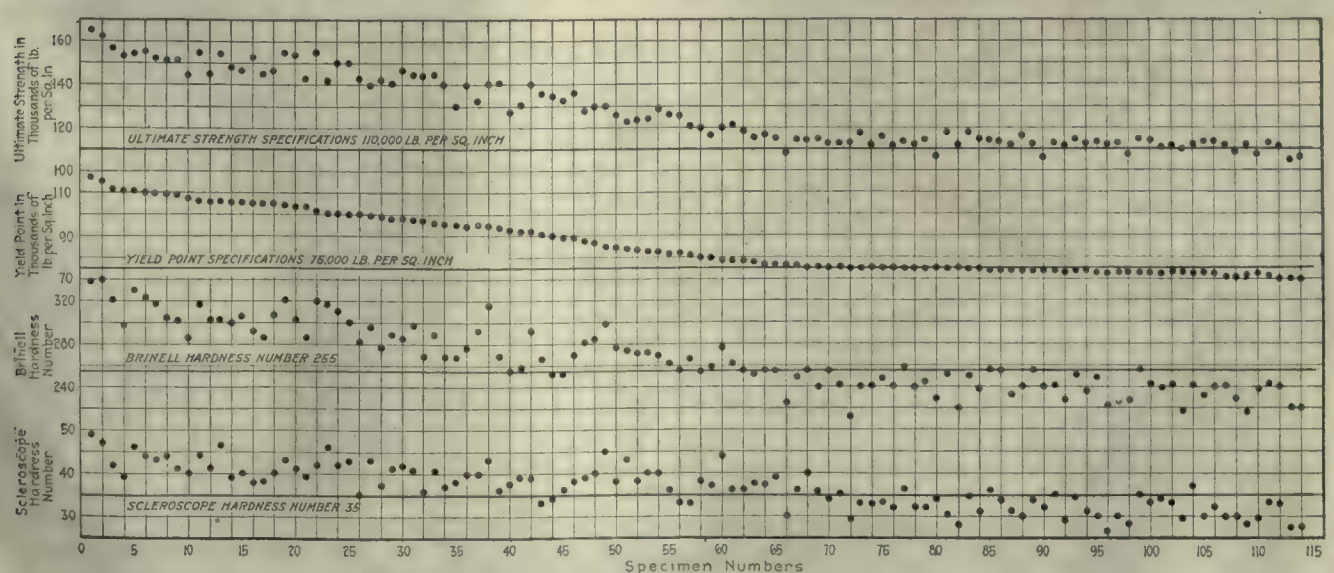


FIG. 1. ULTIMATE STRENGTH, YIELD POINT, BRINELL AND SCLEROSCOPE HARDNESS NUMBER

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cented itself to make Brinell and scleroscope hardness tests in connection with the tensile tests on this one grade of steel.

A flat surface was ground on each gun barrel and this surface smoothed off with a fine file and emery cloth to remove the grinding-machine marks. A smooth surface was of course very necessary, as scratches interfered with the rebound of the scleroscope hammer and with a clear definition of the edge of the Brinell indentation.

The scleroscope hardness tests were made on this surface with the standard universal diamond-pointed hammer.

The Brinell hardness tests were then made on this surface with a 10-mm. (0.39-in.) steel ball and with both an instantaneous and 30-sec. load of 3000 kg. (6615 lb.). The diameters of the Brinell indentations were measured with a Bausch & Lomb microscope, which contained a 7-mm. scale graduated in tenths of a millimeter. This permitted a reading of the diameter to $\frac{1}{100}$ of a millimeter by estimation. The hardness numbers were found as usual by dividing the load of 3000 kg. by the spherical area of the impressions in square millimeters.

The tensile tests were made with the standard 0.505-in. diameter specimens on a 50,000-lb. Riehle universal testing machine. The yield point was found by the drop of the beam.

At the beginning of the investigation the ends of a number of the barrels, test specimens of which had shown results that failed to come up to the tensile specifications, were given the Brinell and scleroscope hardness tests as above described. After a large number of these hardness tests had been found to indicate quite closely the results of the tensile tests a number of the ends of the barrels, test specimens of which had given results that came within the tensile specifications, were also given the hardness tests.

The results of these tests are given in the table and shown graphically in Figs. 1 and 2.

Since the material showed cause for rejection due to the yield point being below specifications rather than the ultimate strength the results have been collected so as to show in Fig. 1, from left to right, a decreasing yield point. Each four points in the same vertical line show for the same specimen the ultimate strength, yield point, Brinell hardness number for instantaneous load and the scleroscope hardness number. Heavy horizontal lines have been drawn in this figure at 110,000 lb. per square inch ultimate strength (specifications). 75.000 lb. per square inch (specifications), 255 Brinell hardness number (Brinell diameter 3.80 mm.) and 35 scleroscope hardness number.

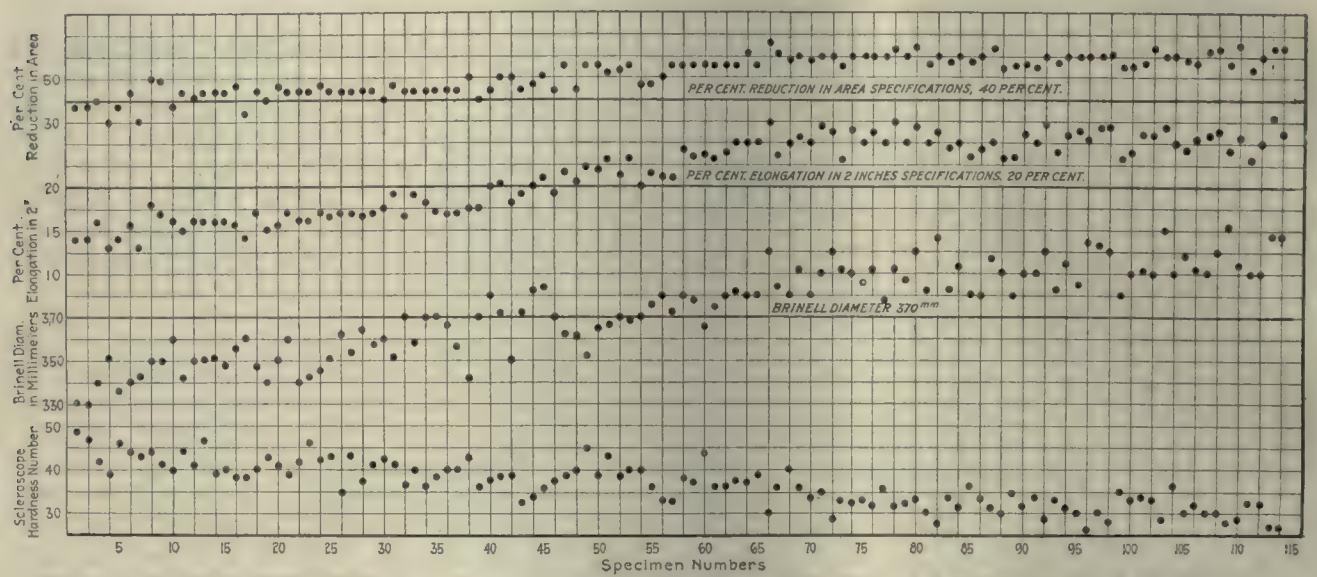


FIG. 2. PER CENT. REDUCTION IN AREA AND ELONGATION IN 2-IN. BRINELL DIAMETER AND SCLEROSCOPE HARDNESS NUMBER

In Fig. 2 the points from left to right represent the results for the specimens in the same order as in Fig. 1. However, in this figure each four points in the same vertical line give for the same specimen the per cent. reduction in area, per cent. elongation in 2 in., Brinell diameter for instantaneous load and scleroscope hardness number. Heavy horizontal lines have been drawn in this figure at 40 per cent. reduction in area (specifications), 20 per cent. elongation (specifications) and 3.70-mm. Brinell diameter (Brinell hardness number 269).

The Brinell hardness numbers or diameters for 30-sec. loads are not plotted in Figs. 1 or 2, since these results, as will be seen in the table, are practically the same as those for the instantaneous loads.

It is seen in Fig. 1, as would be expected, that the Brinell and scleroscope hardness numbers decrease with decreasing ultimate strength and yield point, and that as the values of the yield point begin to fall below the specifications value of 75,000 lb. per square inch the Brinell hardness number comes below about 255 (Brinell diameter 3.80 mm.) and the scleroscope hardness number below about 35.

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An examination of Fig. 1 will show that if ultimate strength specifications had been 115,000 instead of 110,000 lb. per square inch the specimens which showed failure to attain yield-point specifications would also fail in respect to this ultimate strength specification.

In Fig. 2 the Brinell diameters have been plotted instead of the Brinell hardness numbers, as it could be anticipated that increasing per cent. reduction in area and increasing per cent. elongation would be followed by increasing diameter of the Brinell indentation.

It can be seen in this figure that for the specimens the elongation of which is below 20 per cent. the Brinell diameter is in most cases below 3.70 mm. (Brinell hardness number 269).

A further examination of Fig. 2 shows that the values of the per cent. reduction in area have the same trend as the values of the per cent. elongation and that a specification of 45 instead of 40 for the per cent. reduction in area would be in better agreement with the 20 per cent. elongation specification.

The results of the scleroscope hardness tests, as plotted in Fig. 2, fail to show clearly a hardness number above which the percentage elongation for the specimen falls regularly below the 20 per cent. elongation.

The results of the Brinell hardness tests made on the steel used in this investigation seem to show that for instantaneous loads a Brinell diameter greater than 3.80 mm. or a Brinell hardness number less than 255 indicates a yield point for the steel of less than 75,000 lb. per square inch, and for instantaneous loads a Brinell diameter less than 3.70 mm. or a Brinell hardness number greater than 269, an elongation of less than 20 per cent. in 2 in. Therefore for instantaneous loads a Brinell diameter between 3.70 and 3.80 mm. or a Brinell hardness number between 255 and 269 on a barrel made from this grade of steel indicates that the yield point is above 75,000 lb. per square inch and at the same time the elongation is greater than 20 per cent. in 2 in. Consequently the results come within the tensile-test specifications set for the steel.

It is evident that it would not be feasible to replace the tensile test by the Brinell hardness test. However, this investigation seems to show that a very fair indication of the results of the tensile test may be anticipated by a preliminary Brinell hardness test.

The Brinell hardness test has the advantage that it can be easily and quickly made and does not harm the

RESULTS OF TENSILE AND HARDNESS TESTS

No.	Yield Point Lb. per Sq.In.	Ultimate Strength, Lb. per Sq.In.	Per Cent. Reduction in Area	Per Cent. Elongation in 2 In.	Scleroscope Hardness No.	Brinell Diameter Inst. Load	Brinell Diameter 30-Sec. Load	Brinell Hardness No. Inst. Load	Brinell Hardness No. 30-Sec. Load
1	117,000	165,000	37.0	14.0	49	3.31	3.40	338	321
2	115,000	162,250	37.0	14.0	47	3.30	3.35	340	332
3	111,500	156,850	40.5	16.0	42	3.40	3.42	321	317
4	111,000	153,000	30.8	13.0	39	3.52	3.60	298	286
5	110,600	154,000	37.0	14.0	46	3.36	3.38	330	325
6	110,000	155,150	43.5	15.5	44	3.39	3.41	323	320
7	109,200	152,000	30.8	13.0	43	3.42	3.50	317	302
8	109,150	151,200	49.0	18.0	44	3.49	3.50	304	302
9	108,850	151,300	49.0	17.0	41	3.50	3.55	302	293
10	107,050	144,550	37.0	16.0	40	3.60	3.60	286	286
11	106,000	154,800	43.2	15.0	44	3.42	3.49	317	304
12	105,800	145,000	41.7	16.0	41	3.50	3.58	302	289
13	105,500	154,250	43.5	16.0	46	3.50	3.52	302	298
14	105,500	148,000	43.5	16.0	39	3.51	3.55	300	293
15	105,250	146,200	43.5	16.0	40	3.48	3.52	306	298
16	105,000	152,250	46.3	15.5	38	3.55	3.59	293	287
17	105,000	144,700	34.0	14.0	38	3.60	3.64	286	279
18	104,950	146,550	43.5	17.0	40	3.48	3.53	306	297
19	104,700	154,900	40.5	15.0	43	3.40	3.40	321	321
20	103,550	153,750	46.0	15.5	41	3.50	3.52	302	298
21	103,400	142,600	43.5	17.0	39	3.60	3.60	286	286
22	101,850	154,900	43.5	16.0	42	3.40	3.40	321	321
23	100,500	141,900	43.5	16.0	46	3.42	3.55	317	293
24	100,100	150,550	46.0	17.0	42	3.45	3.47	311	307
25	100,000	150,150	43.5	16.5	43	3.51	3.52	300	298
26	99,950	142,350	43.5	17.0	35	3.62	3.68	282	277
27	99,150	139,250	43.5	17.0	43	3.53	3.60	296	286
28	98,900	142,100	43.7	16.5	37	3.65	3.70	277	269
29	97,950	140,500	43.5	17.0	41	3.58	3.61	289	284
30	98,000	146,200	40.5	17.5	42	3.60	3.62	286	282
31	97,750	144,750	46.0	19.0	41	3.52	3.52	298	298
32	97,000	144,200	43.5	16.5	36	3.70	3.70	269	269

RESULTS OF TENSILE AND HARDNESS TESTS

No.	Yield Point Lb. per Sq.In.	Ultimate Strength, Lb. per Sq.In.	Per Cent. Reduction in Area	Per Cent. Elongation in 2 In.	Scleroscope Hardness No.	Brinell Diameter Inst. Load	Brinell Diameter 30-Sec. Load	Brinell Hardness No. Inst. Load	Brinell Hardness No. 30-Sec. Load
33	96,000	144,800	43.5	19.0	40	3.58	3.60	289	286
34	95,850	140,400	43.5	18.0	37	3.70	3.70	269	269
35	95,000	130,300	43.5	17.0	38	3.70	3.75	269	262
36	94,700	139,800	43.5	17.0	39	3.65	3.65	277	277
37	94,250	132,700	43.5	17.0	40	3.56	3.58	292	289
38	94,300	139,350	49.0	17.0	43	3.43	3.50	315	302
39	93,650	140,300	40.5	17.5	36	3.70	3.71	269	268
40	92,150	127,300	43.5	20.0	37	3.80	3.78	255	258
41	91,400	130,750	49.0	20.5	39	3.72	3.72	266	266
42	91,250	139,600	49.0	18.0	39	3.50	3.55	302	293
43	90,400	135,750	43.5	19.0	33	3.72	3.75	266	262
44	90,000	134,500	46.0	20.0	34	3.82	3.82	252	252
45	88,900	132,700	49.0	21.0	36	3.82	3.83	252	251
46	88,700	135,650	43.5	19.0	38	3.70	3.72	269	266
47	87,800	127,850	54.5	21.5	39	3.62	3.62	282	282
48	86,250	129,050	43.5	20.5	40	3.61	3.65	284	277
49	84,750	129,400	54.5	22.0	43	3.52	3.55	298	293
50	84,400	125,350	54.5	22.0	38	3.65	3.68	277	272
51	83,750	122,600	52.0	23.0	43	3.67	3.70	274	269
52	83,050	123,500	52.0	21.0	38	3.69	3.71	271	268
53	82,850	123,900	54.5	23.0	40	3.68	3.70	272	269
54	82,700	128,600	46.0	20.0	40	3.71	3.73	268	265
55	81,550	126,000	46.0	21.0	36	3.75	3.79	262	256
56	81,350	125,950	49.0	21.0	33	3.80	3.80	255	255
57	80,650	120,900	54.5	21.0	33	3.73	3.78	265	258
58	79,650	119,750	54.5	24.0	38	3.81	3.81	254	254
59	79,300	117,000	54.5	23.5	37	3.78	3.80	258	255
60	78,550	120,250	54.5	23.5	44	3.65	3.70	277	269
61	78,300	121,150	54.5	23.0	36	3.75	3.76	262	261
62	78,300	118,400	54.5	24.0	36	3.80	3.80	255	255
63	77,200	115,150	54.5	25.0	37	3.82	3.85	252	248
64	76,850	116,400	60.0	25.0	37	3.80	3.80	255	255
65	76,350	114,900	54.5	25.0	39	3.80	3.77	255	259
66	76,100	108,600	64.5	27.0	30	4.03	4.03	225	225
67	75,750	114,500	60.0	23.5	36	3.84	3.90	249	241
68	75,500	114,000	57.0	24.5	40	3.80	3.80	255	255
69	75,350	114,300	60.0	25.5	35	3.92	3.90	239	241
70	75,000	112,750	57.0	25.0	34	3.80	3.82	255	252
71	75,000	112,350	60.0	27.0	35	3.90	3.92	241	239
72	74,900	112,750	60.0	26.0	29	4.15	4.11	212	216
73	74,850	116,950	54.5	23.0	33	3.92	3.90	239	241
74	74,550	111,650	60.0	26.5	33	3.90	3.92	241	239
75	74,300	115,200	60.0	25.0	33	3.86	3.84	247	249
76	74,300	111,250	60.0	26.0	32	3.92	3.95	239	235
77	74,250	113,450	60.0	25.0	36	3.78	3.80	258	255
78	74,250	111,600	64.5	27.0	32	3.92	3.92	239	239
79	74,200	114,300	60.0	25.0	32	3.88	3.88	244	244
80	74,200	106,100	64.5	27.0	34	4.00	4.00	228	228
81	74,150	117,600	57.0	24.5	30	3.82	3.82	252	252
82	74,050	111,850	60.0	26.0	28	4.07	4.05	221	223
83	74,000	117,250	57.0	24.5	34	3.82	3.82	252	252
84	73,800	114,500	60.0	25.0	31	3.93	3.97	237	232
85	73,800	113,600	57.0	23.5	36	3.81	3.89	254	242
86	73,650	113,500	60.0	24.0	34	3.80	3.80	255	255
87	73,650	111,850	64.5	25.0	31	3.97	3.97	232	232
88	73,500	116,150	54.5	23.0	30	3.90	3.90	241	241
89	73,500	112,800	54.5	23.0	34	3.80	3.79	255	256
90	73,400	115,950	57.0	26.0	32	3.90	3.90	241	241
91	73,400	112,400	54.5	25.0	35	3.90	3.90	241	241
92	73,400	111,650	60.0	27.0	29	4.00	4.00	228	228
93	73,350	114,250	57.0	24.0	34	3.83	3.84	251	249
94	73,350	112,600	60.0	26.0	31	3.95	3.95	235	235
95	73,200	112,550	60.0	26.5	30	3.85	3.90	248	241
96	73,200	111,950	60.0	25.5	26	4.05	4.05	223	223
97	73,000	112,500	60.0	27.0	30	4.03	4.00	225	228
98	73,000	107,800	60.0	26.5	28	4.01	4.02	227	226
99	72,900	114,200	54.7	23.0	35	3.80	3.82	255	252
100	72,900	113,550	54.5	23.5	33	3.89	3.91	242	240
101	72,900	110,900	57.0	26.0	34	3.92	3.93	239	231
102	72,850	111,150	62.5	26.0	33	3.90	3.90	241	241
103	74,200	114,300	60.0	25.0	32	3.88	3.88	244	244
104	72,700	112,000	60.0	25.0	37	3.90	3.91	241	240
105	72,600	113,250	57.0	24.0	30	3.98	3.98	231	231
106	72,050	113,150	57.0	25.5	32	3.92	3.91	239	240
107	71,850	111,750	62.5	26.0	30	3.90	3.90	241	241
108	71,800	108,750	62.5	26.5	29	4.00	4.00	228	228
109	71,750	111,350	57.0	24.5	28	4.12	4.12	215	215
110	71,450	107,650	64.5	25.5	29	3.94	3.95	236	235
111	71,000	111,950	54.5	23.0	33	3.90	3.92	241	239
112	70,700	110,500	60.0	25.0	33	3.90	3.93	241	241
113	69,615	104,400	64.5	28.0	27	4.08	4.08	219	219
114	69,550	105,350	64.5	26.5	27	4.08	4.10	219	217

ARMY ORDNANCE NEWS

barrels for further use. A Brinell test can be made on every barrel and the results will indicate the barrels which are too hard or too soft to come within the limits set for the tensile test.

Brinell tests made on a few barrels chosen at random from a certain group of heat-treated barrels will often show the necessity of a further heat treatment before submitting any of them to the tensile test.

Abstracts of Recent Office Orders of General Interest

No. 605, Mar. 25. The following officers are designated as survey officers in the district ordnance offices: Maj. R. E. Friend, Boston District Office; Capt. A. J. Hudson, New York District Office; Capt. J. H. Hersey, Rochester District Office; Lieut. Sol Harrison, Bridgeport District Office.

No. 607, Mar. 26. The following officers are designated as survey officers in the district ordnance offices: Capt. A. E. Miller, Detroit District Office; Capt. John H. Casey, Cleveland District Office; Second Lieut. C. A. McMullen, St. Louis District Office.

No. 607, Mar. 26. First Lieut. H. C. Davis is designated survey officer for the claims board at the Watervliet Arsenal.

No. 609, Mar. 27. James W. Lyons is appointed acting ordnance district chief, Chicago District, and temporary chairman of the Chicago District Claims Board during the absence of E. A. Russell.

PERSONALS

First Lieut. Roy S. Bridge, lately discharged, is a graduate of Pratt Institute. He has been on duty in Washington. The home of Lieutenant Bridge is at 154 South St., Pittsfield, Mass.

* * *

First Lieut. Walter O'Brien, of Juneau, Alaska, who is a graduate of Massachusetts Institute of Technology, was discharged on his return from abroad. He was formerly manager of the Sullivan Machinery Co., in Alaska.

* * *

Maj. M. M. Hopkins, a graduate of George Washington University, and formerly director of the Engineering Institute of Industrial Research, Washington, D. C., has been discharged. His home address is at Edgemoore, Md.

* * *

Second Lieut. Walter L. Brady has been discharged. He is a graduate of St. Louis University and was previously connected with the St. Louis Frog and Switch Co., and also the United Railways Co., both of St. Louis, Mo.

* * *

Second Lieut. Pliny A. Porter, Berlin, Wis., who enlisted in March, 1918, and was commissioned in August, 1918, has been discharged. He attended Beloit College and was afterward employed by the Fairbanks-Morse Co., Beloit, Wis.

First Lieut. M. F. Roche, who is a graduate of the Pratt Institute, Brooklyn, N. Y., has been discharged. Previous to his being commissioned, he was employed by the Barrett Co., as chemical and mechanical engineer at 17 Battery Place, New York.

* * *

First Lieut. L. A. Weed, who was commissioned in August, 1915, has been discharged. He is a graduate of Harvard and was formerly employed by Browning & Co., importers, New York. Lieutenant Weed's home is at 117 Berkley Place, Brooklyn, N. Y.

* * *

Capt. Carl A. Strand, who was commissioned in November, 1917, and served with the Production Division, has been discharged. Captain Strand's home is at Highland Park, Mich., and before entering the service he was president of C. A. Strand Co. of that city.

* * *

Second Lieut. Gilbert Chandler, Jr., has left the service. He is a graduate of Drexel Institute and entered the service as an enlisted man. Lieutenant Chandler, Jr., was formerly employed by the Massachusetts Bonding and Insurance Co., Saginaw, Mich.

* * *

Capt. Robert E. Briggs, who was recently discharged, was commissioned first lieutenant in November, 1917. He is a textile engineer, and a former student at Wesleyan University. Captain Briggs has been on duty in the Supply and Engineering Divisions.

* * *

First Lieut. Alfred H. Lawson, who was commissioned second lieutenant in January, 1918, and has been on duty in the Supply Division, has returned to civil life. He is a graduate of Georgetown University, and was treasurer of the District Insurance Co., Washington.

* * *

First Lieut. William A. Stoll, who enlisted in June, 1917, and was commissioned second lieutenant in April, 1918, has been discharged at Camp MacArthur. He entered the service immediately after graduating from the University of Pennsylvania. His home is at 2535 Cherokee Parkway, Louisville, Ky.

* * *

Capt. T. E. Raymond, of 84 Ellery St., Cambridge, Mass., who was commissioned first lieutenant in April, 1917, is a graduate of Massachusetts Institute of Technology. Before he came into the service he was instructor in machine design at Michigan Institute of Technology.

* * *

First Lieut. Ira E. Gillen, of Cleveland, Ohio, who was commissioned in October, 1917, and went overseas in December, the same year, was discharged on his return. His work overseas has been in connection with the repair of ordnance material. Lieutenant Gillen is a graduate of the Culver Military Academy.

* * *

First Lieut. H. A. Estabrook, whose home is at 645 Superior Ave., Dayton, Ohio, has been discharged after 16 months' service. He served in the Engineering Division in Washington and was overseas for nearly 10 months. Lieutenant Estabrook is a graduate of Ohio State University and was formerly manager of the Whitehall Paper Mills, Whitehall, Md.

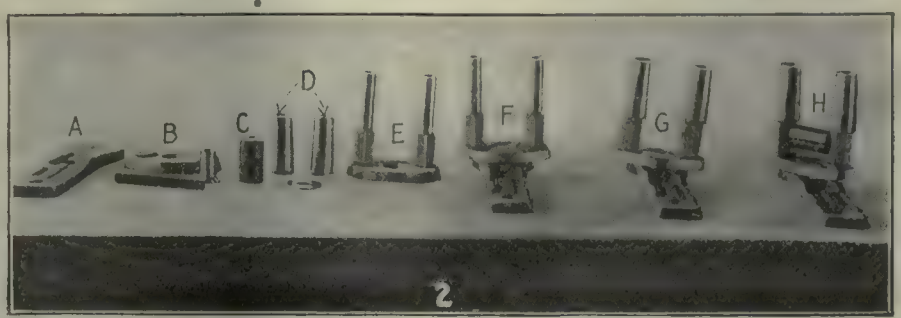
Manufacturing a Safety Belt Shifter

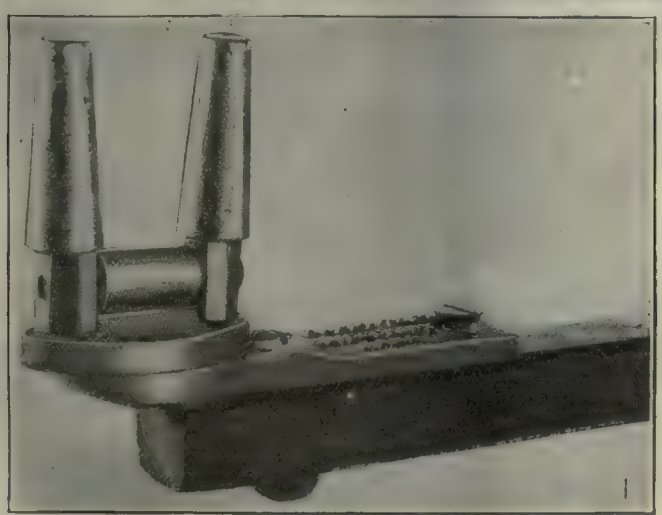
By ROBERT MAWSON

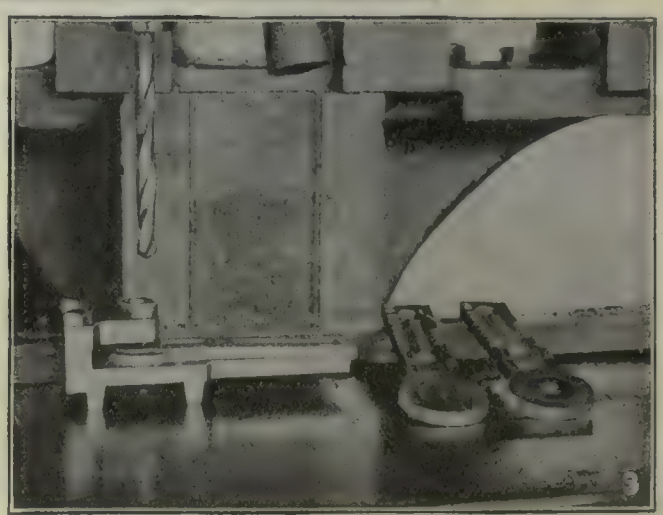
A few of the jigs used in the manufacture of a belt shifter are here shown. While these jigs are comparatively simple they contain some features applicable to other work.

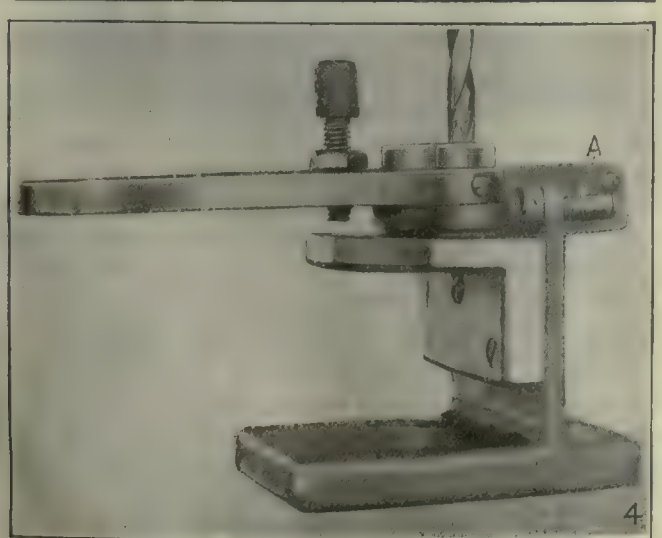
THE tendency now as never before is to provide safety means and devices for various operations in the machine shop. Belt shifting is a common operation in a shop, and to make it as safe as possible a safety belt shifter has been developed by the Ready Tool Co., Bridgeport, Conn., which is known as the "Safety First" belt stick. All are familiar with the two methods commonly used to put a belt on a pulley. The first is to put it on by hand and the second to use a stick at the end of which a pin, or bolt, is attached. Both of these methods are more or less dangerous.

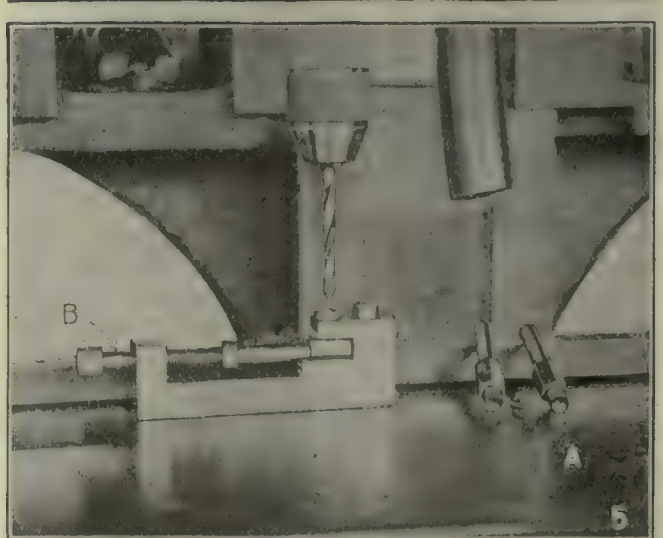
A safety belt shifter attached to a stick ready for service is shown in Fig. 1. It will be seen that the shifting mechanism consists of three rollers, one straight and two tapered. The belt is pushed by means of the straight roller, and owing to the shape of the taper rollers the tendency is for the belt to slide onto the pulley as the shifter slides away. Various shifter parts are shown in Fig. 2. *A* is a base; *B* a plate casting and *C* and *D* are straight and tapered rollers. At *E*, *F*, *G* and *H* are shown various stages of assembling.











FIGS. 1 TO 5. BELT-SHIFTER PARTS AND JIGS

Fig. 1—Complete safety belt shifter. Fig. 2—Shifter parts and stages of assembly. Fig. 3—Drilling the base. Fig 4—Drilling the plate casting. Fig. 5—Drilling the roller studs

The operation of drilling the base is shown in Fig. 3. The rough casting is located in a contoured recess which is approximately the shape of the piece. After it has been pushed into this recess, the operator holds the casting and drills the center hole. Castings before and after drilling are shown to the right of the jig.

The jig used for drilling the plate casting is illustrated in Fig. 4. The piece is placed on a pin which fits into the cored hole, the hinged cover of the jig being thrown back to allow for this operation. The casting is located by two adjusting screws like *A*, one against each boss of the piece. The jig cover is then dropped down and two holes drilled in the part. The post, or studs, on which the tapered rollers fit are made from hexagonal steel, the first operation being turning a certain distance on each end.

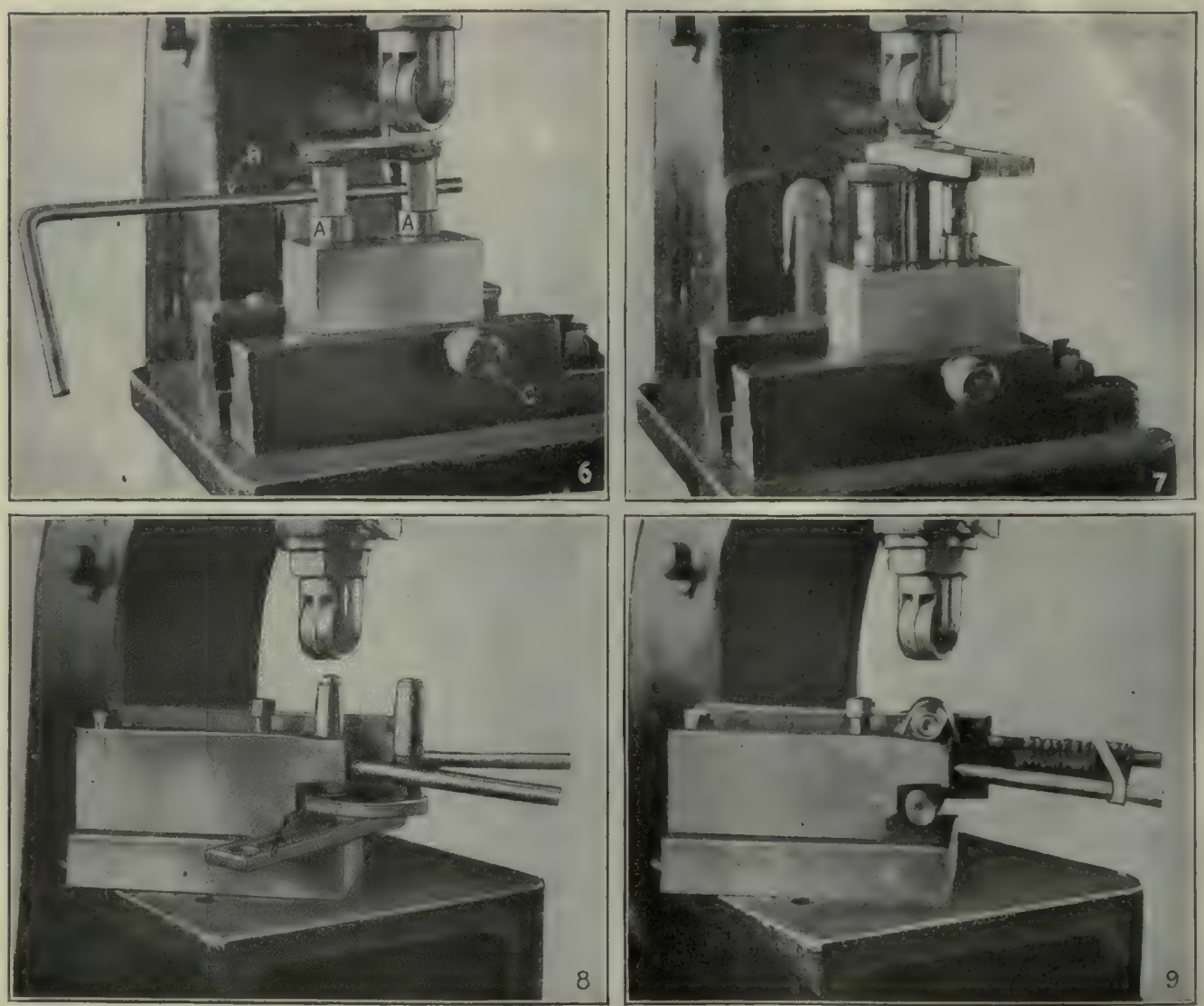
The studs are drilled as shown in Fig. 5. It will be noticed from the two studs at *A* that the ends are turned so as to form a shoulder. The stud is placed on a V-block in the jig with the turned end in a recess. The stud shoulder is then forced solidly against the end of the jig by means of the screw *B*. By this means the distance from the hole drilled to the shoulder is always the same.

When assembling the parts the first operation is riveting the studs into the plate casting, and is shown in Fig. 6. The studs are placed in bushings *A* resting on the turned shoulders. The bar *B* is then placed through the drilled holes to hold the posts in the correct alignment. After the plate has been placed over the turned ends of the posts, as shown, the ends are riveted until they are held firmly in position. The studs are located in turn under the spindle of the Grant riveter by means of the index pin *C*.

The plate casting is next riveted to the base as shown in Fig. 7. The two posts are again dropped into bushings and the short pin rests on a center post as shown. It will be noticed that the side posts do not rest on their respective shoulders. This insures the two parts being rigidly fastened together before there is any danger of the shoulders resting against the top of the bushings.

The next operation is riveting the ends of the studs so as to hold on the tapered rollers. The rollers are placed on their respective studs and the casting placed on the fixture as shown in Fig. 8. The end of each stud is then riveted over enough to prevent the rollers falling off, yet free enough for them to turn as desired.

The last operation is riveting the pin which passes through the center straight roller. The roller and pin



FIGS 6 TO 9. VARIOUS RIVETING JIGS

Fig. 6—Riveting the studs into the plate. Fig. 7—Riveting the base to the plate. Fig. 8—Riveting on the rollers. Fig. 9—Riveting pin for center roller

are placed in position and the shifter held on the fixture as shown in Fig. 9. The lower end of the pin rests on the surface of the fixture at *A* so as to provide firm support during the operation. One end of the pin is riveted over, then the shifter turned over and the other end riveted until the pin and roller are secure between the side posts. The roller is, however, a trifle shorter than the distance between the posts, so that it will turn freely on the pin. The device is now completed and ready to attach to a belt pole.

Keeping Track of Production

By HENRY A. NOAR
Manager, Efficiency Devices Co., Detroit, Mich.

Almost everybody has tried his hand at devising systems for keeping track of jobs or men or tools, and has probably felt that his system was a pretty good one until its wires got crossed with those of somebody else's method. The devices described here are designed to simplify this problem by providing uniform methods throughout the plant and are the result of a combination of ideas taken from all over the country.

THERE was a time not so many years ago, when the subjects of planning and production, routing and dispatch were of secondary importance. When plants were small the superintendent, his assistant, or the department heads could generally see to it that the different parts making up a unit came to assembly at a given time. With the growth of large plants, this personal supervision became not only impracticable but an utter impossibility. Where a plant employing thousands of men figures on production of 400 automobiles per day, the subject of keeping all parts moving on schedule becomes one of utmost importance, for if one department drops behind in its production, it means a jam in the final assembly and the piling up of unfinished units waiting for the slow part. Such a condition may become so serious as to close down all other departments. The financial problem also enters, as unfinished units piled up soon tie up the working capital usually needed to meet the payroll and incoming material expenses.

The problem then is to keep the required number of parts coming on schedule so that the product of the plant flows out in an even stream with just the proper number of men to work up the material and transportation to move it. If equipment of any kind is being sent to a distant point to be erected, it is necessary that this equipment come through on schedule so as to reach the erecting point on time. Otherwise the expense of an idle erecting crew will soon eat up all the visible profits.

The need arises for some system to keep tab on both workmen and material so that data are available on short notice and the production of any department can be kept at its proper percentage of output. The use of devices of various sorts grew with the plant. One man installed a system of pins on the wall on which he hung tickets and kept them moving on the pins. This later required tickets of different colors to record different data. Another installed pockets of wood or metal for holding the job or stock tickets. Another used a large sheet or blotter and with pencil and eraser kept tab on his department. Each selected what seemed best for his own needs and each worked out his own ideas. Out of this maze of different ideas grew the demand for some standard line of equipment that would meet the pressing call of the efficiency and production engineers. This led the Efficiency Devices Co. of Detroit to make a specialty of building devices to meet this need.

One of the earliest appliances was the spring clip which consisted of a double-torsion spring attached to metal wings swinging on pivots, the clips being on both sides of the wing, or on one side only to be attached permanently to the wall. While standard sizes are usually made in convenient multiples, there is no limit to the size or arrangement of the cards or the size of the metal wings, except that of safety and convenience of handling. The greater demand for special groupings has been for groups of three; for jobs unassigned

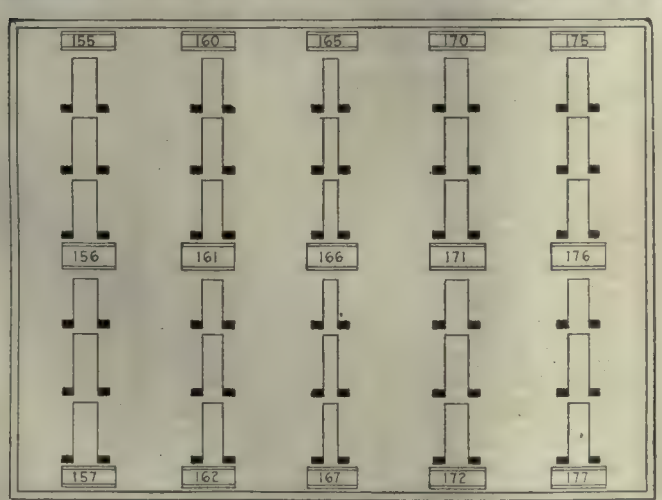


FIG. 1. BOARD WITH SPRING CLIPS IN GROUPS OF THREE

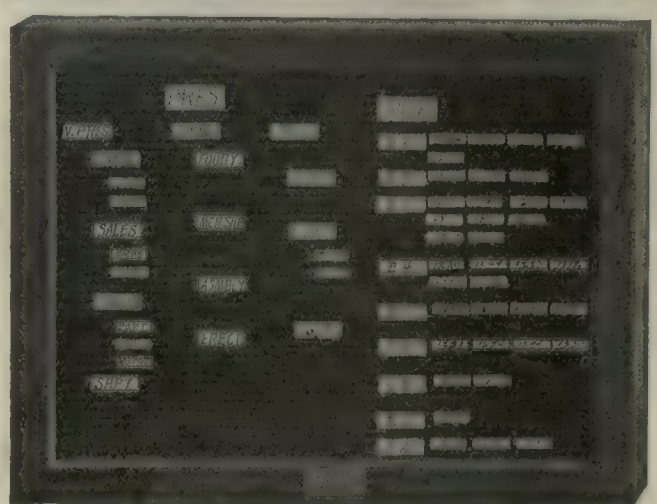
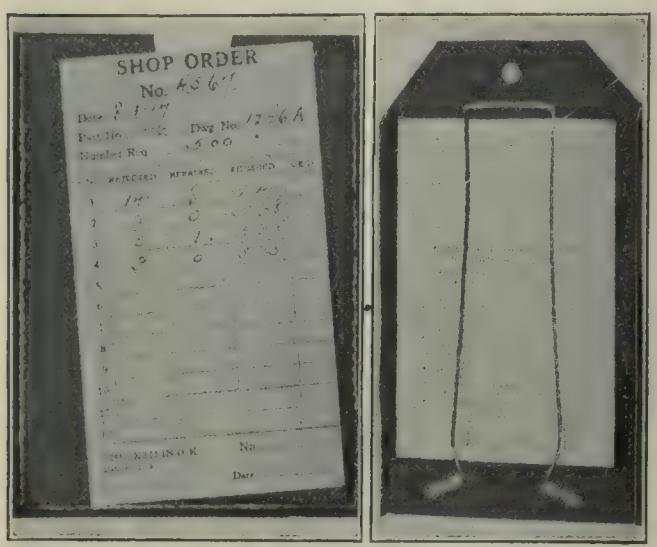


FIG. 2. CONTROL BOARD WITH FELT-COVERED STRIPS

or for which tools and drawings are not ready; jobs assigned for which tools and drawings are ready; and jobs in process, Fig. 1.

These spring clips will hold a bunch of cards or slips up to ⅝ in. thick so that the ordinary assignments can be taken care of and the ease of moving and replacing tickets makes this device one readily adapted to any shop. It can be applied as well to handling bonus tickets, stock cards, material records, perpetual inventory, shipping orders and other records which must be kept up to date and often referred to. The same clips are also used on separate card carriers or travelers, which can be attached to the machine, bench or truck, or carried by the workman.

The use of pocket cases much like those built by the manufacturers of time clocks is also quite general.



FIGS. 3 AND 4. CARD HOLDERS

Fig. 3—Flexible card traveler with celluloid face. Fig. 4—Steel card traveler for bins, boxes, etc.

An installation of a number of these units was made in a plant where wall space, to hang the required number of racks, was not to be had. To overcome this difficulty the racks were placed back to back, two units thus forming a wing with pockets on each face. Five of these wings were hung in pivot brackets against the wall spaced 6 in. apart. When opened full to either end they required a wall space of 7 ft. and when closed against the wall extended out only 15 in. Each rack was 2½ ft. wide and the 10 of them if placed flat would have taken 25 ft. of wall space. By this method of converting them into swinging wings they were crowded into a space of only 7 ft.

A Control Board Device

Another device is a control board, Fig. 2, having a number of felt-covered strips running across it and fitting close together so that the spaces between them form a padded slot. Ticket or tab holders in various sizes are made with the upper and lower edges turned over so that the tickets slip under these edges. A spur is welded to the back and this spur inserted and held in the padded slot. The tab holder with the ticket can then be shifted from one position to another as required.

A similar appliance consists of a board of cork-padded insert with ribbons on spring reels at the left side. As progress is made the ribbons are drawn across from left to right and held at any point by a pin in the cork insert. The ribbon reels are self-releasing and keep the ribbons tight on the surface of the board. The cork insert is self-filling so that the constant pricking with pins does not mar the surface. The top and bottom edges of the frame can be laid off to scale or by numbers so that the ribbons indicate percentage of production or quantity to date.

Demand for Bulletin or Tally Boards

A demand has also arisen for bulletin or tally boards. Plain steel wings with either a slate or japan finish, and soft wood wings with natural wood or slate finish or covered with burlap, can be made in different sizes to attach permanently to the wall allowing the use of one side, or swung on pivot brackets with or without cabinets. Where data or instructions are changing the

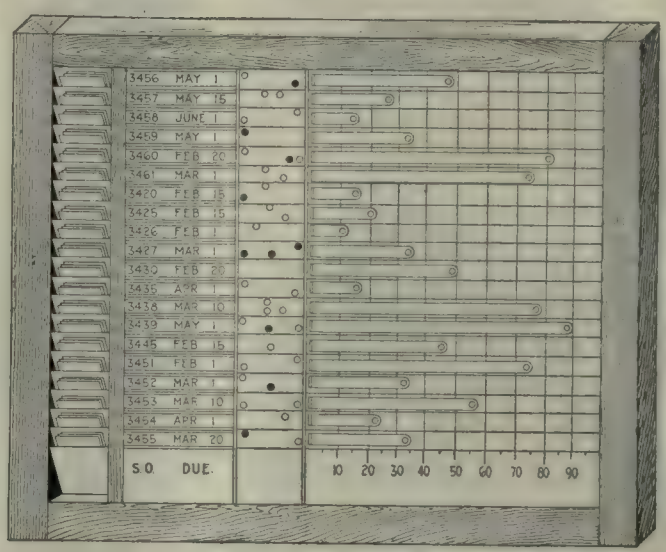


FIG. 5. COMBINATION CONTROL BOARD

slate finish allows the use of chalk tally, while if written bulletins or instructions are to be posted the soft wings permit the use of thumb tacks. Where formulas or prints are to be kept readily accessible and yet of a semi-private nature the swinging wings can be inclosed in a cabinet under lock and key.

One of the problems in repair work or work of a nature where special instruction cards are issued, is to keep those cards clean while in the shop. Handling by the workmen whose fingers are seldom spotless soon renders the instruction cards almost unintelligible and costly errors may then occur through the inability to read the card. Card travelers for cards, blueprints, drawings and instruction sheets have a transparent celluloid front with a leatherette or celluloid back, Fig. 3. An eyelet at the top allows the traveler to be hung up or tied to the job under way. The same idea is carried in a wall-chart holder, which is made ½ in. deep so that charts or reports as they accumulate can be dropped in, the last one in front of the others and fully visible.

Another question often arising in a plant is where to get metal tab, ticket, or card holders for stock bins, shelvings, tote boxes and the like, and several styles have been designed to fit these requirements, Fig. 4.

A number of interesting combinations have recently been worked out and Fig. 5 shows a combination of four styles. The first section is of pockets to hold material and work cards; the second section is a long tab holder to hold the order number and description;

the third section is of cork insert on which different colored pins can be used to denote different data; and the last section has movable ribbons on the cork insert to register percentage of progress. To this may be added a section of movable tab holders on felt pads to denote progress of different elements or units entering into the final assembly.

The subject of routing, planning and dispatch for the control of production will continue to grow as methods and equipment become standardized and more familiar to those who can use them to good advantage.

A Plea for Coöperation

By W. O. Adams

A man came to me not long ago with the statement that with wages as he believed they would be and peacetime competition again in full swing, his margin would be so reduced that his business must fail. His story developed the fact that he had previously been able to get his labor cheaply and had counted upon this factor almost exclusively to enable him to sell his goods at a fair profit against competition. Now he must pay more and he was up against it.

He was overlooking several factors. He believed that the money paid his operatives represented the true value of what they could do under any conditions. If his operatives did what they were assigned to do in the making of his goods and he attended to disposing of the goods at a profit, he had little interest in what happened to the men and felt that they had no rightful interest in what he did with his business or the goods that he paid them to produce.

Of course he was absolutely wrong. He had not reached the point where he could differentiate between legal ownership and coöperative interest. We must have legal ownership vested in some definite form and in this sense the plant, materials, equipment and the type of brain power necessary to make a coördinated whole was his.

Employees Share in Coöperative Interest

But his employees also shared in the coöperative interest for their capital of time and ability had entered into the value of the equipment and the goods. The operative had his problems to solve just as did the employer and he worked them out in a very similar way. In other words, here was one man and a group of men actually working towards the same end but forced by a misconception of their particular functions to carry on blindly without mutual understanding.

It developed that this employer had much to learn as to efficiency of operations and economical handling of his product. It had become necessary for him to install such improvements of production as would enable him to meet competition in spite of a higher labor rate. The details of his changes in methods are not important for they apply with one exception, to his particular business only. But that one exception is of the highest importance, for once his eyes were opened to the new order of things, he began at the base of his structure—with the human element—with the worker.

One seldom meets a business man who is not classed as a pretty good sort of fellow when off duty among his social acquaintances. He goes fifty-fifty with them, as he must, to make good. His employees do just about the same among their friends. They live, in proportion to their means, along very similar lines with similar hopes, emotions and sorrows. But in far too many cases the passing through the factory door throws both employer and employee into that atmosphere mysteriously described as "business" where the understanding and friendship of the outside are smothered by the attitude of worker and worked-for on the inside.

Your operative is glad to be called a worker provided he knows what he is working for and feels that he has a vital share in the rewards that come from intelligent work. He appreciates ability of supervision and respects just authority.

There is in most men an inborn desire to be loyal. But loyalty cannot be bought by wages. It is the flower of its surroundings. We all know many men who believe that system and efficiency go hand in hand. They do not believe it unless there is loyalty as a base. There lies the greatest of fundamentals in creating efficiency and for meeting the conditions of the future.

The old "rough-neck" methods are gone but their passing does not mean that coddling must take their place. Strong medicine suits strong men but it must be the right kind of strong medicine. Draw your men; do not drive them; give to them all your business will stand in fairness to yourself and to them and make them feel that you have an interest in them.

Cutting Threads of Unusual Pitch

By Wm. A. Frank

Upon reading the article by Miles C. Smith entitled "Cutting Threads of Unusual Pitch" on page 451 of the *American Machinist*, I was reminded of an attempt to make a conical worm by setting the mandrel on offset centers and threading. The result was an absolute failure and the condition which brought about this result is present in, and will render impractical, the method described by Mr. Smith for turning straight threads with the taper attachment set parallel to the center line of the work.

By this method the headstock center becomes a universal joint and the faceplate slot or driving stud is the driving pin of the joint. The variation in angular velocity of the driven member with a universal joint is well known, and this variation of angular velocity of the work relative to the lathe spindle and lead screw is the cause of all the trouble, for the lathe carriage and consequently the thread tool is alternately in advance of and behind its true pitch position. Of course this is more noticeable in cases requiring a large angle between the center line of the lathe spindle and the center line of the work, but the difference in the error introduced is one of degree, no matter how small the angle. This method, less Mr. Smith's trigonometric analysis, has been described before, but I do not believe it is used by those whom he calls "wide awake."

The only way I know of to apply this method is to fix a fine-tooth bevel gear to the faceplate and another to the work, having them mesh on the back of the lathe and thus drive the work with the same relative velocity as the spindle. This involves however more trouble that the method Mr. Smith rejects, viz: that of cutting special gears to meet the requirement.

If Mr. Smith desires a "perfect thread," I should advise the use of his method along the line of the doctor's directions for the use of cucumbers: "Pare them very thick, slice them very thin, soak them in salt for six hours, then throw them in the garbage."

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

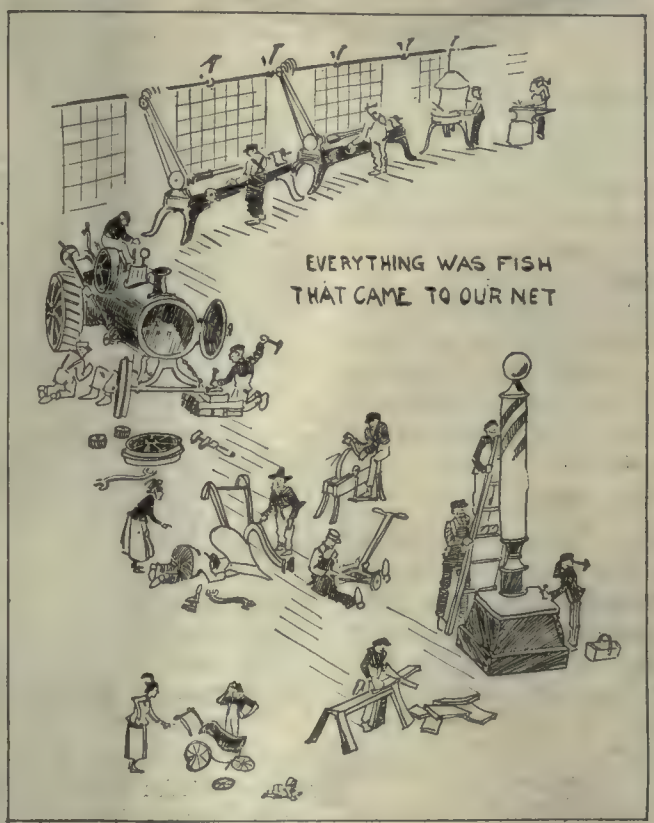
These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

The Modern Foreman—His Job

By M. L. LOWREY

Much has been said of the duties of the modern foreman, and it is apparent that diverse views obtain as to just what these duties comprise. The very diversity of conditions under which these men labor would however seem to make a comprehensive definition impractical. Mr. Lowrey does not attempt to make a definite statement; he merely tells in a very entertaining manner what had happened "at the close of one sad day."

THE articles on the modern foreman appearing in recent issues of the *American Machinist* have greatly interested me. They apparently have been written by men who employ foremen in large, well-conducted shops where the foremen seem to have lost their identity. I want to tell something of the foreman of a Western contract shop, what his duties are, what he must know and what the worries and annoyances are to which he is subjected.



To begin he must be an enthusiast in his trade, ready to shoulder responsibilities and make sacrifices for love of the game, as the little extra he gets does not begin to compensate him for the additional burdens he is called upon to assume.

His work comprises managing the shop and the proprietor, getting out the work without proper tools, collecting bills and keeping peace with the men, who are continually demanding more pay and better working conditions; in this he is "between the devil and the deep sea," for the proprietor is as continually trying to cut down expenses and do the work with cheaper help. The shop of which I write was a small jobbing shop located amid the mountain scenery of a far Western mining town. Everything was fish that came to our net; no job was turned away. We repaired dental instruments and plows; built mining machinery, sawmills and Patent Office models, set up engines and pumps; and once we turned a barber's pole and cut spiral lines upon it to guide the painter. I wonder how many machinists know whether such a spiral is right or left hand? I did not until the question came up on this job.

The day I have chosen to tell about was on the whole no worse than other days, as while there might have been a little extra trouble in some ways many of the regular troubles did not materialize. No one asked for more pay, nobody was sulky or impertinent, and the proprietor was at home sick and could not suggest that I use more boys and fewer men nor tell me of the wonderful bargain he had found in a junk yard in the way of a planer that "with a little fixing up would be as good as new." Further I had but one dispute with a customer about his bills, so I size it up as a fair-average day.

Like many other blue Mondays this day began on Saturday afternoon, which was also pay day. The time was midwinter and a big storm was brewing. Our big job at this time was the building of a double Corliss engine with 16-in. cylinders, and it pushed our resources to the extreme limit; but as work was none too plentiful I had told the proprietor we could handle it, although I realized that it would take lots of hard study on my part to design ways and means for doing it with the equipment at my disposal.

We needed one more good lathe hand, so when on this blustering Saturday afternoon a man applied for work and in answer to my question told me that he had grown up in the Corliss-engine business and had worked in some of the best shops in the Middle West I hired him and told him to report for work Monday morning.

The next day (Sunday), after attending to the 57 varieties of jobs that friend wife always saves up for me to do on Sunday, I went to the shop and put in several hours checking over drawings to detect any possible errors before work was started on the engine.

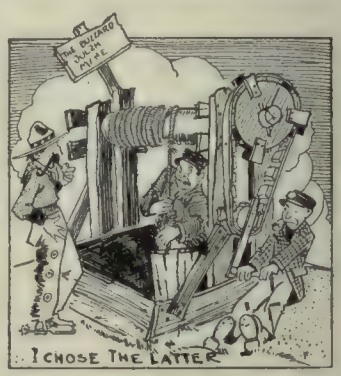
After a good night's sleep I showed up at the shop this eventful Monday morning, at peace with all the world and feeling fit for anything that might transpire. It soon became apparent that I had need of all my faculties and to be an extreme optimist besides.

Two men who were most needed, being on repair work promised at a definite time, had not recovered from their pay-day drunk and could not be expected to work while they had any money left. Also the new man did not seem to be quite so familiar with his work as his talk led me to believe. However as the forging for the crankshaft was already centered and in the lathe I started him on it, first making sure that he understood the drawing and thinking that he could

do little harm on the roughing cuts anyway, especially as I would be there to watch him.

Putting the best apprentice boy on one of the promised jobs I went to work on the other, and all seemed well, as we could still get these jobs out on time as agreed.

Just then I was called to the office 'phone, there being a very much excited man at the other end of the line who said that a second-hand pump we had sold him was not working; the mine " was filling with water; come quick."



This mine was about four miles away, the road hardly more than a trail, it was raining hard and blowing a gale, our trouble shooter was out on a job and the proprietor sick, so there was nothing left but for me to go. I was soon on the road behind a pair of sturdy mountain horses —there are some roads here that even a Ford fears to navigate—the rain had turned to snow and I arrived at the mine chilled through.

This mine was in the development stage and had no proper cage running in ways; only an old Cornish kibble, or iron barrel, swinging loose in the shaft. I could either go down a wet, slippery ladder or ride in the kibble. I chose the latter, and after bumping against the sides of the shaft several times, arrived at the pump station, about 90 ft. from the surface. The pump was an ordinary duplex of a well-known make, and as usual had holes drilled and tapped on both sides for both steam and exhaust pipes, so that it could be piped from the side that was most convenient, and it had left the shop with a plug in one inlet and one exhaust hole as is the usual custom.

One Way to Pipe a Pump

One glance showed the trouble. They had taken the plug out of the inlet and with it and a bushing had plugged the other exhaust hole, the steam now going in at one side of the steam chest and out of the other. (This is absolute fact.) The miners said the piping was done to the superintendent's orders. As no exhaust pipe had been connected the steam in the shaft made it very much like a Turkish bath.

I put the plug back where it belonged and had the pump running in five minutes, and returning to the surface I reported to the superintendent. He was very indignant, saying it was all my fault; that no decent shop would have sent a pump out without a drawing of the piping; that he would give us no more work, and that he surely would not pay for my trip to the mine. I saw at once that this was a case that required diplomacy, so taking a seat on an empty powder keg and lighting my pipe I proceeded to apply the only kind of diplomacy that I have ever known to be of use when dealing with this type of man.

I told him first that we had insisted on getting cash for the pump as it was well known that his mine was no good—in fact it was a wild-cat mine; second, that we did not want to work for such a man as he proved to be, and third, I had noticed that the mine shaft was not timbered to comply with the law, and that I thought it my duty to report it to the state mine inspectors.

The bluff worked, for as I started to leave in a great make-believe rage he called me back, asked what the bill was, and handing me a check for the amount requested me to say nothing about the shaft as he would immediately have it timbered properly.

More Trouble

Quite proud of the diplomatic manner in which the bill had been collected I returned to the shop in a very contented frame of mind, thinking the worst was over, as it was such a stormy day the other mines might not send for their promised jobs. There was however another jolt waiting for me, as on entering the shop I saw that the new man had the crankshaft blocked up and the tailstock pulled back. He had not slacked the center as the shaft expanded in length from the heat generated by the cut, and as a result the center was badly cut. This was apparent at a glance, and seeing the man at the grindstone I questioned him and found that he had ground the center nearly smooth on the emery wheel and was now putting a nice finish on it with the grindstone.

Now of course in the good New England city where I learned my trade it was generally understood that no really good work ever had been or ever could be done west of the Hudson River. Still from reading the *American Machinist* I had been led to believe that it was not considered good practice in the best shops even in the Middle West—where this man claimed to have worked—to finish lathe centers on the grindstone. Also the man was drunk. I was afterward told that as soon as I left for the mine he had sneaked out the back way and got a big bottle of booze.

I wonder if all foremen hate drunken men and the liquor business generally as much as I do! Ordinarily it is hard for me to discharge a man and I never do it without good cause, as I realize that it usually means suffering and privation for those dependent on him for support, but I can truthfully say that I gave this man the three-quarter day's time that was coming to him with pleasure.



The pleasure, however, was not mutual, as he took his discharge with very bad grace and wanted to fight, I explained that I could not possibly spare the time to fight, but I did take time to speed up his departure a little by applying the toe of my boot with considerable emphasis where it would do the most good, to the great delight of our apprentice boys, who deeply regretted that there was no one there to film the scene.

A Few Minor Details

Then after looking the shop over, straightening out several small troubles, starting some men on another urgent repair job that had come in during my absence, having the usual scrap with the foundry foreman about the blast for the cupola not being strong enough, and

wasting a half hour in the office convincing a customer that his bill was not exorbitant, I resumed operations on the promised job, which by working like a good fellow and going without my supper I was enabled to finish at 11 p.m., just as the truck from the mine drove up for it.

The storm was now over and the moon shining brightly. After helping load the job on the truck and wishing the driver a pleasant trip I went home and to bed, and while listening to the somewhat incoherent remarks of a very sleepy woman about a man that didn't know enough to work at his trade as journeyman and let someone else do the worrying I dropped into a peaceful sleep to awaken in the morning with a good appetite and ready for any old thing the fates should see fit to send me.

New Opportunities for Machine-Tool Builders

By L. W. ALWYN-SCHMIDT

Any outlet for our supply of machine tools is of course a welcome prospect and the chances of disposing of some of our products to foreign users look bright. At the same time there will be calls for machines designed to fill requirements different from the old ones, and the man who is ready to jump in with new machines when the avenues of trade are opened will reap a harvest.

THE principal feature of machine-tool construction during the war was the rapid increase in the demand for machines capable of doing heavy work but the coming of peace has put a stop to this demand and the machine-tool makers must turn their production into more normal channels. A good deal has happened, however, during the last three years, and peace is not going to cut short the development put into motion by the war. To replace the dead and to assist the crippled to return to earning occupations will require more than ordinary effort, and it can not be done without changing materially the aspects of our industrial production.

Not the Only Industrial Problem

But this is not the only industrial problem caused by the war. By accelerating the speed of the economic machinery of the world the parts have been tested more thoroughly than would have been the case in times of peace, and some of them have broken down seriously. Defects have come to our notice which we had not expected and which now will have to be repaired. But at the same time new sources of power have been discovered which will continue to be at our call and will equalize to some extent the losses which have occurred in other directions.

The effect of all this on the machinery industry can hardly be overestimated. Supplying the tools for all industrial operations, it naturally must feel keenly all that moves the industries which are its customers. As a result it faces a series of problems, technical and economic, upon the successful solution of which must depend to a great extent the smooth readjustment of the world's industrial activities.

The outstanding feature of this new development seems to be the exceptional demand for raw materials. During the war this demand was met by replacing many standard materials with substitutes, and by opening new sources of the materials already in use. In Germany it became necessary, for instance, to replace the iron bearings which in turn necessitated changes in brass-lined bearings in most machines by all steel or the general construction of individual machine parts. There is, however, a still more interesting form of substitution where entirely new products have taken the place of the old ones. So wooden soles have been substituted for leather ones in many European countries. To make these wooden soles special machines have been designed which are turning out great quantities of the article. Machines also had to be built to weave and spin the many textile substitutes which have been tried. Many of the processes used during the war will no doubt be retained in the future, as will many of the new materials. Peace will give a better opportunity to develop the industrial possibilities of these articles, and with their development there will arise a demand for machinery suitable for their production. This demand will have to be studied by the machine industry with a view to meet it when it arises in our own and in our foreign markets.

New Sources of Raw Materials

As an example of the opening of new sources of raw materials in addition to those already known the case of manganese may serve. Before the war manganese came principally from Asiatic sources. The rapidly increasing demand made necessary the exploitation of additional supplies and led to the development of the manganese mines of Brazil which until then had been of secondary importance only.

In our own country great progress was made in the treatment and production of low grade ores of all kinds. Under normal conditions we would hardly have attempted to work many of the low grade deposits because there was no economic necessity, and the cost of working them was too high for ordinary purposes. Only with the failure of the high-grade ores which was not expected to occur in the near future would we have been compelled to use the lower ores. Now we have been forced to do it many years earlier, and having once begun we can not turn back. We must continue working the mines after operation has once been started, and it is up to our machinery designers to construct machines which will work so cheaply and efficiently as to make possible the exploitation of low-grade ore mines even under the conditions of a normal peace market with lower prices.

International competition will force us to do this in our country, and it will force other countries to do likewise. Our machinery designers, therefore, have here a program for their enterprise already cut out. We must have machines which will cheapen production, not only to be used in mining operations, but in all industrial lines.

The saving of labor is bound to play a considerable part in after-war economics for it is obvious that our

industries will have to get along with a smaller supply of labor than in pre-war times. Europe has lost a great part of its man-power and is not likely to give us much assistance in this respect, even if no special labor immigration law is enacted. We are confronted by the necessity of having to sustain a vastly increased demand for industrial materials with a decreased number of men. Only well directed application of machinery can help us over this serious difficulty.

Before the war Europe was just ready to make the change from individual production to machine production on a large scale, but foreign industrial experts are of the opinion that the war has arrested this movement and directed it into a different channel. In fact, there will be more artisan establishments in Europe after the war than before in proportion to the available producers and they will be better equipped. The explanation given for this is rather simple. The great number of men who have lost in productive efficiency owing to the loss of an arm or leg will be forced to use machinery to make up their loss and to increase their earning capacity, and consequently small shops fully equipped with labor-saving machinery will be found everywhere. With the increase of machine equipment, naturally, there must also be an increase in the number of repairs, and small machine shops will be required to do this work.

No Interest Shown in Building Small Labor-Saving Machinery

The American machine-tool industry so far has shown little interest in the building of small labor-saving machinery. We have been very successful in the designing and constructing of labor-saving tools for all kinds of artisan production, as carpenter tools, lockmaker tools, etc. But we have so far been somewhat behind in designing actual machine tools for the small repair shops. The European machine construction shops have not been much more alive to the situation. They have the advantage of having always built a great number of cheap machine tools which were in the reach of the pocketbook of the small artisan and which in consequence found their way into this kind of establishment. The artisan of today, however, does not want a second-rate machine tool but desires on the contrary a first-class tool at reasonable cost. In former years we have had the excuse that we were not equipped for the construction of machine tools of which a small number only was required. The conditions seem to be changed now as a large demand exists for these tools. For one small repair shop existing four years ago, two or three may be found in a few years in Europe, and each of these shops will be a purchaser of this class of tools, provided somebody will always produce them at a cost which makes their employment possible in a small shop.

The sale of these machines will not be confined to Europe only. We have already a demand for these tools in our own market large enough to make it worth while for any manufacturer to develop it. The South American market has vastly increased owing to the growth of a general industrial activity in countries which in pre-war times were only indifferent customers for American machine tools. Our machine construction shops have many orders from this quarter for minor industrial machinery of all kinds, shoe machinery, textile machinery, button-making machines, and many others having recently been shipped in fair quantities. The installation of these machines and their future maintenance will bring in turn a demand for a larger number of repair and engineering shops similar to that in Europe and the United States. Formerly these shops bought the cheaper English, German, or Dutch machine tools and they also offered a very receptive market for European second-hand machine tools. If we can give them a new American machine tool having all the advantages of a high-class tool combined with that of a lower price, we certainly should find them very appreciative of our offer. Greece, Turkey and the Balkan countries are all just entering a state of industrial development where the existence of a well-equipped machine-repair industry becomes estential. We should therefore be prepared to attend to their wants. A very distinct demand for small machine tools suitable for repair work is also to be expected from the shipbuilding industry. Tools will be required for installation in the repair shops aboard the new ships which are now building all over the world. The submarine warfare has sent hundreds of these small repair outfits to the bottom and they will have to be replaced in the near future.

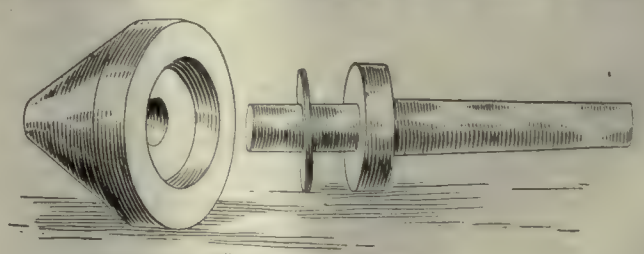
It would not be the first time that our machine constructors have come to the aid of the world to assist in the solution of its problems for it is not so long ago that the reaper and other labor-saving agricultural implements were invented which make possible today the production of the enormous quantities of foodstuffs required to sustain the rapidly-growing population.

A different need has now arisen and there is every reason to believe that it will be met by the machinery manufacturers as they have met other needs. Naturally we hope that the American builders will capture their share of the business for they have a reputation to live up to, but they must be awake to conditions as there are new forces at work along these lines in England and France which are not to be ignored. A time of readjustment like the present offers rich returns to the well-equipped manufacturer who is willing to enter new fields.

The Right Way to Make a Pipe Center

By M. L. Lowrey

The pipe center shown in the cut is what I have been using for many years, but it does not seem to be as generally known as it should be, at least on this coast, judging by the many miserable makeshifts that I see in the shops that I visit.



A PIPE CENTER

The revolving member should be made of rather hard close-grained cast iron and should be turned to an angle of 60 deg. (in many shops I find them turned to 90 deg.) The arbor is usually made of low-carbon steel, and is somewhat better if casehardened and then ground true.

The two features making this a good pipe center are the big collar or flange on the arbor, which helps to steady the center, and the thrust washer of rawhide, if it can be obtained; if not a fiber washer will do.



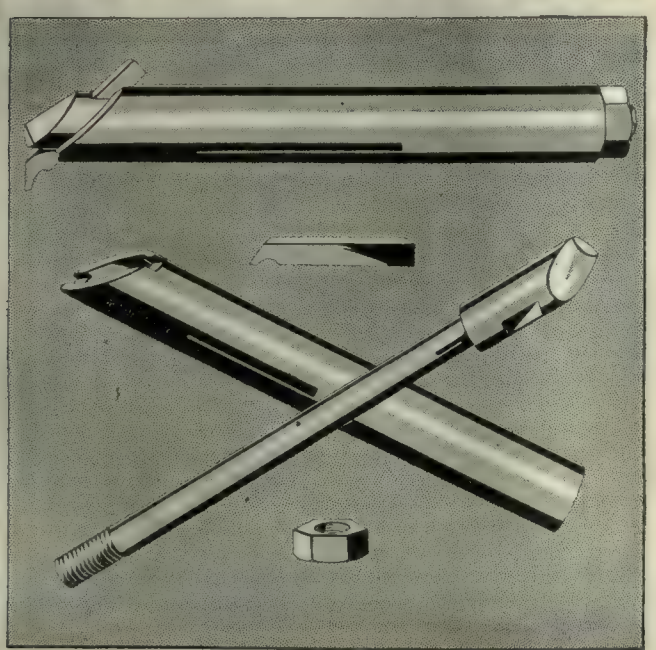
Handy Form of Boring Bar

By M. L. Lowrey

The sketch shows a bar for holding boring, or inside chasing, tools that I think hold the tools more securely than the one illustrated on page 153 of the *American Machinist.*

It may be made of a size to fit whatever fixtures the shop is supplied with and of any required length. If the end of the bar is milled to exactly 45 deg. it is easy to grind the tools to any angle desired by using a protractor.

This bar is especially useful in boring or threading



THE BORING BAR

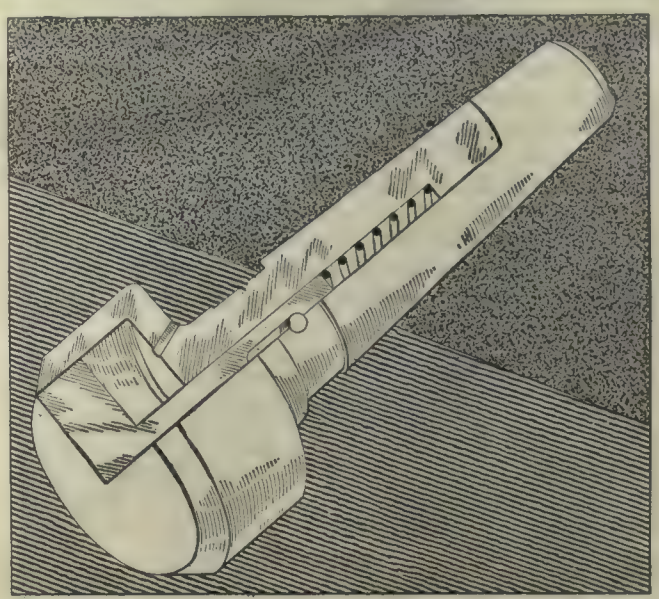
to the bottom of holes, and has the advantage of being easily made, of holding the tool firmly, can be rotated to give any top rake desired, and there is no projecting setscrew to be in the way or to be bent or broken off.

Punch for Cutting Microphotographs

By Charles A. T. Kerr

The tool shown in the sketch is one that I designed for cutting out the round microphotographic prints used in connection with analysis work.

The construction is plainly shown in the cut. The recess in the punch should be ground and lapped smooth after hardening and the spring plunger nicely fitted. The slot in the shank of the plunger, which in connection with the pin keeps the plunger from coming out, is made of the right length to allow the latter to project a few thousandths beyond the edge of the punch. This serves to protect the sharp cutting edge from injury



PUNCH FOR CUTTING PHOTOGRAPHS

and at the same time furnishes a means of holding the photograph flat when cutting it.

The two small holes at the bottom of the recess are air ducts to prevent the trapping of air, which would cause the plunger to work sluggishly.

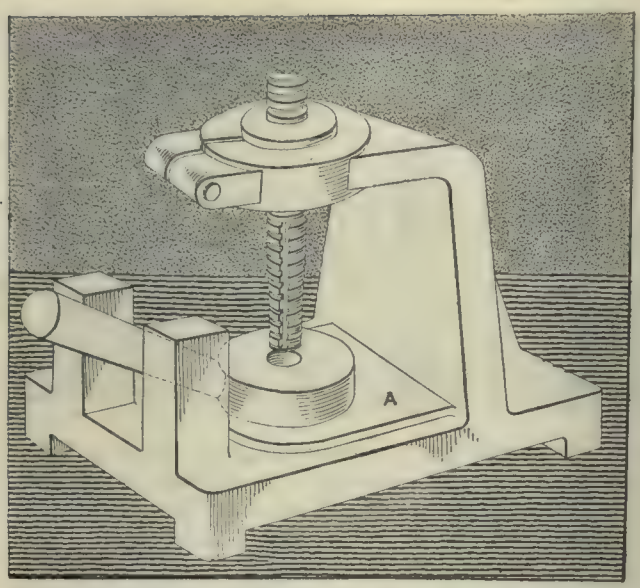
The photograph to be cut should be laid on a hardwood block and the punch struck lightly with a mallet.

Starting a Thread Always in the Same Place

By S. B. Royal

The clamping handle shown in the sketch was required in large quantities and it was necessary to have the handles always stop in the same position when tightening.

The surface *A* of the jig was finished, as was also the under surface of the pieces to be tapped. A bracket that was part of the jig carried a threaded bushing to which was fitted a special tap having a thread 2 or 3 in. longer than was necessary to tap the work. The flutes of this tap were not carried up any farther than was necessary, however, so that the part working in the bushing was a full thread.



JIG FOR TAPPING CLAMPING NUTS

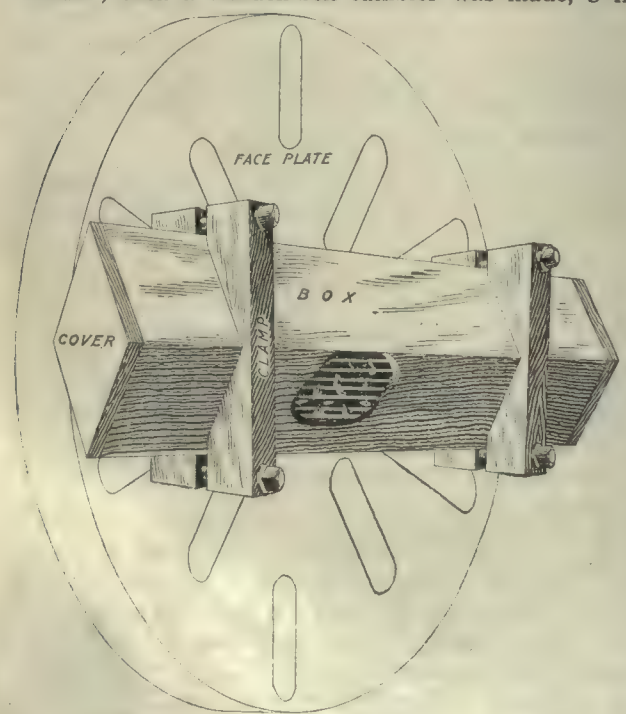
The pieces to be tapped rested on the finished surface of the jig with the handle extending between the two uprights in front, thus the threads would be started in the same place with reference to the handle in each piece. The bushing was a push fit in the bracket and was held from turning by a clamping screw. This allowed an adjustment of the starting point of the thread, which was determined by trial. Correctly set and clamped, all pieces tapped in the jig would be alike.

Improvised Tumbling Barrel

By M. E. Duggan

The tumbling barrel shown on page 158 of the *American Machinist* reminds me of an experiment in one of the large bicycle factories where I was employed to make a machine, or tumbling mill, that would take the place of hand polishing on bicycle spokes.

The commercial sized mill was tried out and proved a failure; then a wooden-box tumbler was made, 8 in. square and 12 ft. long, the inside partitioned off into boxes slightly longer than the spokes to be polished. This was mounted on bearings at each end of the box and revolved at a speed best suited to the work of polishing. The result was tangled and half-polished spokes.



AN EXPERIMENTAL TUMBLING BARREL

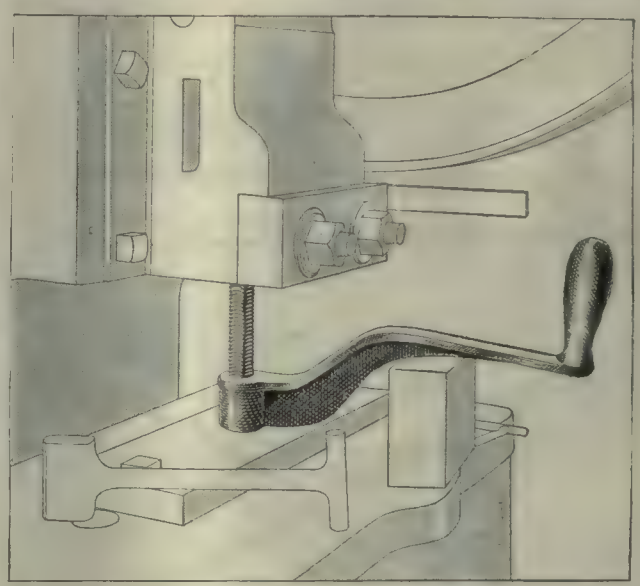
The sketch shows an experiment that was successful. A box was made of maple 1 in. thick, 6 in. square (inside measurement) and 30 in. long, mounted as shown on the wooden faceplate of a patternmaker's lathe. It will be noticed that the box is fastened cornerwise, not square with the faceplate of the lathe.

Leather and pumice stone were the materials used for polishing. Strips of leather $\frac{3}{4} \times \frac{1}{4}$ in. were used. The tumbler was revolved at a speed that would allow the spokes and polishing leather to slide all the way from one end to the other of the tumbling barrel.

Broaching in a Punch Press

By J. Wright

The handles used on the controllers of electric street cars are made with variously shaped holes in the boss which fits over the shaft of the movable contact, these holes being of irregular shape for the double purpose of preventing the operation of the car by unauthorized persons and to insure that when the handle is used it shall occupy the right position in relation to the contact which it controls.



PUNCH PRESS USED FOR BROACHING

The Chicago surface lines use a similar handle for operating the door-opening mechanism of their cars, and on this road the holes in question are four sided with two right-angled corners, the fourth side being curved instead of flat. The handles are made of malleable iron with a cored hole, leaving but a small amount for finish, and the finishing operation is accomplished by broaching in the manner indicated in the illustration.

A short broach is used for this purpose and is driven through the hole by means of an ordinary punch press. The broach, which is small enough on one end to enter the cored hole, is placed in position and the handle then held under the gate of the press so that the first stroke drives the broach a distance of possibly half an inch. The operator holds the small device in his other hand, and on the next stroke of the press

he lays this tool flatwise on top of the broach. The press then drives the broach through an additional inch, and a quarter turn of the piece stands it up into the position as shown, enabling the press on its third stroke to force the broach down until it is nearly flush with the top of the handle, in which position it has finished its cut and is easily removed.

It will be noticed that the plate has been laid on the bed of the press, and this has a hole through which the lower end of the broach passes.

Inside Diameter of Threads

By Holger Carstensen

The table shown gives the root diameters of United States Standard threads when the nominal bolt diameter and number of threads per inch are known. It can be mounted on a 3 x 5-in. card for reference.

FIGURES IN FIRST VERTICAL COLUMN REPRESENT OUTSIDE DIAMETER. FIGURES IN FIRST HORIZONTAL COLUMN REPRESENT NUMBER OF THREADS PER INCH

	20	18	16	14	13	12	11	10	9	8	7	6	5½	5	4½	4
1	0.935	0.928	0.919	0.907	0.900	0.892	0.882	0.870	0.856	0.837	0.814	0.783	0.764	0.740	0.711	0.675
1⅛	1.060	1.053	1.044	1.032	1.025	1.017	1.007	0.995	0.981	0.962	0.939	0.908	0.889	0.865	0.836	0.800
1¼	1.185	1.178	1.169	1.157	1.150	1.142	1.132	1.120	1.106	1.087	1.064	1.033	1.014	0.990	0.961	0.925
1⅜	1.310	1.303	1.294	1.282	1.275	1.267	1.257	1.245	1.231	1.212	1.189	1.158	1.139	1.115	1.086	1.050
1½	1.435	1.428	1.419	1.407	1.400	1.392	1.382	1.370	1.356	1.337	1.314	1.283	1.264	1.240	1.211	1.175
1⅝	1.560	1.553	1.544	1.532	1.525	1.517	1.507	1.495	1.481	1.462	1.439	1.408	1.389	1.365	1.336	1.300
1¾	1.685	1.678	1.669	1.657	1.650	1.642	1.632	1.620	1.606	1.587	1.564	1.533	1.514	1.490	1.461	1.425
1⅞	1.810	1.803	1.794	1.782	1.775	1.767	1.757	1.745	1.731	1.712	1.689	1.658	1.639	1.615	1.586	1.550
2	1.935	1.928	1.919	1.907	1.900	1.892	1.882	1.870	1.856	1.837	1.814	1.783	1.764	1.740	1.711	1.675
2⅛	2.185	2.178	2.169	2.157	2.150	2.142	2.132	2.120	2.106	2.087	2.064	2.033	2.014	1.990	1.961	1.925
2¼	2.435	2.428	2.419	2.407	2.400	2.392	2.382	2.370	2.356	2.337	2.314	2.283	2.264	2.240	2.211	2.175
2⅜	2.685	2.678	2.669	2.657	2.650	2.642	2.632	2.620	2.606	2.587	2.564	2.533	2.514	2.490	2.461	2.425
3	2.935	2.928	2.919	2.907	2.900	2.892	2.882	2.870	2.856	2.837	2.814	2.783	2.764	2.740	2.711	2.675
3⅛	3.185	3.178	3.169	3.157	3.150	3.142	3.132	3.120	3.106	3.087	3.064	3.033	3.014	2.990	2.961	2.925
3¼	3.435	3.428	3.419	3.407	3.400	3.392	3.382	3.370	3.356	3.337	3.314	3.283	3.264	3.240	3.211	3.175
3⅜	3.685	3.678	3.669	3.657	3.650	3.642	3.632	3.620	3.606	3.587	3.564	3.533	3.514	3.490	3.461	3.425
4	3.935	3.928	3.919	3.907	3.900	3.892	3.882	3.870	3.856	3.837	3.814	3.783	3.764	3.740	3.711	3.675

TABLE OF ROOT DIAMETERS

The values in the body of the table were obtained by subtracting twice the depth of thread from the nominal outside diameter. In the U. S. S. thread the depth is obtained by dividing 0.6495 by the number of threads per inch.

Holding Fixture for Grinding Flat Gages

By Hugo F. Pusep

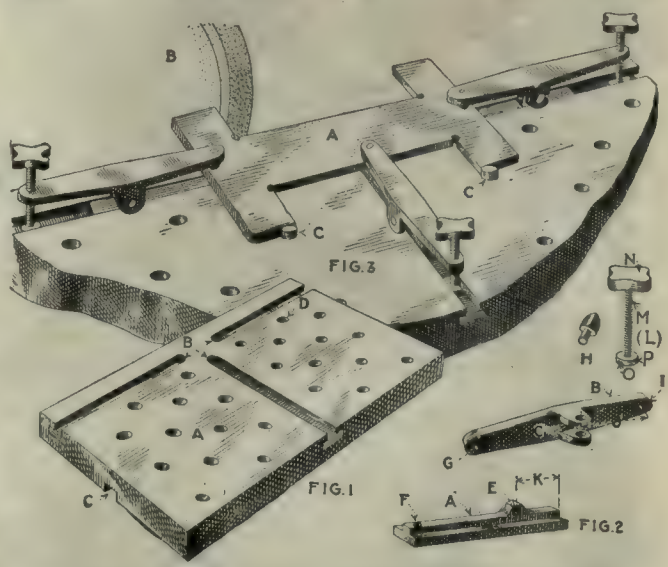
Several months ago a tool shop having a large number of flat gages to manufacture experienced trouble in making the promised deliveries. On investigation it was found that a large majority of the gages after having been ground had to be "closed in" and reground. As the gages were made of machine steel carbonized, it meant annealing and rehardening after the closing-in operation, which necessitated a lot of extra work. It frequently happened, especially with longer gages, that they were ground two or three times before a satisfactory job could be produced, the nature of the trouble invariably being that one edge of the ground-gage opening was found to be over size while the other was much under the size measured when the gage had been ground and was still held by clamps to the gage-grinding-machine table. Gages with comparatively small gage openings seldom if ever gave any trouble; therefore the method of clamping or rather the difficulty of clamping a long, thin gage properly had to be overcome.

All flat gages made of machine steel will distort to some extent after carbonizing and hardening, no matter how carefully these operations are done. This distortion, however, is not sufficient in the majority of cases to warrant the expense of surface grinding the sides; but the ordinary clamping methods of a gage-grinding machine will always find the uneven surface of the gages, thus resulting in more or less faulty work. To overcome this and to enable a semiskilled grinding-machine operator to hold slightly distorted gages for grinding with absolute certainty of no change taking place after releasing the clamps, a holding fixture was designed.

It consists of a cast-iron base plate *A*, Fig. 1, having three T-slots *B* milled on its upper face, as shown. The under side of the base has two milled slots *C* extending about 2 in. from each end for accommodating locating keys. These slots are parallel to the front of the fixture. The series of ⅜-in. holes *D* are so located that any two holes in corresponding rows on either side of the central T-slot are equidistant from the front edge of the fixture base.

Fig. 2 shows the construction of the clamps, of which there are three, all identical, one for each T-slot in the baseplate. The lower half *A* is a free sliding fit in the T-slot; the upper half *B* has two lugs *C* which straddle the single lug *E* on the lower half of the clamp, being pivoted on a pin driven through holes in the lugs. After the pivot pin is in place the two halves of the clamp are set up parallel and the holes *F* and *G* are drilled and reamed in line with each other. Into these holes are driven special bullet-pointed plugs made of vulcanized fiber of the form *H*, Fig. 2. The clamp-screw hole *I* is drilled and tapped with a tap to suit the size of clamp. Distance *J* is to be longer than *K* in order that the clamp screw will come clear of the lower half of clamp.

The clamp-screw assembly is shown at *L*, Fig. 2, and consists of the screw *M*, cross-knob *N* and the thrust collar *O*. This thrust collar is made a loose fit on the



FIGS. 1 TO 3. FLAT GAGE-HOLDING FIXTURE

Fig. 1—Baseplate of fixture. Fig. 2—Clamp and clamp screw. Fig. 3—Fixture in use.

reduced end of the screw, being held in place by a small pin *P*, which engages a groove cut near the end of the reduced portion of the screw. The two halves of the clamp, the clamping screws and the thrust collars are cyanided before assembly.

The sketch in Fig. 3 shows how this clamping fixture works. Gage *A* is located square with the grinding wheel *B* with the gage opening overhanging the front edge of the fixture by two shoulder pins *C* in suitable holes. Then the three clamps are slid forward into position, as shown, and the clamping screws tightened. As the thrust collars at the ends of the clamp screws bear directly on the bottom of the T-slots the action of tightening the clamp screws serves two purposes, that of clamping the gage between the ball points of the fiber plugs in each half of the clamp and at the same time locking the latter in the T-slots of the base-plate. A three-point bearing is thus provided, eliminating all possibility of distortion of the gage, no matter how uneven the surfaces clamped.

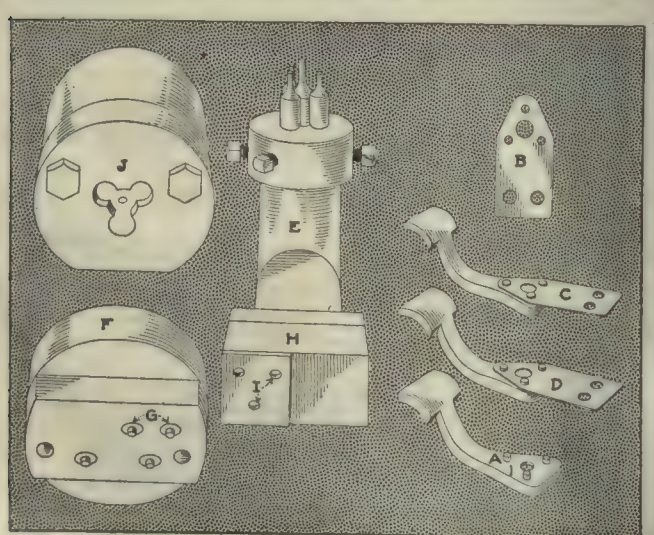
This fixture was originally made for the regular gage-grinding machine, but so successful was the performance of it that another one was constructed to fit the shop tool-grinding-machine table. All trouble from rejected gages through faulty clamping disappeared after the installation of these fixtures.

Method of Forming Substitutes for Copper Rivets

By J. V. Hunter

The contact fingers used on street-car controllers are copper drop-forgings to which phosphor-bronze springs are riveted to hold them in contact with the rotary member which is operated by the controller handle.

One of the fingers is shown at *A* in the illustration and a spring at *B*. When assembled they appear as at *C*. It has been the practice when making these parts



DIES FOR FORMING RIVETS AND RIVETING SPRINGS ON CONTROLLER FINGERS

in the shops of the Chicago surface lines to drill holes in the fingers and rivet the phosphor-bronze springs in place with copper rivets.

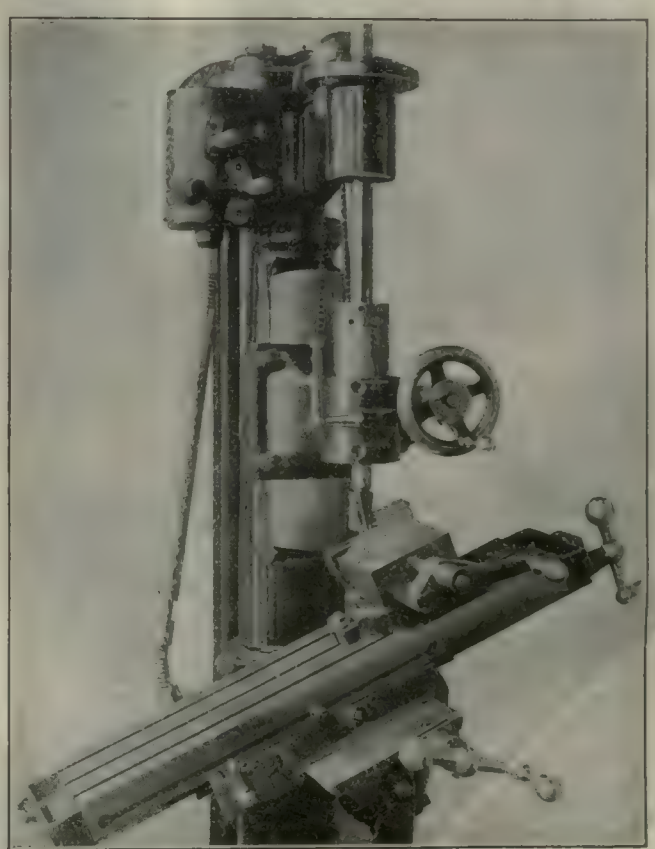
An improvement on this method has been devised in which the holes in the finger are dispensed with and three projections raised from the metal itself by what is practically an embossing or drawing operation. These projections may be seen on the piece *A*, while at *D* is a finger on which the phosphor-bronze spring has been placed but has not been riveted. The completed operation is shown at *C*.

At *E* may be seen the punch that is used for piercing the copper forging. The central punch is longer than the others in order that it may pierce the center hole while the others are drawing the slug projections that form the rivets. The die *F* is used for riveting the work, the small projections *G* fitting into the recesses on the under side of the finger to prevent the metal from being pushed back when struck by the heading punch *H* which is used in connection with this die. The end *I* of this punch straightens and flattens the forging before the spring is put into place to give it a true bearing surface, while the other end is used for riveting. *J* is the piercing and drawing die used in connection with the punch *E* for raising the projections which serve as rivets.

Flexible Couplings Instead of Universal Joints

By George Allen

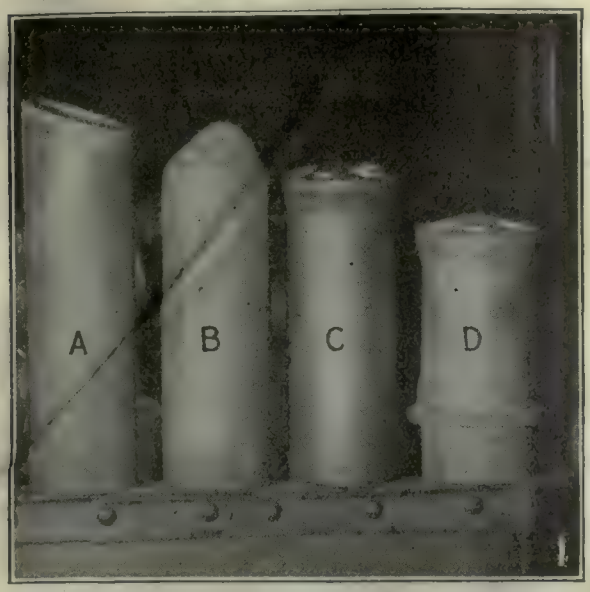
The ordinary universal joint is apt to be more or less jerky in its action. In order to obtain a smooth feeding action on our Knight milling and drilling machine we put on Karge flexible shaft couplings in place



MACHINE FITTED WITH FLEXIBLE INSTEAD OF UNIVERSAL JOINT COUPLINGS

of the regular universal joints, as shown in the illustration. This gives not only a smooth even feed but it "cushions" enough to preserve the cutter in case of a catch anywhere.

AUTOMOTIVE CONSTRUCTION





FIGS. 1 AND 2. STAGES OF LIBERTY-MOTOR CYLINDER FORGING AND FIRST FORGING OPERATION

Operations on the Liberty Motor Cylinders

By FRED H. COLVIN

I. Method of Forging

It is hard to realize just how much the development of the method of forging Liberty motor cylinders shown herewith had to do with making possible the production which was obtained. There can, however, be no doubt as to the great saving in both material and labor over the usual method of making steel cylinders from the solid billet. The operation methods shown should be applicable in other work of a similar nature.

THE use of steel cylinders in airplane motors involves either boring the cylinder from a solid billet, as is done in the Gnome and similar motors, or reducing the weight of the blank, as well as the amount of boring necessary, by some sort of a piercing operation.

When the Liberty motor became an assured fact the cylinders for these motors presented a very serious problem, and the engineering organization of the Ford Motor Co. got busy to devise a way by which cylinders could be made with comparatively thin walls so as to reduce the amount of boring and also to reduce the amount of metal used and to increase the output of the forging plant.

After much experimenting the engineers in charge devised the method illustrated herewith which was so successful that, after they demonstrated the reliability of these forgings, as well as their other advantages, the Ford company received contracts for making the cylinder forgings of all Liberty motors, regardless of who machined them. The tubing used had a wall about ½ in. thick, and the first operation was to bevel the upper end as shown at *A*, Fig. 1. The beveled end was then heated, placed in a die as shown in Fig. 2,

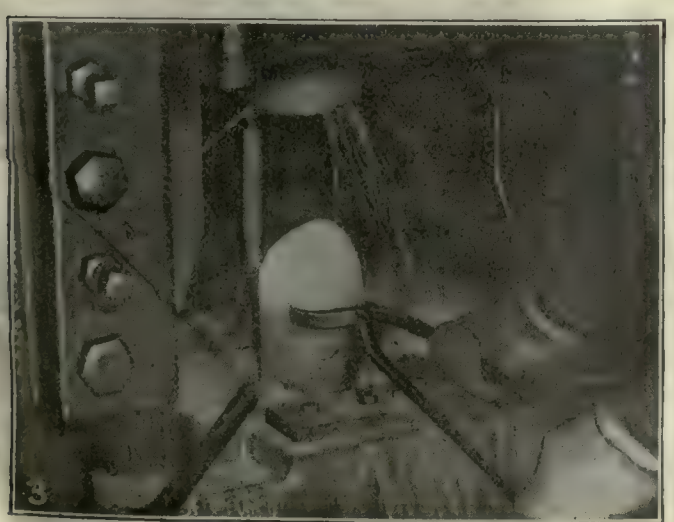


FIG. 3. REMOVING FORGING FROM THE DIE

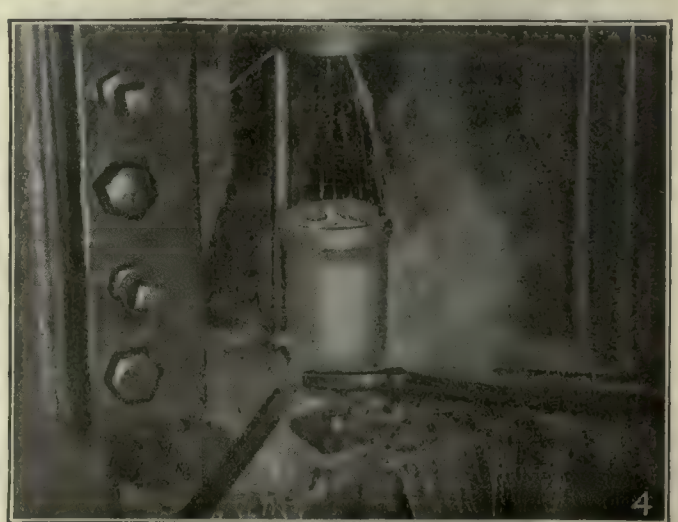


FIG. 4. AFTER THE SECOND FORGING

AUTOMOTIVE CONSTRUCTION

and the punch brought down, which formed the end as in *B*, Fig. 1, also shown in Fig. 3, where a forging is being removed from the die after the first operation.

The next operation closes the end of the cylinder to its proper position as shown at *C*, and as also indicated in Fig. 4, where another forging is being removed from the press. Referring again to *B*, Fig. 1, it will be noticed that the upper end of the tube has not been completely closed, and that a small opening remains. No attempt is made to weld this opening. It will be observed that this hole comes on one side of the cylinder head, this being accomplished by the bevel on the end of the tube before the first operation. The bevel throws the opening over to the other side as shown, and when the head is finally closed down to its proper position the location of the opening is such that it is bored out for one of the valve openings. For this reason no attempt is made to weld it, as it does not matter whether it is welded or not.



FIG. 5. UPSETTING THE FLANGES



FIG. 6. THE FINISHED FORGING

The final operation is the upsetting of the cylinder flange in the bulldozer shown in Fig. 5, a somewhat better view of this being seen in Fig. 6, where the forging is being held in a pair of tongs while being removed from the bulldozer to the pile of forgings. This is also shown at *D*, Fig. 1. Before flanging, the lower end of the cylinder is dipped in water to stiffen it against flow at this point. This method of forging cylinders is interesting and had much to do with making possible the rapid production of the Liberty motor.

British Tractor Trials

In view of the altered European position it has been decided to hold extensive tractor trials in Great Britain during next September. This decision has been reached by the Agricultural Machinery Committee of the Society of Motor Manufacturers and Traders, and has been communicated to firms likely to be interested, with the request for their opinion.

European Motor Truck Sales Field

C. A. Vales, truck sales manager of the Locomobile Co. of America speaking at the N. A. C. C. Truck Convention was pointing toward the difficulties which have to be encountered by the industry in selling trucks to Europe. Concerning post-war conditions, he said: "They are making more plans today to go after the truck business of the world than we are in the United States. Their factories now have the equipment, trained men and quantity producton methods to turn out the trucks. Sales of American trucks in Europe will not only be difficult but European manufacturers will compete with us in foreign markets. The tool equipment of European factories is now five times what it was in 1914. England can produce enough trucks and tractors for all Great Britain and her colonies. France, before the war, made trucks by hand, aided by machine tools, but no real standardization. Now all is changed; progressive assembling and interchangeability is the rule. The French have taken advantage of every improvement found in the American cars and trucks during the war."

Pan-American Aeronautic Convention

The second Pan-American Aeronautic Convention and Exposition will be held during the month of May at Atlantic City, in a form of a big outdoor aviation event, under the auspices of the Aëro Club of America, the Aerial League and the Pan-American Aeronautic Federation. The governing idea of the Exposition is to prove that both the airplane and dirigible can be used for business as well as for pleasure. The program includes three flying contests with prizes of $1000 each, awarded by the will of the late Samuel H. Valentine and by Glenn H. Curtiss. The representatives of railroads, express, steamship and other transportation organizations of America and of all the allied and Latin-American countries have been invited to participate and attend the various discussions.

The Cleveland Universal and Plain Milling Machines

THE Cleveland No. 1 universal and plain milling machines are, of the constant-speed driven type, with 16 changes of feed and of spindle speed. Speeds and feeds are controlled by two levers of the ball-joint type, similar to an automobile gear shift. Changes for both speeds and feeds are obtained through sliding gears which are automatically lubricated. The square overarm and many other improvements are features. Fig. 1 shows the universal type and Fig. 2 the plain type. The detailed specifications will be seen under the illustrations. The column is a complete box section of rigid construction. The base and column are cast in one piece to form a heavy ribbed semi-steel casting, tied together with vertical and horizontal walls. The only openings in the column are those necessary for the change gear levers on the front, the pulley drive housing in the rear, and the cutter lubricant tank on the left side of the machine. Opening of the column is absolutely unnecessary. All the interior parts are lubricated automatically, and all adjustments on the bearings are made from the outside. The dovetail knee slide extends upward to the overarm, thus affording ample surface for clamping the attachments. The depth of the column has been carefully determined in order to place the spindle and the shaft bearings in proper relation to each other to secure maximum rigidity. The dovetail slide on the face of the column is so constructed that the heaviest pressure is not taken at the thinnest section of the column wall as is often the case in milling-machine construction. The horizontal wall separating the lubricating oil reservoir from that of the cutter cooling compound is designed to give added rigidity to the column. The lower surface of the base is finished to give it a firm foundation, while the contour of the upper surface is pan-shaped with depth enough to catch oil and chips, thus keeping the surroundings clean.

The knee of the machine is strong enough to bear any weight which may be placed on it while doing the heaviest work and has an improved dovetail slide. The bearing of the saddle is not on the thinnest section of the dovetail slide, but on the flat, wide surface, the narrow slide acting as a guide only. There is no bearing in the top of the dovetail guide which eliminates the possibility of marring due to the operator laying tools on the top of the knee. The bearing of the knee on the column is carried well above the top of the saddle slide, thus giving the knee a longer bearing on the column and reducing the bearing pressure to a minimum. The feed box, as well as the knee, is entirely closed to eliminate the possibility of chips getting into the feed mechanism in the knee. The elevating screw is large in diameter and in one piece. By the use of the post the telescopic screw has been eliminated, the post acting as a support to the elevating nut and as a guide in the knee. The screw is operated with a double bevel gear, hand-feed and power-feed being independent of each other.

Designers of machine tools find the table and saddle of a milling machine a most trying problem, as these parts are subject to tortional as well as bending moments; therefore these must be designed to resist continuous strains and also maintain their original accuracy. The table of the Cleveland milling machine

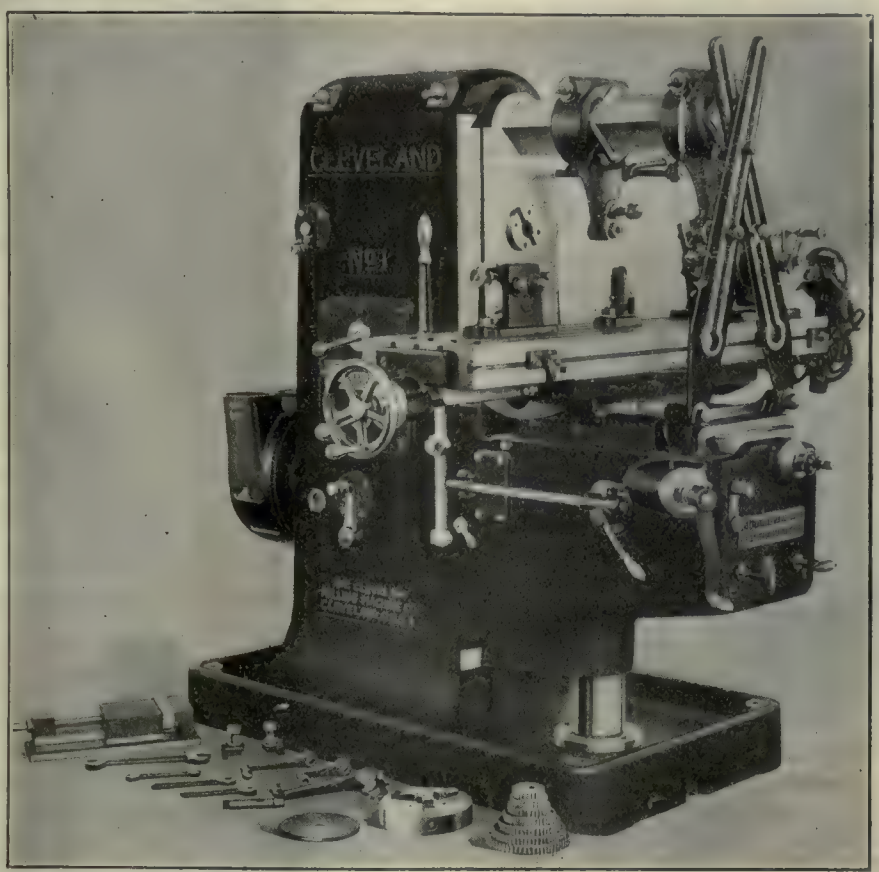


FIG. 1. NO. 1 CLEVELAND UNIVERSAL MILLING MACHINE

Table: Working surface, 44 in. x 12 in.; size overall, 44 in. x 12 in.; T-slots, three ⅝ in.; swivel, right or left, 50°. Range: Longitudinal, 22 in.; cross, 8 in.; vertical, 15 in. Full width, face of column to braces, 23 in. Index centers: Swing, 10 in.; take-in length, 24 in. Spindle, chrome nickel steel: Diameter of nose, 4½ in.; diameter of bolt circle, 3¾ in.; thread bolts, evenly divided, 4⅞ in. x 12 thread; keyway, ⅝ in. x ⅝ in.; diameter front bearing, 2⅝ in.; size taper B. & S., No. 10; size hole through, ⅝ in.; spindle speeds, number, 16; spindle speeds, range, 13 to 350 r.p.m. Overarm square, 3½ in.; distance to center of arbor, 6¼ in. Arbor supports, 2. Drive: Pulley, size, 12 in. x 3½ in.; pulley, speed, 400 r.p.m.; motor recommended, 5 hp. Feed: Number of feeds, 16; feeds, 0.312 in. to 14.37 in. per min. Miscellaneous: Vise (swivel base) jaws, 4 in. wide, 1¼ in. deep; with steel jaws, open, 4 in.; without steel jaws, 4⅝ in.; universal 3-jaw chuck, 6 in.; floor space, 70 in. x 60 in. Equipment: Spiral dividing centers, center rest, index plates, change gears, index chart, 3-jaw universal chuck, swivel-base vise, oil pump for lubricating cutters, and necessary wrenches. Shipping data: Net weight, 4600 lb.; domestic weight, 5100 lb.; foreign shipping weight, 5500 lb.

is machined all over to insure proper alignment, as a table finished on one side only may warp. The bearings on the table are at the top of the saddle instead of at the bottom of the dovetail, a method which secures a large bearing surface and locates the bearings at a greater distance apart. These bearings are automatically lubricated by rollers in the saddle. The bearing on the saddle is also at its widest portion, and both saddle and table bearings are taken up with long taper gibs which are provided with adjusting screws at both ends.

The square overarm provides positive alignment of the arbors and maximum rigidity of the arm pendants.

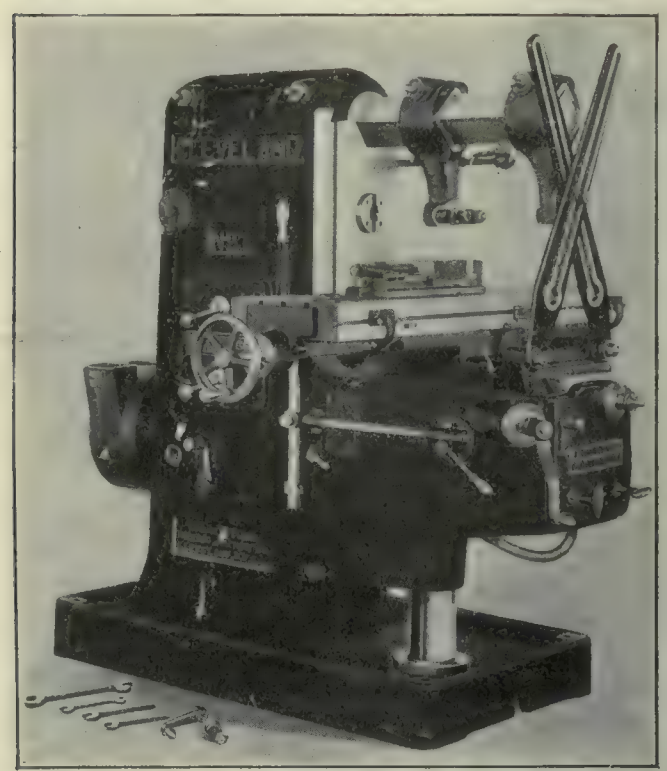


FIG. 2. NO. 1 CLEVELAND PLAIN MILLING MACHINE

Table: Working surface, 44 in. x 12 in.; size overall, 44 in. x 12 in.; T-slots, three $\frac{5}{8}$ in. Range: Longitudinal, 22 in.; cross, 8 in.; vertical, 15 in. Full width, face of column to braces, 23 in. Spindle, chrome nickel steel: Diameter of nose, $4\frac{1}{4}$ in.; diameter of bolt circle, $3\frac{1}{4}$ in.; thread bolts, four evenly divided, $\frac{7}{8}$ in. x 12 thread; keyway, $\frac{5}{8}$ in. x $\frac{5}{8}$ in. deep; diameter front bearing, $2\frac{3}{4}$ in.; size of taper hole B. & S., No. 10; hole through spindle, $\frac{9}{16}$ in.; spindle speeds, number, 16; spindle speeds, range, 13 to 350 r.p.m. Overarm square, $3\frac{1}{2}$ sq.; distance to center of arbor, $6\frac{1}{8}$ in. Arbor supports, 2. Drive: Pulley size, 12 in. x $3\frac{1}{4}$ in.; pulley, speed, 400 r.p.m.; motor recommended, 5 hp. Feed: Number of feeds, 16; feeds in inches per minute, 0.312 in to 14.37 in. Miscellaneous: Vise, jaws, 4 in. wide, $1\frac{1}{4}$ in. deep; with steel jaws, open, 4 in.; without steel jaws, $4\frac{3}{4}$ in.; floor space, 70 in. x 60 in. Equipment: Plain vise, belt guard, oil pump for lubricating cutters, and necessary wrenches. Shipping data: Net weight, 4200 lb.; domestic weight, 4700 lb.; foreign shipping weight, 5200 lb.

If the arbor is not exactly true and the arm pendant is brought into place by the operator to accommodate the arbor, the arbor is working in a cramped condition and may break. With the square overarm it is impossible for the operator to place the arbor supports on the overarm and on the arbor in any other way than exactly in line. This simple principle of the square overarm eliminates the possibility of any revolving movement of the pendant and also gives greater bearing surface in column and pendants.

The flanged spindle does away with the overhang on the end of the spindle as well as the trouble caused by cutters screwing fast on the spindle, and also allows the cutter to be run in either direction. On the flanged spindle is a face keyway, inserted into which are hardened steel jaws for driving arbors and face mills. It is unnecessary to remove these at any time to change from a face mill to an arbor, as the driving is done by the hardened steel jaws. The strain is, therefore, taken off the taper hole. The spindle is provided with a positive lock that enables the operator to loosen the arbor nuts with the least possible difficulty, and is also provided with a handwheel to revolve the spindle, a feature which the operator will find convenient on boring jobs and other milling operations. The spindle lock cannot be operated while the machine is running, nor can the main driving clutch be thrown in while the spindle lock is in this position. The bearings on both the front and rear of the spindle are taken up with a nut on the outside at the back end of the spindle.

All bearings in the column and knee are thoroughly covered with lubricant while the machine is running, thus relieving the operator entirely of the responsibility of oiling the most important parts of the machine and eliminating the necessity of oil holes in any of these parts. This system is highly efficient and is entirely automatic. The reservoir containing the oil has to be filled but twice during the year. As high-speed steel cutters are used almost entirely on milling machines, a reservoir of ample size for cutter cooling lubricant has been provided. This medium is circulated by a centrifugal pump which operates only when the spindle does; therefore, it is not necessary to shut off the cutter lubricant when changing work or when stopping the machine to measure it. This pump operates automatically when the clutch is thrown in and the machine is running, and supplies a heavy flood of coolant at low pressure to avoid splashing and permit its use in the most ample quantities.

Speed and Feed Arrangement

The speed and feed arrangements are both of the sliding-gear type. All 16 changes of speeds, as well as feeds, are made by two levers located conveniently for the operator. The spindle speeds are 16 in number, in either direction, and the feeds are 16 in number, in either direction also, so that this machine will efficiently handle all classes of cutters. Speeds and feeds being in geometrical ratio, the correct changes of speed and feed for the work to be done can be made without trouble. All gears and shafts in the drive, as well as the feed, are of hardened steel, automatically lubricated, running in bronze bearings, and protected against breakage by a safety device.

Power is transmitted through a constant-speed drive pulley and the machine is so designed that it requires no loose gears on the spindle. All shifting of gears is done on the secondary shafts below the spindle. The objectionable feature of the tumbler in both the main drive and feed works has been eliminated. The starting and stopping lever can be operated from both sides of the machine and the single pulley running at constant speed for the drive is protected by a belt guard, so constructed that it can be adjusted to any angle and any added extensions. The spindle reverse is contained within the machine so that right- or left-hand cutters can be used, and all the speeds, feeds and other driving mechanism are self-contained within the machine. All power gear shafts between the drive shaft and the main spindle are in a vertical line to eliminate all side thrusts in the column casting. These machines are manufactured by the Cleveland Milling Machine Co., Cleveland, Ohio.

∴ EDITORIAL ∴

The Shelves of the World Are Bare

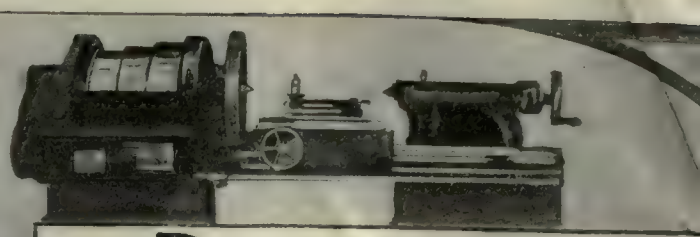
FOR fifty-two months billions of dollars' worth of created value in commodities were fed into the insatiable maw of war. For fifty-two months the world decreased or totally stopped the production of homes, schools, office buildings, public works of vital necessity, railroad facilities and machinery for peace-time uses, farm implements and fertilizers, and many other commodities, in order to build ships and cannon, make ammunition and uniforms. and to release our men for the business of war.

Now the shelves of the world are bare, and the demand for peace-time goods is earth-wide. Here is opportunity! An opportunity that requires for its capture neither more nor less than any opportunity requires, and that is work, energy, industry, confidence, unity and co-operation.

Opportunity is here! Let us get busy, and with the same faith and confidence and unity of action that helped to win the war, let us fill those shelves, and empty them, and fill them and empty them again!

With the quickening of exchange and production to replace the destruction and waste of war, prosperity will come to all. With confidence and faith in our ability and in each other and working *all together,* let us face these empty shelves.





Putting the Industry where

By Fred H. Colvin, Principal Associat

In pointing out the failure of the builders of industry, it is the desire of the author to make machines realize the part they play in the world's be suitable rewarded. The industry should opportunities for advancement and for service

WE HAVE known for years—and if we had not known, the war would have taught us—that the machine-tool industry is at the foundation of modern civilization. Without it we would have none of the thousands of things we count as necessary to modern comfort. We would use the scythe instead of the mowing machine, the sail instead of the turbine, and the horse instead of the locomotive, the automobile or the airplane. There would be no telephone, or telegraph, or wireless. Instead of the electric light we would still be using the pine knot or the tallow dip. The forked stick would still be used for plowing, and the locomotive and the modern stove would be unknown.

We have known all this, and yet we have not made it real enough to use this knowledge to place the machine-tool industry in the position to which it is justly entitled. We have bent our energines, both of brain and brawn, to devise and construct machines by which others have made fortunes, for the users of machine tools have secured rewards far in excess of those of their builders.

The machine-tool industry designed and built all the machinery which made possible large sewing machine and typewriter plants, the bicycle manufacturing establishments and the new automobile shops, which are now such an important part of our national industries. Yet in every case, the machine-tool industry has suffered because all of the other industries have in turn offered inducements which made it extremely difficult to keep the men interested in the machine-tool shop.

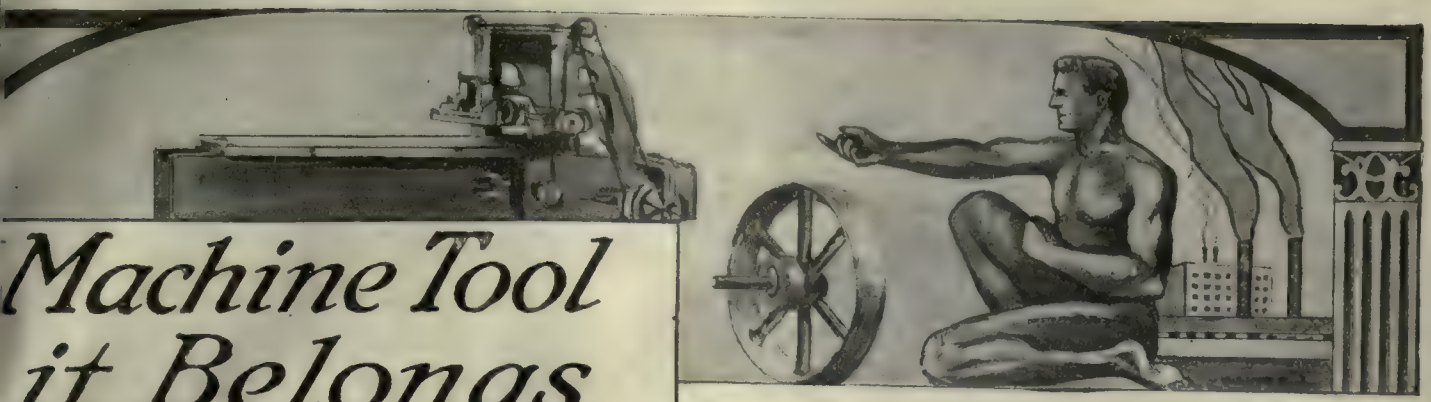
Stealing Young Men For Other Industries

The automobile shops, for example, were able to offer half-trained apprentices several times the wages paid at that time, and as a consequence robbed the machine-tool shops of many young men on whom considerable time and money had been spent in training. In the same way automobile shops secured the services of more men and superintendents of great value to the machine-tool industry. This not only resulted in much mental wear and tear on the part of managers of machine-tool shops, but we have no means of knowing to what an extent it discouraged highly desirable young men from entering the machine-tool field.

There is every reason why the machine-tool industry should have the pick of men of all ages. It can be made so attractive that every young man who is mechanically inclined will first think of the machine-tool building shop in his vicinity as the desirable place for his mechanical activities. There is a romantic side to the building of the machines which are at the bottom of all our civilization, that can be emphasized and made to appeal to all that is best in the mechanic of real ability. To have a part in the manufacture of the machines which make all other machines possible and without which they could not exist should be made to play its part in attracting the most desirable mechanics to this select branch of the machine-building industry. The higher the class of men we attract to the machine-tool industry the more highly perfected machines will be designed and built, and the result of this will be felt in every other industry. The fact that it must of necessity remain small in comparison with other branches of the machine-building trade, makes it possible to select the highest type of men in its various branches, assuming, of course, that all the conditions in connection with the industry are as good, or a trifle better, than can be found elsewhere. The very fact that it is so comparatively small in numbers makes this a task which should not be difficult considering the types of men to be found in these machine-tool lines. Shop conditions, wages and the matter of personal relation to the men and the management, are three of the questions to be considered, and there is every reason why these can be made more attractive in the machine-tool industry than in any other.

Wages Must Be Attractive

It has unfortunately been true that in many cases the mechanic in the machine-tool shop has received a lower wage than the man using the lathe or planing machine which he built, and this in spite of the fact that the machine-tool building machinist was a highly skilled mechanic while the other man often became only an operator of that particular machine. The reason for this is not hard to find, but that does not help the situation in the least, nor make the real machinist any more contented with his lot. The fact that the machine-tool industry is the oldest in the country, and that the concerns who use machine tools on a new product charge enough for their product to enable high wages to be paid, explains in most cases the reason for the difference, but it can hardly be expected to satisfy the man who has spent years in becoming a skilled machinist. Nor is there any reason why it should.



Machine Tool it Belongs

Editor, American Machinist

machine tools to appreciate their importance to both the builders and the users of these important progress and to demand that the services rendered attract the best designers and mechanics and should be at least equal to those in other lines.

Perhaps the fundamental reason for all this is that the average machine-tool builder has underrated the value of his product to his customer and to the country at large. He has in most cases built up a business from a small beginning, which made it necessary for him to consider every dollar's expenditure most carefully, and in too many cases has not realized the changes which have taken place in the industry at large.

The automobile manufacturer, on the other hand, has, with the exception of a few pioneers, started business with ample capital and has charged enough for his products to enable him to make wages attractive to all classes of men he desires to employ. Automobile builders spend money lavishly for machine tools and other equipment, because this cost can be distributed over a large output and can very soon be charged off the books, although he may continue its use for years.

The Real Value of Machine Tools

Machine-tool builders have overlooked the fact that, as the basic industry, they produce machines for a single profit on which the user profits day after day and year after year. The value of the machines to the consumer has not been computed on the basis of so many cents per pound as is too often attempted. Its real value is on the amount of product per dollar of expense for machines and labor which he receives from it. A special machine costing, perhaps, $2000, and on which the machine-tool builder makes 20%, or $400, if he is lucky, may save the purchaser the entire price of the machine every three months, and in so doing enables him to pay an unskilled operator double the wage received by the man whose skill was necessary in producing this special machine itself. This is not advocating a radical or unwarranted advance in prices, but is only for a careful consideration of the facts as they exist today. The machine-tool industry does not as a rule pay as high wages or salaries as some other lines of the machine-building industry, and until it does it cannot hope to attract the best men, which are so necessary for its future development.

In normal times the machine-tool industry employs less than 50,000 people out of a total population of 110,000,000 in this country. Even assuming that it paid 10% higher wages and salaries than other machine industries, this cannot affect but 50,000 workers out of our entire population. The fear that it may antagonize customers is practically groundless, as is the idea that it will disrupt the labor conditions of the entire country. It is well known that the Wall St. district in New York pays decidedly more money for its stenographers and clerical help than any other part of the city. It also has the custom of paying substantial bonuses in addition, but this by no means disrupts the employment situation in the entire City of New York. It simply gives the employers of this district the pick of the personnel, and, after all its positions are filled, applicants must go to the other business houses for positions.

Exactly the same condition applies in the machine-tool industry, for, like the Wall St. district, it is comparatively small and can in the same way secure the best talent to be obtained in the country. There is no reason why the machine-tool industry should not be at the head of manufacturing so far as the talents of its personnel and the attractiveness of the industry is concerned. But this is not all. There is another and equally important side to the question—that of securing the personal interest of all concerned.

The Best Industry in the World

The artist or sculptor is an enthusiast over his creations, yet they give pleasure to but a few. Machine tools make civilization possible and not only give comforts but even the bare necessities to the whole world. It is not only our right but our duty to be enthusiastic over our product and to pass this enthusiasm down the line; to make the men in the shop see and feel that they are engaged in the best industry in the world. What is more, we can make it the best in every sense of the word.

Can anyone doubt the advantage of having a shop filled with interested and enthusiastic men? We have all deplored the lack of interest in the modern shop, but we have overlooked the fact that we have in many cases taken the interest out of the work and made the man a part of his machine. We must put back the old interest or create new ones. Those of us who came up through the shop took a keen interest in the planning of the work and in the devising of new ways for carrying it out. How many of us would be interested in doing one operation, hour after hour, day after day and month after month, especially when everything was planned out for us in the office and we had no voice in it?

We are not going back to the old methods; specialization has come to stay, and it is up to us to devise other ways of securing and maintaining the interest of the men. That it can be done is clearly shown by the brilliant example of Robert B. Wolf, the General Manager of the Spanish River Pulp and Paper Co., who under two quite different circumstances has aroused the interest of his men in their work to such an extent as to increase both the quantity and quality of their output to an amazing extent. Mr. Wolf has proved very clearly that other incentives may be fully as effective as money, although the results he secures justifies a high rate of remuneration. All should read and study Mr. Wolf's paper on "Non-Financial Incentives" before the A. S. M. E. in December, 1918.

There are several points to be considered which may be summed up as follows:

1. Realize the importance of the machine-tool industry and make your enthusiasm in it extend to every man in the shop.

2. Demand a substantial return which will enable the machine-tool shop to be made as attractive as any other.

3. Institute real training not only for boys and new men but for all who are not highly efficient. This will do more to increase output and reduce costs than we realize.

4. Have a real personnel director who will not only direct employment but who can devise ways and means for securing and maintaining a live interest on the part of the men. Among the methods which might be employed for doing this are:

a. A real house or employees' paper for large shops. This is a difficult problem but is an excellent means of contact when rightly done.

b. Bulletins in each department giving news of interest to the shop, such as where machines are going, showing perhaps one of these lathes in use in South Africa or Australia or on a battleship.

c. Talks to the men to enthuse them on the product just as we do to the salesmen; to let them know the good points of the machines they are making. Opportunities for the men to inspect the machines and to have their families see what kind of work they do. A good workman takes pride in showing his mother, his sweetheart or his wife and family the kind of work he does; to point out the necessity of his making the spindle within a half-thousandth of the exact size. This increases his own pride in his work and also raises him in the eyes of his family who too often only think of him as a man who gets his clothes and hands very dirty every day. This increase of respect for his skill adds to his self-respect and is reflected in many ways.

d. Devise every way possible to make the men feel that they are really a part of the family. While this is the work of the director of personnel, he cannot do it alone. He must have the coöperation of every official to insure the proper relations with the men in the shop. Some shops are beginning to post bulletins showing the cost of the plant, of the equipment, the value of the output, and the cost of material and of labor in percentage of the total, and other facts which impress the men not only with the fact that they are part of a good-sized business but that the firm is not afraid to be frank with them and has nothing to hide.

These are merely suggestions and can be modified and improved to suit local conditions. The main thing and the necessary thing is to get the men interested in the plant and in their work. It is not any easy task to undo the work of the past 10 to 20 years in this respect. But it can be done and it will well repay the effort. The benefit becomes evident in better relations, in more contented workmen, in lower labor turnover, in increased output and last but not least, in better citizens for the community and the country.

Indispensability

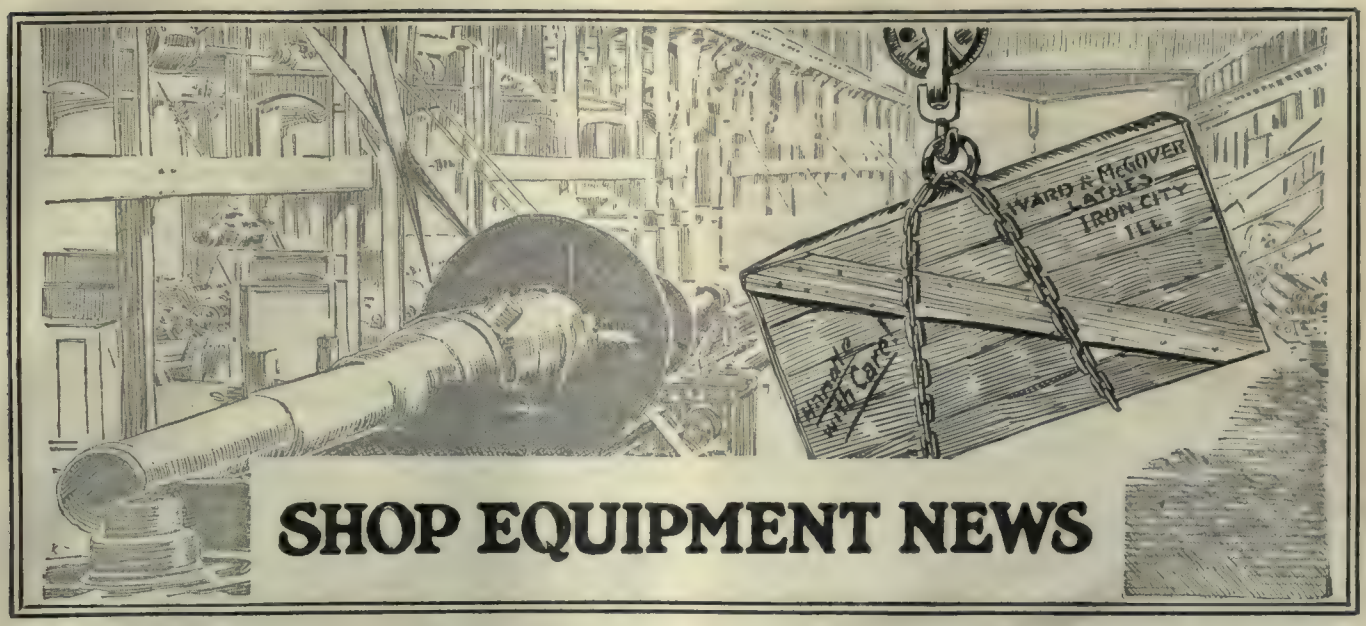
By A. Ellsworth

Mr. R. Blondin writing under the title "Indispensability" on page 520 of *American Machinist* presents an excellent example of the shortsighted manager who vents the irascibility, which is the perfectly natural concomitant of the always unexpected and unwelcome results of his own lack of judgment, upon the head of a poor "Andy" who, until the very moment he was fired for it, had evidently never been told that he was doing wrong. I don't know Andy by that name but I am acquainted with other members of his family. He generally has a swelled nut and firmly believes in his own indispensability, but this is rather the fault of his early employers than his own failing. He possesses, however, a faculty that under proper supervision is capable of rendering service of infinite value; a faculty which a wise manager should recognize and develop, at the same time endeavoring to repress features that might, under some circumstances, becomes undesirable.

Probably not one of these early "managers" knew enough about "man" to recognize the value of Andy's gift or the danger that is its inevitable companion. Not one of them had ever taken Andy to one side and kindly explained to him that while a good memory is a very valuable possession, there are certain adjuncts in the way of records, indices, filing systems, etc., with which it can be advantageously supplemented; that while he, Andy, knew a whale of a lot about the business there still remained numerous points which he had overlooked, and if he wanted to become really indispensable he should cop off some of them while the copping was good and set them down on paper so that he could transfer them to his wonderful memory at his convenience.

Instead of that the manager had probably bawled him out somewhat after the manner of the one noted by Mr. Blondin, and Andy quite naturally assumed that "the old man was jealous because somebody knew more about the business than he did"—indeed, he or some one of his brothers has told me just that. In my opinion the manager who fired Andy because he had a good memory and didn't know there was anything bad about it because he had never been told, is exactly on a par with the machinist who would smash up a perfectly good lathe because he couldn't see how he was going to turn a square shaft on it.

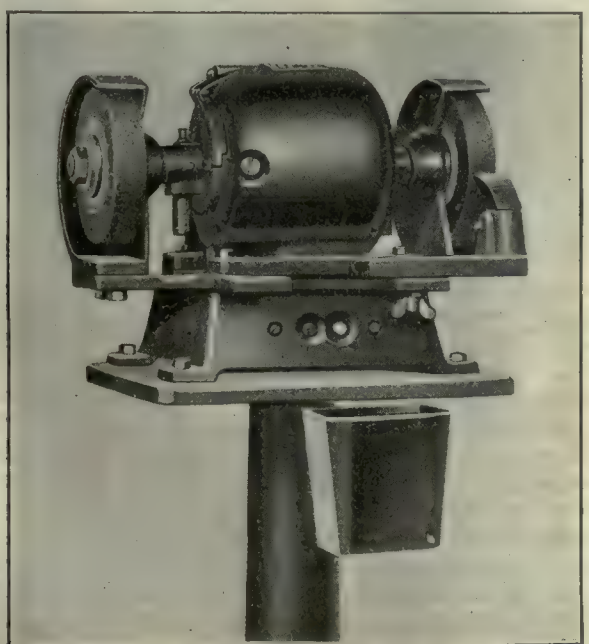
There have been marvelous developments in our field, not to mention others, in the past few years; there have been disastrous failures and disappointments as well. I wonder if, after all, some of us who are or have been directors of the activities of men should own up, would we not find that the credit for a considerable amount of this progress belongs to the man in the overalls or apron and at least a little of the trouble, a few of the mistakes, are chargable against us?



SHOP EQUIPMENT NEWS

Janette Electric Grinding Stand

The Janette Manufacturing Co., 617-625 West Jackson Boulevard, Chicago, Ill., and 149 Broadway, New York, is now marketing the electric grinding stand shown in the illustration, this being furnished in either bench or floor type as desired. The machines are identical except for the pedestal and can be furnished



JANETTE BENCH-TYPE GRINDING STAND
Floor type: Height, 46 in.; width, 14 in.; weight, 105 lb.; wheels, ¾ in. x 5 in. Bench type: Height, 10 in.; width, 14 in.; weight, 55 lb.; wheels, ¾ in. x 5 in.

for either 110 or 220 volts, d.c., or for 30, 50 or 60 cycles, 110 or 220 volts, a.c. The d.c. motors are of the compound-wound type, of 3500 r.p.m. and ¼ hp. Electrical connection can be made to any lamp socket, an extension cord being furnished, and a switch being located in the base of the grinder. This is of the push-button type and can be seen in the base of the machine. The spindles are made from 90-point carbon steel, hardened and ground to size, and the bearings of hard-drawn phosphorus bronze SKF ball bearings being furnished at an extra charge. Lubrication is of the grease and wick-pattern type with an oil cup on the upper bearing, and the bearing arranged with the oil return holes leading back into the oil well. Wheel mountings are of standard dimensions, and the flange washers are machined all over in order to insure balance. The inner flanges are keyed to the spindle and can be removed if desired. The wheel guards protect the grinding wheels for two-thirds of their circumference. Adjustable grinding rests are furnished and held in position by means of a clamping bolt and a wing nut in a T-slot. They may be removed if desired. The water pot at the front of the machine is detachable.

Arcwell Welding Apparatus for Alternating Current

The Arcwell Corporation, 42 Broadway, New York, has just placed on the market a new electric welding machine built for operation on alternating current of any specified voltage or frequency. It differs from the company's standard machine in that it is being put

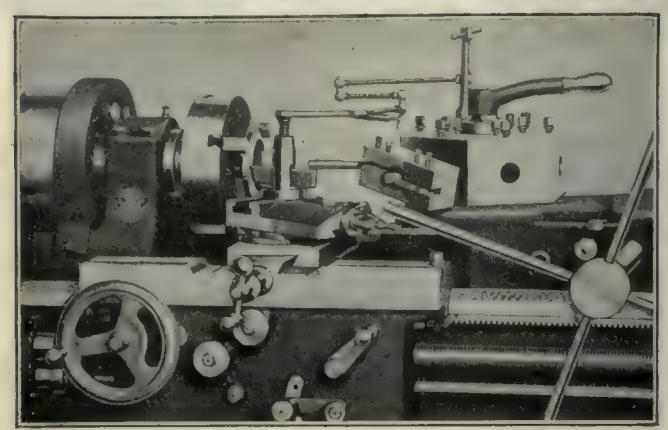


ALTERNATING-CURRENT WELDING APPARATUS

out expressly for the use of smaller machine shops and garages, its capacity not being sufficient to take care of heavy work on a basis of speed. It will do any work that can be done by the larger machines, but the work cannot be performed as rapidly, the machine being intended expressly for use by concerns who have only occasional welding jobs to perform. The machine weighs approximately 200 lb., and being mounted on casters, it can be moved from one job to another.

Cincinnati Turret Attachment

The illustration shows a new attachment that has just been placed on the market by the Cincinnati Lathe and Tool Co., 3207-3211 North St., Oakley, Cincinnati, Ohio, for use in connection with its regular line of engine lathes. This hexagonal turret is designed for various



CINCINNATI HEXAGON TURRENT ATTACHMENT

types of work and is shown machining a bevel gear 5½ in. in diameter, 1¼ in. wide, having a 1⅝-in. x 1½-in. hub, through which a ¾-in. hole is bored. The lathe shown is supplied with a pan, a pump, a turret toolholder in compound rest, double back gears and hexagonal turret on the bed, together with power-feed.

"Hack" High-Power Universal Relieving Machine

The "Hack" high-power, universal relieving machine shown in the illustration is one of the latest products of the American Machine Tool Engineering Works, Chicago, Ill. The machine is made with capacities of 6, 10 and 16 in., and is said to be of very massive and rigid construction. The pan and legs are cast integral, the pan being close to the floor in order to allow plenty of room for the proper width and breadth of bed. There are two sets of ways, one upon which the head and tailstocks are aligned, while the second set is used in connection with the first set to carry the carriage. The second set of ways is also used for aligning the side-relieving attachment. The lead screw is located in the center of the rear set of ways upon which the carriage slides, which is said to permit the movement of the carriage with a degree of positiveness that is not obtainable when the power is transmitted through the apron.

The headstock is said to contain a number of new features, some of which are radical in design. A countershaft forms a part of the head itself, and power is transmitted to the machine directly from the line-shaft or jackshaft through one forward and one reverse belt direct to the machine without idlers of any sort. Power is transmitted from the pulleys to the head through a Carlisle-Johnson friction clutch, and to the spindle through spur gearing, the majority of which is made from 60-point-carbon-steel forgings. Speed changes are obtained by sliding gears controlled by five levers, the gearing running in a bath of oil to insure proper lubrication. The spindle and other bearings are equipped with sight feed oil cups. On the end of the machine are two quadrants, one for change gears for such leads as may be desired up to approximately 6 in., the other controlling the cam-driving shaft that extends along the back of the

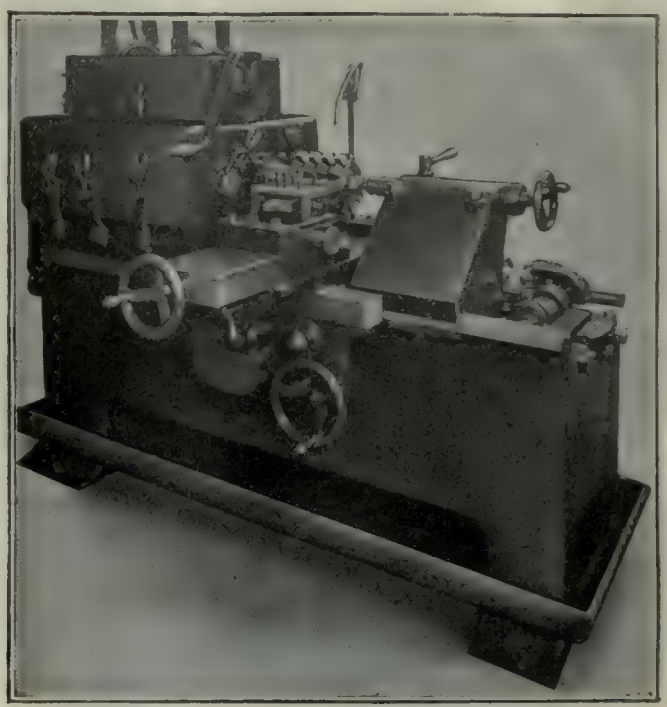


FIG. 1. "HACK" UNIVERSAL RELIEVING MACHINE

Specifications for 16-in. machine: Weight, 8000 lb.; capacity, cutters 14 in. in dia. up to 16 in. long; speeds 9; diametrical pitch of teeth in bull gears, 4.

machine, these gears regulating the number of gashes or the spiral of the gash, as the case may be. The rear cam-driving shaft is driven through change gears from a stud in the rear of the headstock, obtaining its power directly from the bull gear. This shaft rotates at six times the spindle speed. By means of a ratchet dog arrangement on the camshaft, the cam movement is suspended while reversing the spindle, and is ready to again take up its motion at the proper point when the spindle again moves forward. This cam-driving shaft extends the entire length of the machine, being supported in bearings at both ends, and from it is taken the power to rotate the cam arbor-driving mechanism at the back of the carriage, as well as the driving mechanism for the side-relieving cam, the adjustments being such that it is possible to time the two cams together or otherwise, as may be desired. The side-relieving attachment causes the entire carriage to move while the regular relieving attachment causes the cross-slide only to move.

The carriage cross-slide and compound-slide are heavy, and the tool block, which in itself is a horizontal slide, is made of cast steel, carbonized, hardened

and ground on all working surfaces. This construction permits the use of micrometer adjustments when required, and a device is incorporated to lock the block securely in place. A safety device inside of the headstock prevents the carriage from being run against the headstock by accident; a second safety device in the tailstock prevents the carriage running into the tailstock.

The tailstock is made in one piece, and when taper relieving is handled, a special spindle with offset center can be furnished. The carriage is moved by a rack and pinion mechanism within the apron. A special mechanism is incorporated to provide for concave relieving, the purpose of which is to relieve the barrel effect resulting in all hobs and cutters being more than several inches in width as the result of hardening. The arrangement of this feature is such that where three hobs or more of a kind are placed upon the relieving arbor, each hob can be produced with a concave contour corresponding exactly in curvature and depth with that of the other hob in that set, or where only one large hob is being made, the curvature can be distributed in its proper form over the entire length of the long hob. This curvature is controlled entirely from the mechanism within the apron, and can be readily adjusted and set for any desired length or depth of curvature. The machine is completely universal, capable of relieving spiral or straight gashed hobs, plain form cutters, counterbores, either left or right-hand, as well as internal relieving on special tools when such may be required.

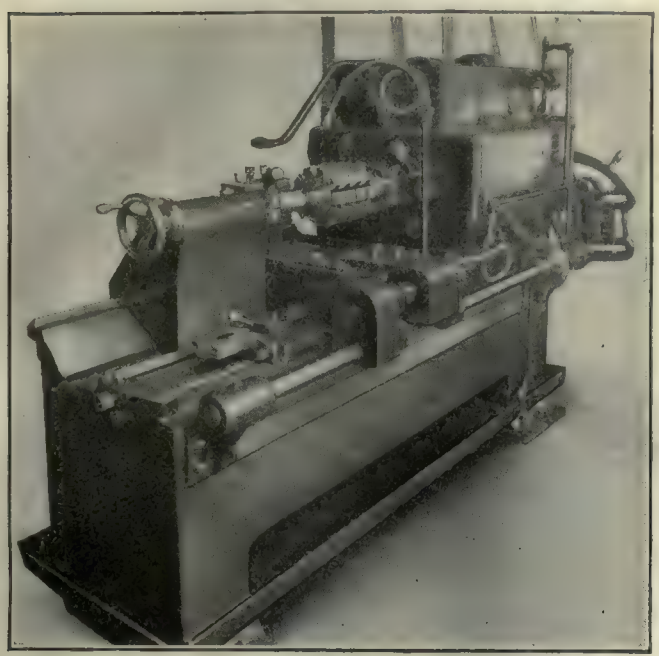
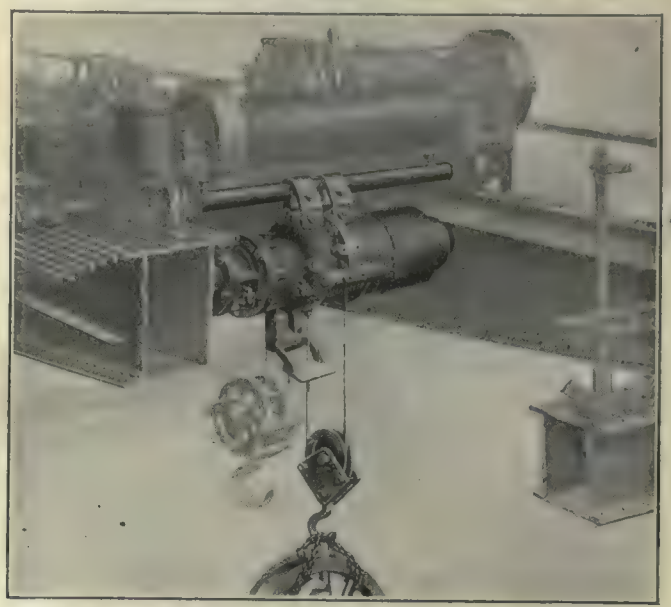


FIG. 2. REAR VIEW OF "HACK" UNIVERSAL RELIEVING MACHINE

Payne Auxiliary Electric Hoist

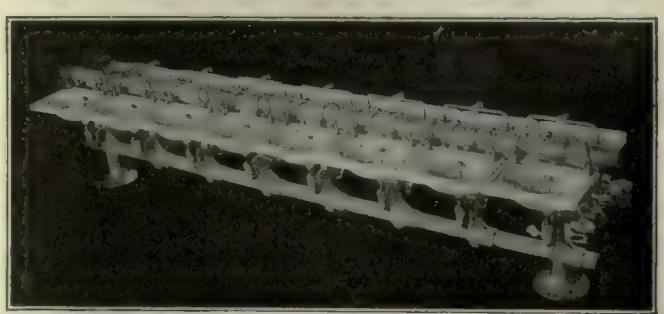
One of the disadvantages of the ordinary overhead traveling crane for heavy work is that a large percentage of the work handled is often far below the capacity of the crane with the result that the handling speed of the light pieces is rather low. To obviate this difficulty the N. B. Payne Co., 25 Church St., New York, is now marketing an auxiliary electric hoist that is intended to be installed on the regular traveling crane for handling light loads. The hoist is made up to suit the various requirements of the customer and is made ordinarily in sizes up to 5 tons, but special hoists of larger size can be furnished if desired. The hoist does not take any more headroom than the regular crane, does not require an extra trolley, and does not shorten the travel of the trolley on the bridge, nor does it interfere with the accessibility of the main hoist. The advantages claimed are, saving in power over the use of the main hoist and the saving in time required in handling of light loads. The hoist is hung from an axle on the hoist carriage and is equipped with oilless lubricated bearings.



PAYNE AUXILIARY HOIST INSTALLED ON AN ELECTRIC TRAVELING CRANE

Manufacturing Equipment Factory Washbowls

The Manufacturing Equipment and Engineering Co., Framingham, Mass., is now manufacturing the type of factory washbowls shown in the illustration. These have a common water-supply, common waste, and common vent, each bowl being trapped and vented. The bowls are furnished in either single or double batteries as the user may desire. The illustration shows a double battery, there being a row on each side of the middle line of the structure. Each pair of bowls is trapped into an upright pipe which in turn connects vertically with the common vent that is formed by the large pipe

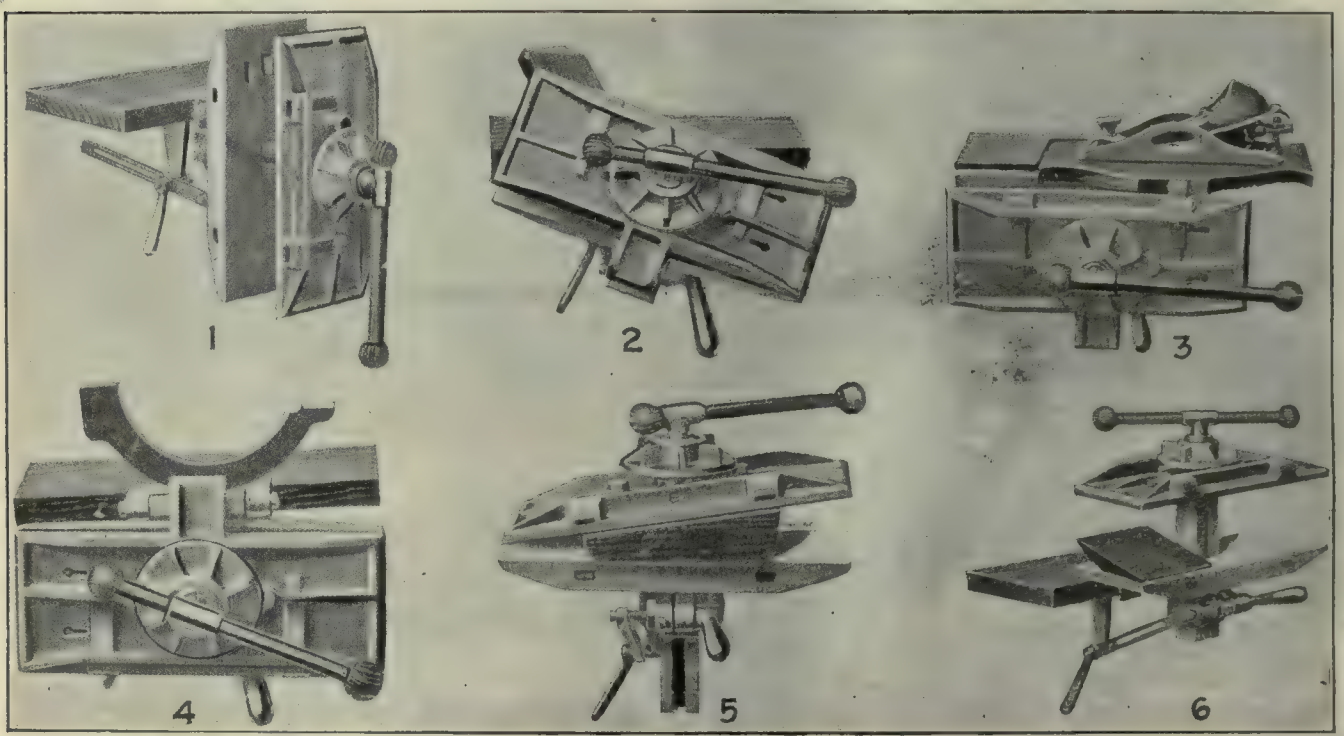


FACTORY WASHBOWLS

at the top of the apparatus, this being supported by hollow cast-iron pipes extending from the top to the bottom flanged feet of the apparatus. There is a hollow upright casting for each set of two bowls, each casting being one piece with two traps, one on each side, extending below the waste or bottom pipe in the apparatus. The bowls shown are piped for hot and cold water but can be furnished for water of one temperature if desired. They are made with plain cast iron, galvanized iron, or vitrified porcelain enameled bowls, and are shipped completely assembled.

The "Victor" Vise

A new woodworkers' vise called the "Victor" has been placed on the market by the Victor Tool Co., Waynesboro, Penn. The jaws are 7 x 18 in. with an opening of 15 in. and are smoothly finished for fine woodworking. It is claimed that the vise will hold all classes of work in almost any conceivable position. The figures illustrate some of the various uses to which the vise may be put. It has only 15 parts and its weight is 75 lb.

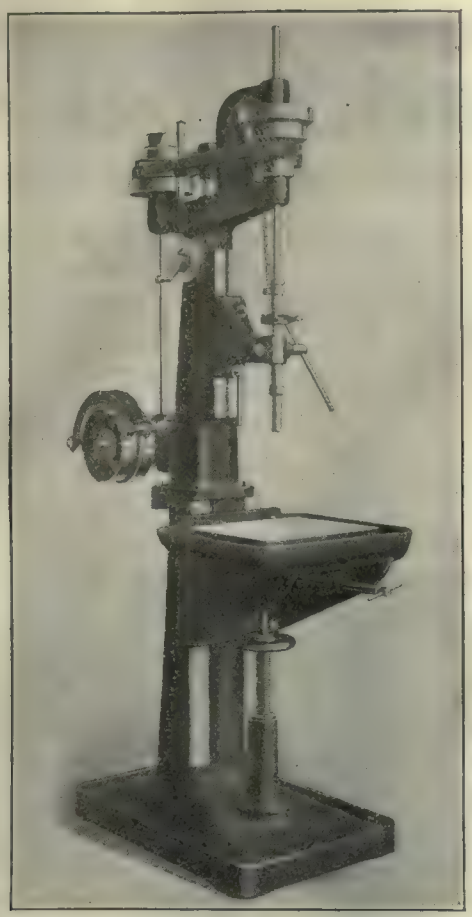


THE "VICTOR" VISE

Fig. 1—Jaws swung into position for work above the bench level and rack bar for raising or lowering jaws. Fig. 2—One of the many positions in which the vise can be set for handling work of irregular shape. Fig. 3—Holding-dogs in position for grasping thin pieces for surface working. Fig. 4—Jaws for holding metal parts. Fig. 5—Setting for wedge-shaped pieces showing adjusting collar and clamping lever for revolving jaws. Fig. 6—Upright position with tilt or angle jaw in place.

Edlund Sensitive Drilling Machine

The illustration shows one of a line of sensitive drilling machines that are being manufactured in the 1-, 2-, 3-, 4-, 5- and 6-spindle type by the Edlund Machinery Co., Inc., Cortland, N. Y. These machines are of the quick-change, high-speed, ball-bearing sensitive type, the operator making all speed changes from the working position without stopping the machine. Ten ball bearings are used for each spindle and it is said that the bearings used throughout are extra large. The power is transmitted from the drive pulley through two bevel gears and a vertical shaft to the rear four-step cone pulley, from which it is carried by a straight endless belt to the forward cone driving the spindle, this arrangement eliminating the quarter-turn belt. The spindle is of high-carbon steel, turned and ground to size and is provided with two driving splines on opposite sides. The spindle and cone pulleys are balanced to eliminate vibration. An oil reservoir at the top of the spindle contains sufficient oil so that frequent oiling is unnecessary. The spindle is counterbalanced by a weight located inside of the column and has a covered or protected ball thrust bearing at the lower end of the sleeve. The spindle sleeve is made of cast iron reamed inside and ground on the outside and is fitted at the upper end with an adjustment to take up end wear. The sleeve has a spline in full length to assure accurate meshing between the rack and pinion teeth, and two adjusting screws are provided to take up the wear in this bearing. A locking screw is also provided which locks the adjusting screws and keeps the spline in position. A stop collar and an adjustable depth screw are also provided. The sliding arm has a 9-in. bearing on the column and is fastened by a bolt at the upper end. This bolt is so adjusted that the raising and lowering of the arm is accomplished by simply unlocking the clamping lever on the lower end of the arm, making the use of a wrench unnecessary. The bevel driving gears are contained in the gear case and are made of steel, packhardened with planed teeth. The splash system of lubrication is used and provision is made to take up the wear in the ball bearings. Four speed changes are provided, the belt running in a shifting device operated by a rack and pinion controlled by a handle at the left side of the machine within reach of the operator. An adjustable idler is provided to take



EDLUND SINGLE-SPINDLE SENSITIVE DRILLING MACHINE

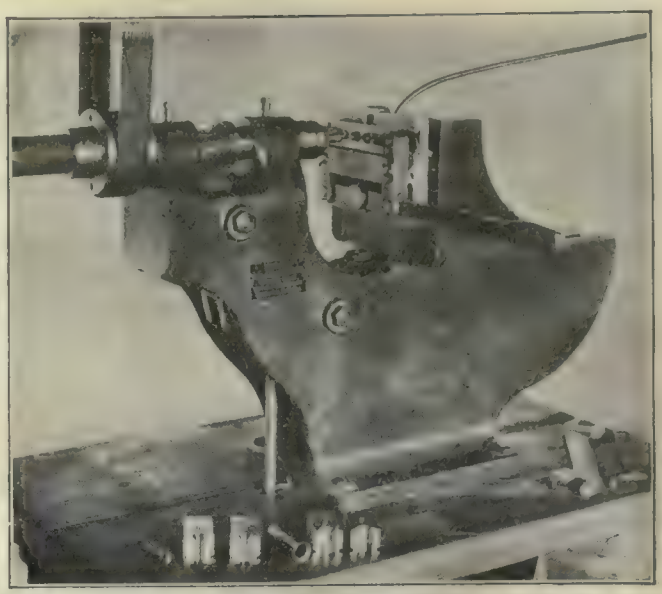
Maximum distance from spindle nose to table, 32¼ in.; diameter of spindle, ⅞ in.; diameter of spindle nose, 1 5/16 in.; taper in spindle, Morse No. 2; vertical traverse of spindle, 6½ in.; vertical traverse of arm, 9½ in.; vertical traverse of table, 16½ in.; diameter of drive pulley, 9 in.; width of drive belt, 1¾ in.; width of spindle belt, 1¼ in.; face of column to center of spindle, 8 in.; distance between spindles on multiple machine, 9½ in.; working surface of table, 14⅝ in. x 16, 25½, 35, 44½, 54, or 63½ in. in length for one to six spindle machines respectively; outside dimensions of table, 19 in. x 21, 30½, 40, 49½, 59, or 68½ in. for one to six spindle machines respectively; weight, 825, 1100, 1400, 1850, 2400, or 2750 lb. for one to six spindle machines respectively.

up slack in the belt. The table is supported by a telescopic screw, the back part being raised to protect the ways on the base. The chip groove is said to be extra large and is so designed that it can be easily cleaned. The gib is fitted with two adjusting screws and two locking screws to insure ease in adjusting.

Grant Tube-End Spinning Machine

The Grant Manufacturing and Machine Co., Bridgeport, Conn., has developed and placed on the market a spinning machine, intended for flanging the ends of brass and copper tubing, such as used for connecting brass or copper pipes to carbureters and oilers for automobiles, aircraft engines, motor boats, or copper coils for hot-water heaters. A quick hand-clamping arrangement is attached to the table or knee of the machine for holding the tubing securely in position while the flanging is being done. This clamping arranging is so designed that the gripping jaws can be removed and others inserted for different sizes of tubing.

The machine will flange tubing from the smallest up to and including 1 in. in diameter, and the output from the machine will depend entirely upon the operator, as it requires only a second's time to form a perfect flange on the end of the tubing.



GRANT TUBE-END SPINNING MACHINE

It will also be noted from the illustration shown that the machine is mounted upon a bench in a horizontal position which will permit the flanging of pipes of any desired length. The flanging is done through the medium of a foot treadle thus leaving the operator's hands free to manipulate the work. The machines are arranged for either belt or motor drive.

National Metal Trade Program

Following is the program for the 21st annual convention of the National Metal Trades Association to be held at the Hotel Astor, New York, during the week of Apr. 21: Monday, the executive committee and local branch secretaries will hold their meetings, followed by a dinner in the evening to the administrative council and secretaries. On Tuesday, the secretaries will continue their meeting and the administrative council will also meet. Tuesday evening, the alumni dinner will be held and on Wednesday the convention will take place. The program in the morning will consist of the reports of president, John W. O'Leary; treasurer, F. C. Caldwell; commissioner, John D. Hibbard, and secretary, Homer D. Sayre, followed by the report of the Committee on Industrial Education presented by the chairman, Harold C. Smith, Illinois Tool Works, Chicago. Harry F. Atwood will then address the convention on "Our Constitution, the Antidote for Bolshevism." At the Wednesday afternoon session, Frank Jewel Raymond, East Orange, N. J., will speak on "The Dust in Industry," Hon. William C. Redfield on "Work of the Department of Commerce and Its Relation to Business," Howard Coonley on "Problems of Shipbuilding," Rev. Dr. Charles Audrey Eaton on "Industrial Democracy." The convention banquet will take place in the evening, John W. O'Leary, president, presiding. The speaker of the evening will be Senator James E. Watson of Indiana. The Thursday morning session will be devoted to an open and informal discussion, by the members present, of recent important industrial tendencies. This will be followed by the reports of the convention committees, report of the nominating committee, and the election and installation of officers for the coming year. The incoming administrative council will meet immediately following the adjournment of the convention.



Sparks from the

The High Shipping Rates

Representatives of American Manufacturers in Europe Subject to Loss Through Ocean Freight Rates Recently Announced

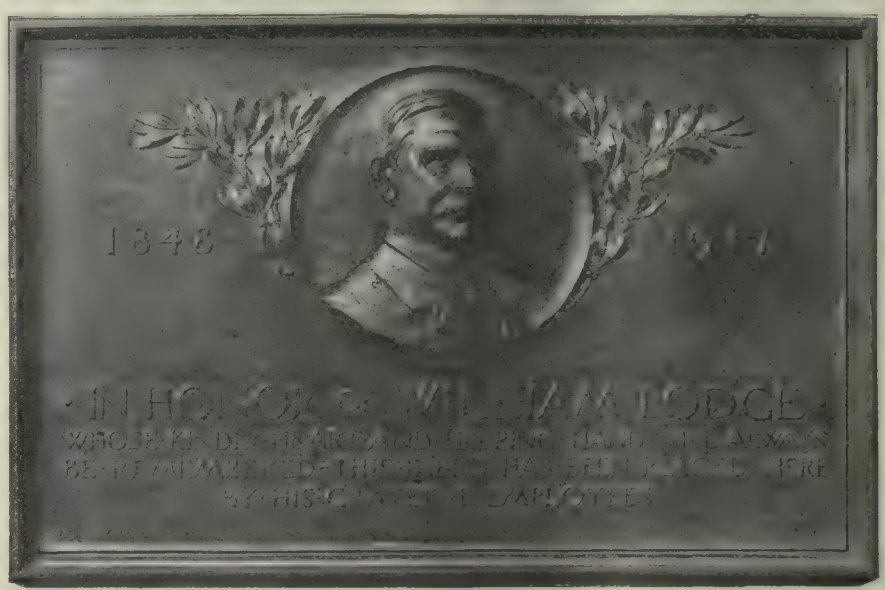
A well known and responsible correspondent of the *American Machinist* writes: Foreign dealers representing American manufacturers are being subjected to material losses in handling our goods, due to the fact that they have sold goods over there at delivered prices, basing their selling price calculations on the ocean freight rates recently announced by the Shipping Board. When it comes to a showdown, large quantities of our products have been shipped at exceedingly high rates as compared with the announced rates of the Shipping Board, for two reasons, first—because the goods had to be delivered in a certain time under penalty; second — because the Shipping Board, by not giving the service at the reduced rates, forced these agents to accept shipments at comparatively exceedingly high rates. Where the agents are compelled to deliver at the high rate, due to terms of sale they have lost money pushing American goods, instead of making money, with the result that many large contracts for American goods have been cancelled.

While in New York, I saw one cable from Spain which cancelled every American order, stating clearly that they could not accept further shipments with the overhead charges as they exist today, this cable indicating that their competitors were securing material at much lower delivered cost price.

This situation is detrimental in the extreme, when it comes to the foreign dealer wishing to place stock orders for future sale. Naturally, no sane dealer is going to stock up on American goods and have a large percentage of his profit tied up in ocean costs. If the shipping rates were more reasonable and staple, he would be more inclined to take a chance, principally for the sake of having goods for prompt delivery, and consequently make quick sales, but under present conditions, stock orders are hard to get.

It is needless to point out what the Shipping Board rates to Belgium and Spain have been within the last few weeks, and what the other lines have done to the rates when they realized that the Shipping Board was not giving the service.

While this situation has greatly affected the writer's own foreign business, yet he is only one of the many in this district who are crying for relief, and in the name of the foreign traders I ask that the powerful influence of the National Foreign Trade Council be brought to bear to bring about relief, not in a year, but immediately, if we are to keep our businesses going, keep labor employed and give jobs to the boys who have come back home and who expect us to take care of them.



Bronze tablet recently placed on the wall in the Lodge & Shipley Machine Tool Company's shop by the employees, as a memorial to the late William Lodge. Clement J. Burnham a sculptor of Cincinnati, is the designer

* * *

Employment of Discharged Soldiers as Civilian Guards

The attention of all concerned is called to the desirability of employing discharged soldiers as civilian guards at places where such guards are required. The civil service regulations permit of preference being given in such cases to the employment of men who have had service in the United States Army. The training which these men have had was such as to especially fit them for the work of guards and watchmen. The employment of civilian guards, as that of other civilian employees of the Ordnance Department, should be taken up with the Civil Service Commission.

Wants Bids for Mail-Carrying Aeroplanes

The Post Office Department has issued specifications for multimotored aeroplanes of strictly commercial type and particularly adapted for the carrying of mails. The specifications are general in their terms and are designed to allow aeroplane builders the widest latitude of design and construction to give the performance required for carrying the mails. They are the result of a symposium of views of pilots, aeroplane mechanics, aeronautical engineers and practical aeroplane builders on what should be the qualifications of a practical commercial plane. Consideration will be given to a plane of two, three or more motors connected on one shaft or set in the wings or central fuselage, or both, and carrying a minimum of 1500 lb. of mail. While the needs of the department are preferably for a plane carrying a ton or 1½ tons of mail, consideration will be given to a machine of 1500 lb. What the department especially desires is an aeroplane of the lowest possible landing speed, whether that speed is structurally inherent in the machine or accomplished through mechanical devices, and a cruising speed of between 90 and 100 miles an hour, with a top speed of between 110 and 115 miles and a cruising radius of about 6 hours with normal load prescribed. A serviceable ceiling of at least 15,000 ft. is wanted. If the planes are built around Liberty or Hispano-Suiza engines the department will furnish the motors.

According to the views of postal officials, a plane with a mail-carrying capacity of 1½ tons, with a six-hour cruising radius, should not exceed 100 ft. in the wing span. Engines if placed in the wing must be made accessible with safety to the mechanic for minor repairs in the air. Each engine is to be equipped with independent and, as far as possible, fuel gas, oil and ignition systems to minimize engine failure.

The bids are to be opened on June 2, and it is expected that planes will be ready for delivery within six months.

World's Industrial Forge

By E.C.Porter
News Editor

American Business Preparing Constructive Suggestions

A preliminary outline of the program for the Seventh Annual Meeting of the Chamber of Commerce of the United States, to be held at St. Louis, Apr. 28 to May 1, as given out at the chamber's headquarters here, discloses that American business is preparing to offer constructive suggestions with respect to the future relations between government and business.

Having the advantage of experience gained during the war and during a five months' period of industrial readjustment, business men now are in position to give advice from their point of view on some of the important questions that are agitating the country. The meeting, coming as it does on the eve of an extraordinary session of Congress, furnishes an opportunity for obtaining a composite opinion from the business world on many things that Congress will take up.

Will Call Meeting of Chairmen

A very large part of the things that Congress will be called on to consider touch industry and business at some point. At St. Louis the representatives of business from 48 states attending the meeting will express their views not only as to policies and principles but will advance detailed programs as to carrying them out.

A call has been sent out asking a meeting at the time of the convention of the Advisory Council of American Industries, made up of chairmen of the nearly 400 War Service Committees named under the chamber's direction during the war to represent industry before the Government. These men will come together for the first time since the first of the year, when they met at New York to form an organization to perpetuate the War Service Committees.

Subjects for Discussion

The subjects for discussion and action at St. Louis include the disposition and operation of the country's railroads and merchant marine; proposed revision of anti-trust legislation; the future of public utilities; foreign relations and foreign trade, agriculture; industrial production; domestic distribution; waterways and highways; industrial relations; international commercial arbitration; finance and the Victory Loan.

The chamber is obtaining the services of the best authorities of the country as speakers and those who will deliver addresses include Carter Glass, Secretary of the Treasury; William C. Redfield, Secretary of Commerce; Edward N. Hurley, Chairman of the Shipping Board; Walker D. Hines, Director of Railroad Transportation; Senator Albert S. Cummins; George Ed. Smith, President of the Manufacturers' Export Association, and others.

The French government is sending to the meeting as speaker a special representative in the person of Maurice Casenave, formerly French Minister to Brazil, who comes to the United States as Director General of the French Services in this country, succeeding the French High Commission.

* * *

Export Association to Give Luncheon in Chicago

Following the custom set last year in Cincinnati, the American Manufacturers' Export Association will tender a luncheon to all members who may be in attendance at the National Foreign Trade Convention in Chicago, Apr. 24-26, 1919.

The luncheon will be held in Congress Hotel at 12:30 p.m. on Friday, Apr. 25th, and will precede the Group Session on "Direct Selling" which begins at 12:30 p.m. in the same hotel under the association's auspices. The speakers will be Alba Johnson, president Baldwin Locomotive Works; E. M. Herr, president, Westinghouse Electric and Manufacturing Co.; C. E. Jennings, president C. E. Jennings Co.; W. B. Campbell, president, Perkins, Campbell Co., and Mr. George Ed. Smith, president Royal Typewriter Company, all former presidents of the association.

* * *

Outlines the Machinery Needed By French Nation

The agricultural machinery needed by France, according to George Ford, head of the Red Cross reconstruction work in Paris, is of the following varieties: 81,000 plows, 56,000 cultivators, 30,000 mowing machines, 115,000 farm wagons, 88,000 harrows, 50,000 rollers, 48,000 hoes, 36,000 seed drills, 13,000 fertilizers, 16,000 beet extractors, 21,000 winnowing machines, 18,000 horse-drawn rakes, 32,000 reapers and binders, and 53,000 root cutters, besides other farm implements.

* * *

Uncle Sam's Resources

From United States reports we learn that we represent but 6 per cent. of the world's population and own but 7 per cent. of the world's land. But we produce 70 per cent. of the world's copper, 66 per cent. of the oil, 75 per cent. of the corn, 60 per cent. of the cotton, 33 per cent. of the silver, 52 per cent. of the coal, 40 per cent. of the iron and steel, 20 per cent. of the gold, 85 per cent. of the automobiles, 25 per cent. of the wheat and we operate 40 per cent. of the world's railroads.

Federal Association Formed

Its Purpose Is To Facilitate and Hasten The Liquidation of Cancelled War Contracts.

The Federal Liquidating Association, with local offices at 84 State St., Boston, Mass., Room B, has been formed to facilitate and hasten the liquidation of reduced, suspended, terminated or cancelled war contracts.

Thousands of contracts have been suspended by the Government in the midst of performance. Commercial contracts were never broken in such sudden and wholesale fashion and there is little precedent to guide. The tedious processes of litigation must be avoided. Settlement must be made just as the contracts were made—by newly negotiated settlement agreements fair to the Government and to the contractor. But this negotiation cannot proceed with the freedom of private business. The governmental administrative organization is bewildering, especially in respect of this new and unprecedented situation and procedure.

The advantage of system and coöperation in dealing with the Government was very clearly and thoroughly shown by the Association of Manufacturers of War Material formed early in January to insure the enactment of a satisfactory bill validating informal war contracts and to obtain a modification of the ruling of the War Department affecting settlements with sub-contractors. Both objects were attained. Considering the highly important legislation that failed of passage, the value of the work done by the association in its first task cannot be minimized.

The essential idea of the new plan is to secure the services of the best men for the work and to create an organization which will make their services available to all contractors.

Brig. Gen. Hugh S. Johnson will be president of the association. He was the man selected by General Crowder to prepare a plan for the execution of the draft. The plan was revolutionary, but its simplicity and practicability so commended itself to the War Department that it was adopted and General Crowder entrusted General Johnson with its execution.

The greatest difficulty in presenting claims lies in estimation and accounting. Figures must be set up in precise accord with departmental regulations. Col. R. H. Montgomery will have charge of the accounting for the association. Colonel Montgomery was General Johnson's chief adviser in accounting matters during the war. He was a member of the War Department Board of Appraisal and of the War Industries Board Price Fixing Committee. In these capacities he had a wide contact with

American business and industry and with all departments of the Government, and his work has been highly commended by all who are familiar with it.

The new association has also secured the services of a carefully selected personnel, familiar through service in governmental bureaus with departmental methods and with war contracts.

The officers of the Association of Manufacturers of War Material who share in the direction of the affairs of the new association are W. S. and C. J. Symington and H. H. Dinneen. These gentlemen add to an intimate association with all departmental agencies, acquired during the war and in the work of the old association, a wide experience in governmental contracts. They bring to the direction of the association the practical point of view of interested contractors. W. S. Symington is general counsel for the Symington interests. He was chairman of the Association of Manufacturers of War Material. C. J. Symington is president of the Symington Machine Corporation and has been the Washington representative of the Symington interests during the war. As such, he derived an intimate knowledge of departmental geography, methods and precedure, and of war contracts. Mr. Dinneen has been actively engaged in Washington in a legal capacity during the war. As secretary of the old association of the 75-mm. Shell Association, the American Fuse Maufacturers' Association, and the Committee on Boosters and Adapters, he has acquired familiarity and contact with the departments and has gained wide acquaintance among manufacturers.

Organization and Plan of the Association

The Washington headquarters of the association will keep in close contact with the various governmental departments, presenting the contractors' point of view generally, and, more particularly, attending to the expedition and presentation of all matters pending before any departmental agency.

Local offices have been established at each of the following points selected because of their convenience to local boards of adjustment: New York, Boston, Philadelphia, Baltimore, Rochester, Bridgeport, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago and St. Louis. Each local office has a business manager, an accounting and engineering department, a local counsel and a competent office personnel.

The plan of having accounting, engineering and legal departments is not intended to restrict the use by contractors of their own experts in these lines. The personnel of the association for this service is selected with special reference to its instruction and competency for departmental work.

The system of local and Washington offices enables business to be rapidly despatched and energetically followed from its inception locally, through the Washington departmental organization, to final settlement and payment.

R. W. Belcher Gets New Position

R. W. Belcher, who has been especially identified with civil service work, has been elected secretary of the War Service Executive Committee of the Chamber of Commerce of the United States, of which Joseph H. Defress, of Chicago, is chairman.

Mr. Belcher takes up the work which was inaugurated by W. H. Manse, whose present work is in connection with executing the detail of interest to the War Service Committees which are to meet at the annual convention of the Chamber of Commerce of the United States, to be held in St. Louis.

Mr. Belcher has been serving for a year and a half in the army as a captain in the Ordnance Department, in connection with civilian personnel. He was secretary of the Civil Service Commission of the City of New York during the administration of Mayor Mitchell. His headquarters are in the Riggs Building, Washington, D. C.

* * *

Program for Foreign Trade Convention

This Convention Will Take Up Every Phase of Foreign Trade on April 24, 25 and 26.

The complete program is now ready for the Foreign Trade Convention which is to be held in Chicago, Apr. 24, 25 and 26. The convention is to take up every phase of foreign trade, and includes such well-known experts as James A. Farrell, Hugh Frayne, Eugene Meyer, Jr., P. S. Steenstrup and others. Following is the program:

Thursday, Apr. 24—Morning

Session Topic: America's Need of Foreign Trade.
The Effect of Increased Productive Capacity Upon Our Foreign Trade—Edward Prizer, president, Vacuum Oil Co.
America's Financial Equipment for Foreign Trade, Fred I. Kent, vice president, Bankers Trust Co.
The Interest of Labor in Foreign Trade—Hugh Frayne, War Industries Board.
The Element of Labor Cost in American Exports—William Pigott, president, Seattle Car & Foundry Co.

Afternoon

The Vital Concern of Agriculture in Foreign Trade—Charles J. Brand, Chief of Bureau of Markets, U. S. Department of Agriculture.
The Mississippi Valley and Foreign Trade—John M. Parker, president, Mississippi Valley Association.
The Bargaining Tariff—Hon. William S. Culbertson, U. S. Tariff Commission.
The Stabilizing Effect on American Industry of a Definite Foreign Trade Policy—J. W. Hook, president, Allied Machinery Co. of America.

Evening

Group I. Commercial Education for Foreign Trade.
Export Technique: Job Analysis of an Exporting House, Showing What Employees Should Know—D. E. Delgado, export manager, Eastman Kodak Co.
Cultural Equipment for Foreign Trade—John F. O'Hara, C.S.C., Notre Dame University.
Vocational Education for the Business of Exporting—R. S. MacElwee, assistant chief Bureau of Foreign and Domestic Commerce.
Report of Foreign Trade Training Survey of U. S. Bureau of Education—Glen Levin Swiggett, specialist in Commercial Education, U. S. Bureau of Education.
Group II. Foreign Trade Merchandising.
America's Foreign Commerce and the Necessity for Co-operation of All Interests to Protect It—W. H. Douglas, president, Arkell & Douglas, Inc.
The American Foreign Trader—John F. Fowler, vice-president, W. R. Grace & Co.
Can American Fabricated Products Hold Foreign Markets?—Wm. E. Peck, president, W. E. Peck & Co.
The Mechanism of Foreign Trade—Wm. H. Knox, president, Wm. H. Knox & Co.
Group III. Financing Foreign Trade.
Financing Our Excess of Exports—Eugene Meyer, Jr., managing director, War Finance Corporation.
Acceptances in Foreign Trade—D. C. Wills, Federal Reserve Bank, Cleveland.
American Branch Banks Abroad—James H. Carter, vice president, National City Bank.
Foreign Exchange—J. McCurrach, vice president, Continental and Commercial National Bank.
Group IV. Advertising for Foreign Trade.
Survey and Method—F. A. Arnold, manager, Foreign Department, Frank Seaman, Inc.
Media—Stanley Resor, president, J. Walter Thomson Co.
Foreign Advertising Successes—W. G. Hildebrandt, Gotham Advertising Company.
Discussion—J. W. Helburn, Canners Council of U. S. A.

Friday, Apr. 25—Morning

Session Topic: The American Merchant Marine.
American Shipbuilding—Homer L. Ferguson, president, Newport News Shipbuilding and Drydock Co.
The World's Merchant Fleets To-day—W. S. Tower, Division of Planning and Statistics, U. S. Shipping Board
The Future of the American Marine on the Pacific—Frederick J. Koster, president, San Francisco Chamber of Commerce.
The Relation of Law to the Development of Our Merchant Marine—Ernest J. Baldwin of the New York Bar.
The Relation of Inland Waterways to Foreign Trade—James E Smith, president, Mississippi Valley Waterways Association.

Afternoon

Group V. Foreign Credits and Credit Information.
What Part Must Credit Play in the Expansion of Our Foreign Trade?—E. D. Fisher, vice president, Bank of Detroit.
Some of the Peculiar Difficulties and Problems in Foreign Credit Granting—F. D. Rock; credit manager, Armour & Co.
In What Form and Manner Can Exporters Coöperate for Developing Foreign Credit Information?—H. F. Beebe, Winchester Repeating Arms Co.
What Assistance May the Government Give Exporters in Selecting Safe Foreign Credit Risks?—E. E. Pratt, vice president, Overseas Products Corporation.
Group VI. Direct Selling and Representation.
Direct Selling in Europe—Larger Nations. . . . .; Smaller Nations, H. S. Demarest, general export manager, Green-Tweed Company.
Direct Selling in South America—P. S. Steenstrup, General Motors Export Company.
Direct Selling in the Orient—Howard E. Cole, Standard Oil Company of New York.
Direct Selling through the Parcel Post—Maynard D. Howell, export manager, Montgomery Ward & Co.
Group VII. Export Combination—The Webb Law in Operation.
The Webb Law in Operation—John Walsh, chief counsel, Federal Trade Commission.
Forming an Export Association.
Discussion—William T. Nardin, American Canners' Export Association; E. E. Judd, American Webbing Manufacturers' Export Corporation; R. R. Fox, Simonds Manufacturing Co.
Group VIII. Ocean Service.
Marine Insurance—Benjamin Rush, president, American Foreign Insurance Association.
Improved Port Service and Foreign Trade—R. A. C Smith, New York.
Freight Forwarding for Export—W. J. Riley, export manager, Judson Freight Forwarding Co.
Inland Traffic Management for Export—Andrew Young, traffic manager, American Sheet & Tin Plate Co.

Friday, Apr. 25

Banquet, Congress Hotel, Gold Room
The Relation of Diplomacy to Foreign Trade—Hon. Breckinridge Long, Third Assistant Secretary of State.
The Meaning of Foreign Trade to the Middle West—Hon. Frank C. Lowden, Governor of Illinois.
American Maritime Policy—James A. Farrell, chairman National Foreign Trade Council.
The Future of Our Foreign Trade—Edward N. Hurley, chairman, U. S. Shipping Board.

Saturday, Apr. 26

Packing for Export—Captain H. R. Moody, Q. M. C., U. S. A.

The British Imports and Exports

Extract from *London Times* Indicates the Policy of the English Government Regarding Imports and Exports.

The following extract from the *London Times* of Mar. 11, is of interest as indicating the policy of the English Government with respect to imports and exports. It is a statement by Sir E. Geddes, Minister of National Service and Reconstruction, when challenged on this subject in the House of Commons by the Liberals.

"The policy of the Government in regard to imports was announced in the House recently. No import restrictions would be imposed, or continue to be imposed, on goods coming from any part of the empire without the assent of the War Cabinet, which would not be given unless some unforeseen necessity arose. All raw materials required for our industries would now be admitted without restriction. Some manufactured articles which were necessary as material for the manufactures of this country would also be admitted free without restriction, except so far as they were produced by industries which it was essential to foster in this country, and which required shielding. In such cases manufactured articles would be restricted.

"Manufactured articles would also be subject to restriction when not essential for consumption in this country, or when produced in this country by industries which required to be shielded from foreign competition while re-establishing themselves, industries which were disorganized for the purposes of war, or which had been created or encouraged to extend owing to circumstances arising out of the war. Restrictions in such cases covered a period extending not beyond Sept. 1 next, when there would be a further review of the whole situation.

The Time-Limit Policy

"The policy of the time-limit is quite clear. These are war restrictions; this is to deal with the transitional stage. We may find in the summer that the transitional stage is going to be prolonged. We may find it may be shortened, but it is not to be extended beyond Sept. 1 without further review. This is not the peace policy, this is the transitional policy, and what I am saying now is without prejudice to any policy which may or may not be arranged with regard to the permanent policy.

"The next thing, so that the House and the country may know exactly what is going on, is the form of instruction which has been given to the Board of Trade. The Board of Trade is to take steps to consider what shall be done to maintain in this country industries which it is the policy of the Government to foster—these are the industries such as I have stated—to consider definitely in detail the steps which are to be taken and to report to the Government. That policy need not be limited to any existing restriction.

"That, I think, covers as a general statement, not in detail, the policy on which the Government is working: raw materials free at once; part-manufactured materials which are the materials of other industries free, if possible, unless by so bringing in those materials we are going to kill out industries which it has been shown by the war it is definitely in the interests of this country to have in the country. Otherwise, of course, the imports, though not prohibited, will be licensed, and the total amounts brought in will be watched.

Sir E. Jones: "Are free goods coming right off the list at once?"

Sir E. Geddes: "Raw materials will."

Sir Jones: "Not manufactured articles?"

Sir Geddes: "The raw materials will be free; the partly manufactured goods will be free, as far as possible; completely manufactured goods not free, and, as far as possible, not to be brought in unless they are essential for use in this country."

Mr. Kiley: "Does that mean that the present manufactured goods imported under license will also cease?"

Sir Geddes: "No. Licensed imported goods will continue."

Mr. Kiley: "As now?"

Sir Geddes: "I cannot say entirely without change. All sorts of considerations must necessarily arise with regard to the position of the exchanges. Take the United States for instance. We have there the whole question of exchange to consider. Probably there will be a heavy drain on the Exchequer as the flow of raw material increases. It is not contemplated, it is no part of the policy of the Government to shut down the existing importation of manufactured goods, if without detriment to the interests of the country the importation can continue."

* * *

War Contract Settlements

The War Department authorizes publication of the following letter from Benedict Crowell, Assistant Secretary of War, Director of Munitions, to Carter Glass, Secretary of the Treasury:

"I have been asked by your department as to the basis of compensation which contractors receive on the termination of war contracts and the method by which that compensation may be secured. I have gone into this matter at some length in the memorandum which I enclose.

"Immediately upon the cessation of hostilities it became necessary for the War Department to reduce production on many thousands of its contracts for production of supplies for the army. The department immediately set up an organization to handle these adjustments so that the matter could be handled in a prompt and business-like manner. Some thirty-six local boards were established throughout the country composed of civilians and officers drawn from civil life who were familiar with what had been done under the contracts to be adjusted, and whose training and experience were such as to make it possible for them to handle these adjustments in a broad, business-like way. It is now nearly five months since these organizations were set up and since their machinery was available for the process of adjustment. Nevertheless, claims aggregating nearly one-half in the amount of money involved of the total to be adjusted have not yet been formally presented. This failure on the part of the contractors to present their claims promptly is occasioning the department great embarrassment. The organization which is handling this matter is essentially civilian in character and composed of men who have come into the department merely for the purposes of the war and who remain in this work only at a very great personal sacrifice and at the urgent request of the department.

"I do not feel that I can continue indefinitely to impose that hardship and have determined that all contractors who desire to avail themselves of the existing organization in the department for the settlement of their claims must present them prior to May 15, 1919, as after that date the method of handling these claims will necessarily be changed through the impossibility of continuing the present personnel."

Personals

W. F. McLAUGHLIN has been made factory superintendent of the Hyatt bearings division, General Motors Corporation, at Harrison, N. J.

E. E. WOOD, who for the past several years has been a member of the sales force of the Jones & Lamson Machine Co., Springfield, Vt., at Detroit, has been made sales manager.

H. W. CHAMPION, president of the Newton Machine Tool Works, Inc., Philadelphia, Penn., has gone to Europe where he will visit all the allied countries in the interest of his company.

J. W. BRUSSEL, formerly superintendent of the Wright-Martin Aircraft Corporation, Long Island City, has taken a position as factory manager of the Dyneto Electric Corporation, Syracuse, N. Y.

F. V. SARGENT has been appointed district manager of sales for the Chicago Pneumatic Tool Co., in the Boston territory succeeding T. S. Eggleson. He will make his headquarters at 182 High St., Boston, Mass.

C. R. BULLEY has been appointed sales metallurgist for the Hess Steel Corporation in Baltimore. He was formerly in charge of the design, building and operation of the heat-treating department of the Symington-Anderson Co., Rochester, N. Y. Prior to this he had several years' experience in the metallurgical department of the Halcomb, Midvale, and Carpenter Steel companies.

Obituary

FRANK W. HASKELL, president of the Carborundum Co. and its allied companies, died suddenly at Daytona, Florida, Apr. 2, 1919. Death was due to heart failure. He had been in Daytona since January and seemingly had been in the best of health. The news of his sudden death came very unexpectedly.

Mr. Haskell was born in Brooklyn, N. Y., Dec. 17, 1861. In 1879 he became connected with the Chicago, St. Paul & Milwaukee Ry. in a clerical capacity. In 1887 he took a position



FRANK W. HASKELL

with H. C. Frick and became identified with several of the many Frick interests. He remained with Mr. Frick until 1898, when he was made vice president of the Carborundum Co. at Niagara Falls, N. Y. One year later he was made president, succeeding Dr. Edward Goodrich Acheson, who organized and became president of the Acheson Graphite Co. Mr. Haskell had been a resident of Niagara Falls up to 1916, when he moved to Buffalo. He was a member of the Niagara Club, the Buffalo Club, the Country Club of Buffalo, the Park Club of Buffalo, the Duquesne Club of Pittsburgh, the Automobile Club of Buffalo and the Automobile Club of America. He was also a director of the Power City Bank.

J. E. JOHNSON, JR., mining and consulting engineer, 52 William St., New York City, died on Apr. 4 as the result of an automobile accident. Mr. Johnson was born at Long Dale, Va., in 1870. He received the degree of M.E. at Haverford College in 1891 and M.M.E. at Cornell University in 1892. He has been connected successively with the Baldwin Locomotive Works, the Straight Line Engine Co., Oswego Machine Works, Long Dale Iron Co., and Sanderson & Porter. He was a member of the American Society of Mechanical Engineers and a director of the American Institute of Mining and Metallurgical Engineers.

EDWIN H. WARREN a member of the firm of Woburn Gear Works, manufacturers of gears, sprockets chains, etc., Woburn, Mass., died at his home on Apr. 2, 1919, of pneumonia. He was 39 years old.

Business Items

The Schietz Tool, Gear and Machine Works has recently been established at Waterloo, Iowa, with Otto Schietz as president and manager. Mr. Schietz during the war was superintendent of the Gray Machine and Tool Co., Buffalo, N. Y., which was taken over by the Government as a standard shell plant during the war.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A commercial agent in France wishes to secure the agency for the sale of iron and steel, tools of all kinds, agricultural implements, machinery and motors. Correspondence should be in French. No. 29014.

A company in England wishes to purchase pressed-steel unions with bronze seats. If satisfactory quotations are given, inquirer will place order for a large quantity. No. 29005.

A firm in the Netherlands desires to purchase and to secure an agency for the sale of tools, machinery, and hardware of all kinds, cutlery and novelties. Quotations should be given f.o.b. New York. Payment, cash against documents. Correspondence may be in English. Reference. No. 28996.

A company in Belgium desires to secure the representation from manufacturers of wood-working machines and tools. Correspondence should be in French. References. No. 29008.

An agency in desired by a man in Italy for the sale of motor cars, iron and steel pipes and fittings. Correspondence may be in English. References. No. 28988.

A man in Belgium desires to secure an agency for the sale of all kinds of machinery, metals, and metallic construction material. Correspondence should be in French. References. No. 28989.

A commercial agent in France desires to secure an agency for the sale in France and Morocco of metallurgical products, hardware and small tools. Correspondence should be in French. Reference. No. 28990.

A company in Norway desires to secure agencies for iron, steel, metals, heavy hardware machinery. Reference. No. 28991.

A man in France desires to secure an agency for the sale of industrial supplies, except oils and greases, and machine tools. Correspondence may be in English. Reference. No. 29018.

A commercial agent in France desires to secure an agency for the sale of machine tools, industrial supplies, belts, oils, greases, etc. Correspondence should be in French. Reference. No. 28932.

A merchant in France desires to secure an agency for the sale of mining machinery and mining materials and tools of all kinds. Correspondence may be in English. No. 29024.

A request has been received from a man in France that he be placed in touch with important metallurgic factories manufacturing such articles as iron, steel, copper pipes, accessories, and everything in the pipe trade, for high pressure and steam hydraulics. Correspondence may be in English. References. No. 29020.

A man in France wishes to purchase and to secure an agency for the sale of cast steel, mining bars, high-speed steels, steel tools, raw iron, plates, boiler plates, ship plates, and all articles included in the steel and tool trade. Correspondence may be in English. Reference. No. 29026.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary-treasurer, Harris Trust Building, Chicago, Ill.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, N. Y.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. Other meetings on Apr. 24, when Allen S. Crocker will speak; also on May 29 with Maurice A. Wilder as the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, Apr. 28, 29 and 30.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

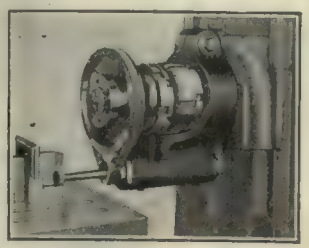
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Attachment, High Speed

Liberty Tool and Gauge Works, Woonsocket, R. I.

"American Machinist," March 27, 1919



To be attached to surface grinding machines for using wheels of small diameter running at high speeds. Is so constructed that it can be quickly secured to the machine, and when fastened in place is rigid. Consists of a combination bracket and spindle housing, grinding spindle, driving pulley, and driving belt. The spindle is made of special steel and mounted on self-aligning ball bearings, these bearings permitting the use of high spindle speeds that enable the correct surface speeds for wheels as small as ⅝ in. in diameter to be secured. Speed of spindle, 15,000 or 20,000 r.p.m. with the grinding-machine spindle running at 3300 r.p.m., the speeds being changed by means of the two large driving pulleys furnished; wheels used, ⅝ to 1½ in.; equipment includes belts and extra wheels.

Straightening and Cutting-Off Machine for Sheet Metal

Halliden Machine Co., 27 Benedict St., Waterbury, Conn.

"American Machinist," March 27, 1919



Designed to straighten and cut sheet metal into lengths with rapidity and accuracy. The feed mechanism consists of a reciprocating rack connected to an eccentric crank disk, the rack meshing with a gear connected to a one-way clutch. The crank-feeding device gives an accelerating motion when starting the feed rolls and a decelerating motion in stopping. Gate shear is connected to the crank-disk shaft by means of two eccentric cams and is so timed that during one-half of the revolution of the crankshaft the metal is fed through the shear. The machine is directly connected to a 5- or 7½-hp. motor, as desired. Two sizes are made, the No. 2 taking metal up to 14 in. wide and ⅛ in. thick, and cutting any length up to 12 ft.; while the No. 3 machine takes metal up to 18 in. wide and ¼ in. thick.

Drilling Machine, 21-In.

Weigel Machine Tool Co., Peru, Ind.

"American Machinist," March 27, 1919

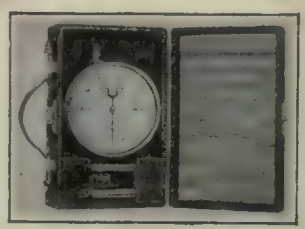


Extreme height with spindle extended, 9 ft. 10 in.; distance from base to spindle, 46⅜ in.; distance from table to spindle, 30½ in.; drills to center of 21⅝ in. circle; traverse of table on column, 13½ in.; traverse of head on column, 21 in.; traverse of spindle, 9 in.; diameter of table, 19 in.; diameter of column, 7 in.; diameter of spindle above sleeve, 1⅞ in.; diameter of spindle in sleeve, 1¼ in.; diameter of sleeve, 2⅝ in.; spindle bored, No. 4 Morse taper; ratio of bevel gears, 2.5 to 1; ratio of back gears, 6.44 to 1; speeds with open belt, 400, 200 and 100 r.p.m.; speeds with back gears, 63, 31 and 16 r.p.m.; net weight, 2100 lb. Equipped with back gears, tapping attachment and plain quick return. Also built without the tapping attachment or back gears.

Tachometer, Type H-2

Jones Motrola, Inc., 29-33 West 35th St., New York.

"American Machinist," March 27, 1919

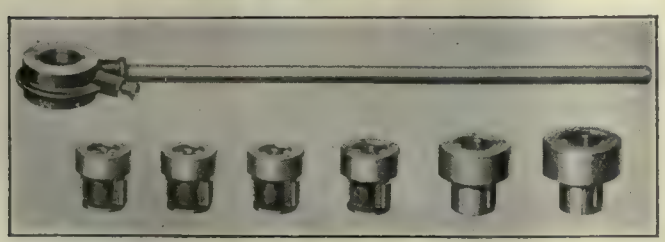


Useful where it is desired to be able to test the speeds of shafts, engines, etc., directly by the use of a portable instrument. Is intended to be held in the palm of the hand, but a handle can be supplied at additional cost if desired. The instrument is supplied with a set of couplings comprising a triangular steel tip, a center punch for the triangular tip, a rubber tip, a rubber funnel cup for pointed shafts, and an extension rod. The body is finished in black japan with nickel-plated trimming, and the case is covered with morocco. Three different types of instruments are provided, No. 1 for indicating revolutions from 100 to 1200 per minute, No. 2 for revolutions from 500 to 2500 per minute, and No. 3 for revolutions from 1000 to 5000 per minute. The size of the dial of all instruments is 4 in. in diameter.

Threading Tool Pipe, "No. 3 Beaver Jr."

Borden Co., Warren, Ohio.

"American Machinist," March 27, 1919

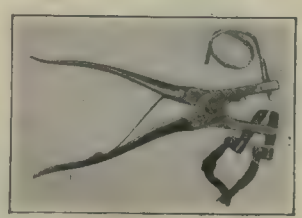


The pipe threading tool shown is built on the unit plan and can be purchased complete or in separate units. The dies will cut threads on ¼-in., ⅜-in., ½-in., ¾-in., and 1-in. pipe respectively. The set contains the ratchet handle and six dies packed in wooden box. The ratchet is entirely enclosed to keep out dirt and grease.

Soldering Device, Electric

F. H. Hendrick, 513 Congress Bldg., Detroit, Mich.

"American Machinist," March 27, 1919



The metal to be soldered is heated directly by an electric arc established between two carbon points. Closing the tool brings the solder into contact with the electrodes and does the soldering. The device is intended to be used with an ordinary 6-volt storage battery, but ordinary lighting voltages can of course be used if stepped down. It is stated that as the heat is applied directly to the point where it is needed and is only used during the time necessary for soldering, the energy consumed is only about one-tenth of that required by other soldering irons of equivalent capacity. It is ready at all times and the workman does not have to wait until the iron becomes hot.

Lathe, 11-In. Quick-Change "Star"

Seneca Falls Manufacturing Co., Inc., Seneca Falls, N. Y.

"American Machinist," March 27, 1919



The quick change gear equipment consists of a train of nine gears in the form of a cone mounted on the lead screw, the whole inclosed in the main gear box and controlled by a tumbler handle. By means of another tumbler carrying a set of compounding gears, 45 changes of speed and thread, from 3 to 96 including 11½, are obtained. Any desired thread not given on the index plate may be obtained by making the necessary gear changes on the feed stud. The usual extra attachment may be used with this lathe.

Micrometer Caliper, "Reed Junior" ½ In.

Reed Small Tool Co., Worcester, Mass.

"American Machinist," Apr. 3, 1919



The "Reed Junior" is a sturdy ½-in. micrometer equipped with solid anvil and two part thimble adjustment. It is small enough for the vest pocket and yet large enough to be operated with one hand. It is claimed that the design permits a firm grip even under oil. Dull nickel finish is used and the micrometer will be furnished with English or metric graduations and with lock nut and ratchet stop if desired.

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$34.60
Northern Basic	27.55	31.80
Southern Ohio No. 2	28.55	32.80
NEW YORK, Tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	36.15
Southern No. 2 (silicon 2.25 to 2.75)	34.70	39.95
BIRMINGHAM		
No. 2 Foundry	26.75	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	31.90*	36.15*
Virginia No. 2	33.25†	38.10†
Basic	29.65*	33.90*
Grey Forge	29.65*	33.90*
CHICAGO		
No. 2 Foundry Local	26.75	31.00
No. 2 Foundry Southern	33.00	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.25	31.00
Basic	25.75	30.00
Bessemer	29.35	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅜-in. plates the extra is 30c. per 100 lb.
Note—For less than carload lots add 4 c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.62	6.22	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.52	6.12	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.47	6.07	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.42	6.02	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	5.37	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	5.27	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	5.17	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	7.42	7.57	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	7.12	7.27	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.97	7.12	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at **15c. per lb.**

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
5/32, 11/32, 3/16, 1/4, 7/32, 1/8	25.50 to 33.00	3/16 by 12 in. long	14.00
No. 8, 9/32 and No. 10		1/4 by 19 in. long	12.00
5/16		5/16 by 19 in. long	10.00
No. 12		3/8 by 21 in. long	10.00
7/32, No. 14 and 1/16		Special Welding Wire, Coated	
No. 18		1/4	33.00
No. 20		5/32	30.00
Domestic 20c. for 1/16, 15c. for 1/4 to 3/16.		3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	50½%	24%	⅜ to 1½	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	¾ to 1½	39½%	24½%
½	51½%	39%			
¾ to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.37½	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	5.25	5.10	7.25
Spelter	6.65	6.85	7.50
ST. LOUIS			
Lead	5.00	4.80	7.10
Spelter	6.30	6.50	7.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	24.50	35.00	26.00	35.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	34.00	22.00	34.00
Brass sheets	18.75	23.75–28	30.75	25.00	30.00	21.50	35.00
Brass pipe	28.00	34.00–37	36.50	33.00	41.00	31.00	41.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	41.50	41.50	39.00	48.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	35.00



F YE BREAK FAITH WITH THEM WHO DIE
THEY WILL NOT SLEEP,
THO POPPIES GROW IN FLANDERS FIELDS

plement to American Machinist, April 24, 1919.

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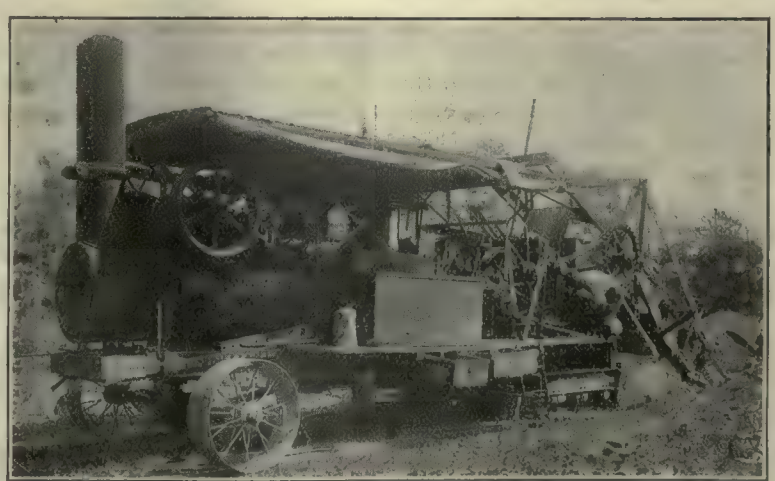
The Army's Foreign Stock of Machinery

By JOHN B. WOODS
Formerly Captain of Engineers, Forestry Division, A. E. F.

American machinery valued at millions of dollars is now in France and Belgium, having been brought there for the use of our engineers. What is to become of it? In this article Captain Woods tells us some of the possibilities of disposing of this material when it is no longer needed by our army.

NOW that the fighting is ended and the tide of American troops is ebbing back toward the United States, the question arises as to what is to be done with the vast stores of foreign-service equipment that we have in France. There is an astounding quantity of our machinery over there; one has only to travel from any French city to any other to be impressed by the fact that our organization extends throughout that country and depends for efficiency upon machinery.

Let us begin at the base ports; there are lighters, motor craft and dredges, gantry cranes, hoisting engines, yard locomotives, machine shops and what not, to improve the ports and to handle the routine business of war shipments. Then there are the steam-railway and motor-truck lines of communication to the depot areas behind the front. The strictly combatant installations, such as repair shops, where they work on everything from top-sergeants' whistles to railway naval guns, within sound of the artillery rumble, and the depot organizations where stores are reconsigned, are all built up around the efficiency of American machinery. Back in the peaceful parts of France there are hundreds of tributary industrial plants furnishing needed material which can be obtained from the country roundabout; crushed rock for railroad ballast, timber and lumber for ties and buildings of all sorts, and other products of the soil. If the war had gone on another year, we probably would have installed agricultural machinery for our own convalescent wounded to make use of in the hospital areas, as European doctors had reached the conclusion that such work is by far the best for men who need something for occupation while being patched up for the front.



MANY OF THESE EXCAVATORS WERE USED FOR DIGGING INNER LINE OF TRENCHES

Of course the war was won by machinery, and we may pride ourselves that American factories built a goodly portion of this equipment from the very beginning, culminating fortunately in an overwhelming preponderance of the most-needed types in the hands of our own armies. Germany got the start of the whole world because she had not only more well-trained fighting men than her opponents but more high-class machinery lined up to do the work she had to have done. The others stumbled along improvising and making men to do the part that machines should have handled, and when supplies failed they held the line with nerves and blood. But when it came time to turn about and make the final dash, they went through because the machines were working both at home and in the field. The never-ending line of steaming ships, the plentiful supply of ammunition, and the new naval guns that threw their shells more than 30,000 yd. to break the Longuyon-Mezieres railway behind the Germans, all testified to the efficiency of our machinery, both in their construction and in their operation. France had her mobilization plans quite well conceived, but the first dash through Belgium robbed her of her finest industrial region, and factories that never turned a wheel for France worked almost until the last day for the enemy.

Many fortunes were made from the machinery scrap-heaps of France. Naturally everything that could be renovated and made to function was seized upon. Lathes and machine tools of all sorts were at a premium long before the American Army came into the war, and new equipment was unbelievably high in price. The shell makers bought lathes and the like, paying the market price but profiting by a yearly government concession so long as they devoted their plants to war work. Power was probably the most sought-after item in all the list. There is a man at Nantes, an Englishman, who has been in the second-hand machinery trade for 15 years. He is acquainted with every piece of power plant in northern France, and during the war has ac-

cumulated a vast fortune by virtue of this knowledge. The market price for combination boiler-engine plants, such as we term portable outfits in this country, was 1000 francs per horsepower. This price was not for new stuff but anything in working order, if the boiler would pass inspection. For a small rig of 15 hp. this meant $2700 or thereabouts. Electrical equipment was another high item. French towns do not enjoy electric lights as do so many of our small places, and therefore there was very little spare stock of generators. When factories went upon day and night schedules to meet the needs of war, there was a rush for lighting plants, and the available stock disappeared. One could mention



AMERICAN DINKY ENGINE USED ON NARROW-GAGE ROADS IN FRANCE



TYPE OF FRENCH PORTABLE ENGINE USED FOR LIGHT WORK DURING THE WAR

items ad infinitum, all showing that France was in a bad way for machinery of all kinds.

Such was the situation when America went into the war. The shipping crisis being what it was at that time, our army added the weight of its first demands to the scale. The program outlined for us called for power above all, and chiefly in small portable units. So engineer officers were put upon the road to buy engines, and they scoured the country. Some of the stuff they obtained was valuable only from the antiquarian standpoint, but most of it would and did do good work. We needed lighting plants for warehouses and other projects. We needed locomotives and dinky shifting engines. For our repairs we required machine shops, for the French shops were overloaded with war contracts, they lacked laborers, and could help us little or not at all. Although all the available ship space was being used to bring machinery, it was limited, sinkings were heavy, and France and England were obliged to supply many of our early demands. Naturally enough, we paid the price that the others would pay plus enough premium to swing it away from them. So, therefore, the American Army has on hand at this date a large quantity of second-hand European machinery, bought at war prices and undesirable from any operator's standpoint if modern material is available.

In the ports and depots which we improved or established, there is a great deal of up-to-date freight-handling machinery. France was woefully behind the times in the matter of port facilities. At most of the seaports ships were warped alongside the wharves and unloaded either by human hands or with small swinging-boom cranes that operated by double cranks. The principle upon which all their machinery was built in the old day was cheap labor and high-priced power. There were few giant cranes, and these generally were geared so low (to save power) that they were unbelievably slow. But our engineers showed them the way to handle freight, brought the wherewithal to do it, and the French are loud in their assertions that they never will go back to the old methods where the new are available. Having lost a pathetically large percentage of their labor supply in battle, they probably will be obliged to readjust their machinery-building principles. In short, we should be able to dispose of most of our great port installations at a fair price and to the mutual advantage of France and ourselves. As a matter of fact such a solution of the problem has been commonly understood as a foregone conclusion among the men of the army who did not know the plans of those higher up, but wondered about such things because they were interested. The big depots also should be salable, even if they cannot be used where they stand.

The forestry organization of the A. E. F. was organized in 1917 and developed into a giant that produced as much in a month as a score of our biggest home mills. The plants were small-type mills, equipped when possible with over-size power plants, and were worked night and day. Many French engines were installed in certain sections, but were very seldom retained after American engines arrived, because they had not the necessary power. The usual mill was a rope-feed, circular-saw rig, using insert tooth saws, and built for speed at sacrifice of wood. When one reflects upon the fact that 50,000 men were engaged in getting out timber products in France, one can see that this was a big field for our machinery, and fortunately most of the machinery we used was from our own country.

Description of the Equipment

There may be interest in a description of the equipment of one forestry district which was located in the pine forests in southern France. There were four mills that cut from 70,000 to 100,000 ft.-b.m. of lumber daily, also two smaller plants whose combined output was slightly larger than one of the others. Each plant was fed by narrow-gage railroads from the woods, using small steel cars and 18-ton Porter dinky engines, or jacket-boiler locomotives. Each plant was equipped with vertical steam-engine generators for the electric lighting, and good American steam pumps for water supply. There was a big steam skidder working at one camp to help pull in logs, while a motor boat worked

on a lake rafting logs to one mill in addition to the railroads. The district organization took over 25 miles of railroad from the French and operated trains to and from the mainline junction of the Midi. Altogether there was a big plant, and together with several motor trucks and the steam rolling stock, a machine shop was required to take care of all repairs. With that installed the proposition was practically self-sustaining.

When the hostilities ceased, there was no more use for the mills in any part of France except to clean up certain burned areas. Thus, a great additional quantity of machinery was ready for sale. The forestry equipment was mentioned in detail because it was one of the really large groups of equipment installed over there, and constitutes a problem in itself.

Three Chances of Disposition

The same rule applies in other disposal problems as in the forestry-equipment question, namely, that our machinery does not appeal to all Frenchmen. One will desire to buy, while another complains about the expensive saw-kerf cut by the circular saws. Among engines one finds that one man is delighted with our high-pressure and high-speed engines, while another wants compounding and low-speed machines. In short, there is a great deal of patient salesmanship needed to dispose of this stuff properly so that no regrets will ensue. There are three possibilities that appear to offer the best chances of disposing of the A. E. F. machinery. To sell everything in a lump to the government of France, if they will buy, for distribution to industries that need it most; or the stock may be divided regionally and sold to large moneyed interests for storage and later selling; or thirdly, each item can be sold separately to whoever will pay the nearest to what it is worth. The French object to the second measure because they believe the large interests will obtain the material and hold it to make big money, thereby keeping it off the market when the need is greatest. Apparently no definite policy has been adopted as yet, except that all equipment not in use is being boxed for export and shipped to the depots.

Worn to Less Than Half Value

Whatever is done, we cannot hope to sell the machinery at what it cost laid down in France. The foreign second-hand stuff is a doubtful asset now that its usefulness under war conditions is outlived, and it may well be charged up to profit and loss without spending money to box and ship it even to depots. Much of the American machinery is worn to less than half value, and the less time and money wasted upon it the better. In fact unless our used equipment can be sold where it stands, it would be better financially to leave it alone to the thieves that to try to ship it back to America to be thrown upon a dull market. The French are eager to help us in handling this problem, as they want most of what we have left behind us, and an intelligent handling of the problem will save the War Department a great deal of money and help France get back upon her industrial feet. The machines from America have helped to win the war, which is the main consideration, so perhaps we should not worry about their ultimate fate. But it is an interesting question nevertheless, involving the considerations mentioned herein and such others as import duties and ocean freights.

A Machinist's Criticisms of Modern Shop Systems

By J. B. Gray

Several articles have appeared in the *American Machinist* lately about various systems, good, bad and indifferent, but they are all negative criticisms, and I have looked in vain for that constructive element that we so much need just now. System in the machine shop, the office, the drafting room, and in the corner grocery is alike essential and since so many "hammer artists" are about would it not be as well to hear something from the other side?

On page 518, John R. Godfrey describes, figuratively, a "system"—or a total lack of system—that it is difficult to believe has any counterpart in actual practice. The natural effect of such criticism is to bring into contempt, to burlesque, all shop systems, regardless of their merit. Of course, we appreciate the fine humor of the sketch and I daresay many of us enjoy a good laugh at the expense of "Mr. Johnson," et al.; however, isn't there danger when a subject is persistently and adversely criticized, of producing an undesirable psychological effect, of creating an unreasoning antagonism between the office and the shop that can have no result other than to render more difficult the realization of that coöperative policy we are all desirous of obtaining?

Harry Senior Makes a Wild Blow

On page 493, Harry Senior makes a wild blow in the dark and comes pretty near hitting the nail on the head, in so far as enlisting the sympathies of the men is concerned, but is this all that is required to secure maximum production? I say "No"—most emphatically "No!" Mr. Senior sees only effects and does not go into the matter deep enough to locate and analyze causes, nor does he prescribe remedies except in a very vague and indefinite way—too much "I told you so" stuff, which has never cured any ill, industrial or otherwise.

As it happens, I have had considerable experience as a journeyman machinist under the Taylor and various other systems. While it is true that most of these tend to perplex, discourage and even to provoke the opposition on the part of the workmen that Mr. Senior refers to through excessive application of scientific detail, it does not follow that the system as a system is wrong. I am firmly of the opinion that all systems that have received recognition to any extent, even Mr. Godfrey's "pink slip system" are founded upon sound logic, probably being diverted from the path of reason through unwise elaboration and devotion to the abstract on the part of scientists and mathematicians.

Some 10 years ago, it was my fortune to be employed as a plain machinist by the Tabor Manufacturing Co., of Philadelphia, then, and probably now, the headquarters of the Taylor system, where I had an opportunity to study this system in its purity and at close range. I had heard about those stop watches, "white shirted and becollared youths," etc., and was pleasantly surprised to find that both the stop watch and the becollared youth filled very small and very definite places and were obliged to "function" as part of the system and strictly in accordance with one small-typed instruction card.

Under the Taylor system, the nonproductive force in the shop is composed of a foreman and sometimes one assistant, an inspector, a speed, feed and chucking

boss, one or two drawing boys, one or two tool boys, and one or two laborers. The shop paraphernalia consists of a system of individual bulletin boards, and a work or tool table with a sheet-iron box, or pocket, on either side—that is all.

The modus operandi is as follows: You go to your bulletin board, take the top card which is the job card, and going over to the window, have the clerk stamp it "in." Upon returning to your machine, you find that the drawing boy, who, like the tool boy walks the floor constantly, has already been around to your bulletin board, obtained the number of the job you are to start with from your job card, obtained the drawing and instruction card for you, and placed both in the right box or pocket of your work table. The tool boy at the same time has taken the number of your job card and brought everything you will require, tools, bolts, clamps, blocking, etc. Of all such tools as drills, reamers, counterbores and so on, you have two of each so if one should break or in any way be damaged, you have only to throw it on your work table and go ahead with the second tool. Presently the tool boy will pass by, take up the damaged tool and bring you another one in place of it. All tools, clamps, etc., have been placed in a metal tote-box beside your machine and by the time you get back from having your card stamped you are ready to start to work, no questions to ask, nothing to hunt for and everything right at hand.

The first thing you do is to take your drawing and instruction card from the right-hand pocket of your work table, and while reading your instruction card, place the drawing in the left-hand pocket of your work table so that the drawing boy can bring you the drawing for the second job as per your bulletin board while you are working on the first job; the tool boy will also bring you the tools for the next job and place them beside the work table out of your way. Since this is your first job of the day, Rule 1 on your instruction card will read "oil machine" and time and bonus will be stated. On the other hand, if it is the second or a later job, the first rule will be "clean machine" and the rest of the card goes on to tell about setting up the job; where to set up (base or table if a radial drilling-machine job), what clamps and bolts to use, what speed and feed is required, etc.

Two Exceedingly Good Points

So far this system has two exceedingly good points: First, it relieves the foreman of an enormous amount of detail and permits him to develop ideas, see to the upkeep of the machines, attend to requisitions for material, tools, etc., and other necessary and important work; secondly, it relieves the machinist of those long weary hunts for bolts, clamps and packing; it relieves him of those sloppy, tiresome jobs at the grinding wheel; and it relieves him of those pleasant (?) little constitutionals in search of the drawing.

But Mr. Taylor and his engineers made a mistake when they tried to change the name of every tool, clamp and bolt in the shop; when a common U, or horseshoe clamp becomes a "CCF" clamp, the machinist feels that he is entitled to an explanation. Though a man may be ever so capable and have years of experience, he will be absolutely lost when he starts in a Taylor system shop. It makes you remember vividly the first day of your apprenticeship; other machinists tell me that is the way they feel about it too. No matter what you ask for, you haven't got the name right, according to the system, and it is this highly scientific development that causes the trouble in the shop. Trying to carry the job along and learn the new name of everything at the same time is what "gets your goat."

It seems to me that the Taylor system either should be greatly modified or an elaborate instruction book should be issued to men explaining the operation of the system as well as illustrating and giving the new names of standard shop equipment.

Using the Stop Watch

The stop watch is used when setting the time on a new job and sometimes in re-setting the time on an old one that through improved equipment or because of a better way of chucking or setting up really ought to be re-timed as a mere matter of business.

The "speed, feed and chucking boss" is not the driving, fuming, swearing individual that his title would indicate; he carries a typed sheet giving the various speeds and feeds and if, through faulty material or for any other reason, the feed or speed must be changed, he merely notes it on your card and the speed or feed or both are changed accordingly.

Mr. Senior to the contrary notwithstanding, what we need is not more science, but more hard horse sense.

Suggestions in Welding Cutting Tools

By C. A. Hart

It has been discovered in connection with welding experiments, that it is practicable to weld high-speed tool-steel bits to common cold-rolled steel shanks for lathe and planer tools, drill, reamers, etc., with very satisfactory results. Electric welding high-carbon to low-carbon steel is not a difficult operation, although a little care should be exercised as a slightly different condition exists than where materials of the same analysis are employed.

Experiments have demonstrated that best results are obtained if the thickness of the tool steel is from ¼ to ⅓ the total thickness of tool at the weld. Where two pieces of the same kind of steel are spot welded together they heat evenly, but care must be taken in welding high-speed steel to common steel, the former heats more quickly owing to its offering greater resistance to electric current. The high-speed steel should be thinner in order to generate greater heat at the junction of the pieces. As the copper points used in making these welds are subject to very extreme heat and pressure, they will last longer and do better work if cooled by a stream of water passing through them while in use. When both metals have reached a welding heat, the current is cut off and pressure applied forcing them together. It is not necessary to use any flux in welding but is sometimes advisable to apply a solution of borax water which has a tendency to improve the weld.

If it is desired to temper the tool at the same time it is being welded, it should be plunged while white hot into a bath of good hardening oil. When welding a large toolbit to a shank, it is advisable to corrugate the welding seats in a perpendicular direction and keep them free from oil, dirt or rust.

After the butt weld has been made, the stock must immediately be heat-treated or annealed, in order to keep the high-speed steel from checking or breaking.



III. Empirical and Technical Methods

The current installment gives a comparison of results obtained by empirical and technical methods in cam design. Two different cases of single-step radial cams are solved for definite size and pressure angle. The importance of the pitch line and pitch circle in cam work is illustrated by a discussion of the relation existing between pressure angle and cam size. The proper limit for the follower-roller radius is shown to depend on the pitch surface of the cam and to depend also on whether the cam is single or double acting.

PROBLEM 1. Required a radial cam that will operate a V-edge follower: (a) Up 3 units while the cam turns 90 deg.; (b) down 2 units while the cam turns 60 deg.; (c) dwell while the cam turns 120 deg.; (d) down 1 unit while the cam turns 90 deg.

Applying the simplest process for laying out cams it is only necessary in starting to assume a minimum radius *CD*, Fig. 27, for the cam and then lay off the given or total distance of 3 units as at *DB*. The assigned angle of 90 deg. is next laid off as at DCD_1 and the point D_1 marked so as to be 3 units further out than *D*. Any desired curve is then drawn through the points *D* and D_1 and part of the cam layout is completed. The same operations are repeated for obtaining the points D_2 and D_3 and the entire cam is finished.

If the follower had roller instead of V-edge contact a minimum radius *CD*, Fig. 28, would be assumed as in the previous case, and *D* would be taken as the center of the roller. The closed curve $D\ D_4\ D_1\ \ldots$ would be obtained as before and another closed curve $EE_1\ \ldots$ would be drawn parallel to it at a distance equal to the assumed radius of the roller. The latter closed curve would be the actual outline of the cam.

The closed curve $EE_1\ \ldots$ would be known as the working surface and the curve $DD_1\ \ldots$ as the pitch surface of the cam. In Fig. 27 the pitch and working surfaces coincide because the follower has a V-edge.

Cams are sometimes designed with no more labor than that entailed in the previous preliminary problem, and it may be added that where one has had a sufficient

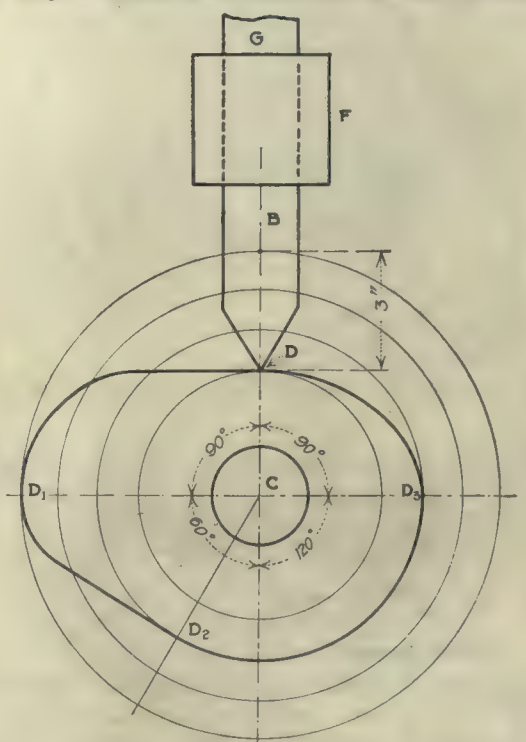


FIG. 27. EMPIRICAL DESIGN OF CAM FOR DATA IN PROBLEM 1, V-EDGE FOLLOWER

experience good practical results may be obtained by following only this simple method.

The method of cam construction described above, however, does not enable the cam builder or designer to hold in control the velocity or acceleration of the follower rod *DG* as it moves up its 3 units; nor does it enable him to know the variable and maximum side pressures which exist between the follower rod and the bearing or guide *F*, Fig. 28, as the rod moves up. In order that these things may be known this preliminary problem will now be redrawn with additional specifications.

Problem 2. Required a radial cam that will operate a roller follower: (a) Up 3 units while the cam turns 90 deg.; (b) down 2 units while the cam turns 60 deg.; (c) dwell while the cam turns 120 deg.; (d) down 1 unit while the cam turns 90 deg.; (e) the follower in all its motions shall have uniform acceleration or uniform retardation; (f) the angle of side pressure of the cam against the follower roller shall not exceed 40 deg.

Items (a), (b), (c) and (d) are the same as in Problem 1.

Inasmuch as this problem is given at this place simply to show that velocity and acceleration and side pressure can always be controlled with very little additional labor beyond that necessary for the simple layout shown in

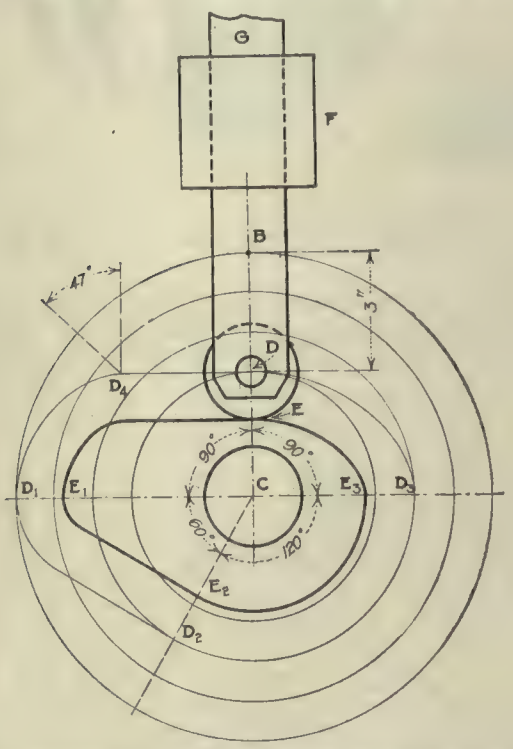


FIG. 28. EMPIRICAL DESIGN OF CAM FOR DATA IN PROBLEM 1, ROLLER FOLLOWER

Fig. 28, the full explanations of the formula and figures used will not be given here. They will be taken up in their proper order in subsequent paragraphs. For this problem the only necessary computation is:

$$r = 57.3\frac{hf}{b} = 57.3\frac{3 \times 2.38}{90} = 4.55 =$$

radius of pitch circle $= CH$, Fig. 29

In the above formula f is the cam factor required for the data specified by e in the problem, h is the greatest assigned follower motion, and b is the number of degrees alloted for this motion. Lay off CH in Fig. 29 and then lay off the follower motion of 3 units equally distributed on each side of H, as at HB and HD. Divide DH into nine equal parts and take the first, fourth and ninth parts; do likewise with BH. Divide the 90-deg. angle BCD_1 into six equal parts by radial lines, as shown, and swing each of the six division points between D and B around until they meet successively the six radial lines. A curve through the intersecting points will be the pitch surface of the cam, as shown by the dash-and-dot curve DH_1D_1. . . The working surface will be EE_1, . . . which is found as described in connection with Problem 1.

The pitch surface D_1D_2 is obtained in the same way as DD_1 was found. The curve D_2D_3 is an arc of a circle, and the curve D_3D is found in the same manner as DD_1.

Advantages of the Technical Design—With the cam constructed as above, the follower will start to move with the same characteristic motion as does a falling body starting from rest, and the follower will be stopped with the same gentle motion in reverse order. It will be definitely known also that the greatest side pressure of the cam against the follower is at an angle of 40 deg., as specified, and that this pressure will occur when H_1 of the pitch surface of the cam is at H, or when the roller is in contact with the point H_2 of the working surface. Where the cam form is assumed, as in Fig. 28, nothing is known positively of the starting and stopping velocities of the follower. Further, as may be found by trial, the maximum angle of pressure of the cam against the rod runs up to 47 deg. in Fig. 28, as shown at D_4. The minimum radius of the cam in Fig. 29 was taken equal to that in Fig. 29 for comparison.

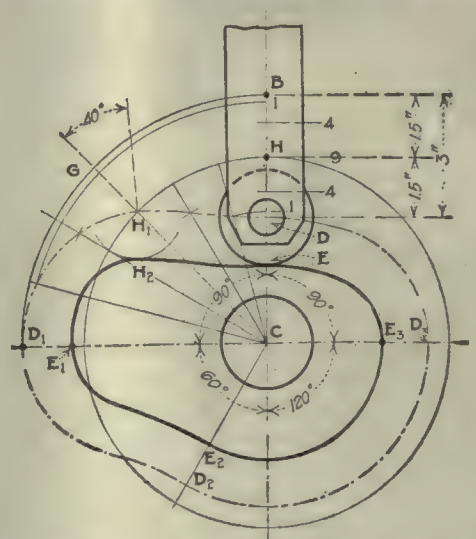


FIG. 29. TECHNICAL DESIGN OF CAM FOR DATA IN PROBLEM 2, DRAWN TO SAME SCALE AS FIG. 28

The two previous problems have been given as brief exercises without going into all the detail necessary to a full understanding, in order to give an idea of the method of producing cams on a scientific basis. In the problems which will follow, the several steps in building cams of various types will be explained. In many of the problems the same data will be used so that comparisons of different forms of cams which produce the same results may be made.

Single-Step Radial Cam, Pressure Angle Equal on Both Strokes

Problem 3. Required a single-step radial cam in which the center of the follower roller moves in a radial line, the maximum pressure angle to be 30 deg. and the follower to: (a) Move up 3 units in 90 deg. with uniform acceleration and retardation; (b) move down 3 units in 90 deg. with uniform acceleration and retardation; (c) rest for 180 deg.

The first step in the solution is to determine the total length of the cam chart for a parabola chart curve and for a 30-deg. maximum pressure angle. From the table of factors in the previous installment, repeated here, the

factor for this case is found to be 3.46. Since the travel of the follower is 3 units in ¼ revolution the total length of chart will be $3 \times 3.46 \times 4 = 41.52$, which therefore is

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of *f*				
	20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion.
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

the length of the chart AA' in Fig. 30. This length represents the 360 deg. of the cam. Lay off AW equal to 90 deg., according to item (a) in the data. Construct the parabolic curve AEC as directed in article II. Completing the entire chart the base curve is found to be $ACMNA'$. The next step is to find the radius of the pitch circle. The circumference of this circle is equal to the length of the pitch line DD'. Its radius is therefore equal to $\frac{41.52}{2\pi} = 6.61$, and this value is laid off at OD, Fig. 31, and the pitch circle $DFXT$ drawn. The quadrant DF is divided into the same number of parts as DF in Fig. 30. The vertical construction lines HH_1, II_1, JJ_1 . . . in Fig. 30 now become the radial lines correspondingly lettered in Fig. 31, and the pitch surface is drawn through the points $AH_1I_1J_1$. . . . The positions of maximum pressure are shown at E and Q; at all other points it will be less. The working surface $BGRP$ is found by assuming a radius AB for the roller, and by striking a series of arcs as shown at H_2 I_2 J_2 . . . with the points H_1 I_1 J_1 . . . as centers, and then drawing the working curve tangent to these arcs. With the same specifications for the up and down motions of the follower, as given by items (a) and (b) in the data, this type of cam will be symmetrical about the line CO in Fig. 31.

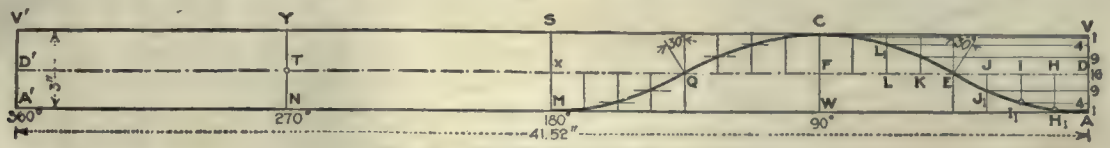


FIG. 30. PROBLEM 3, CAM CHART

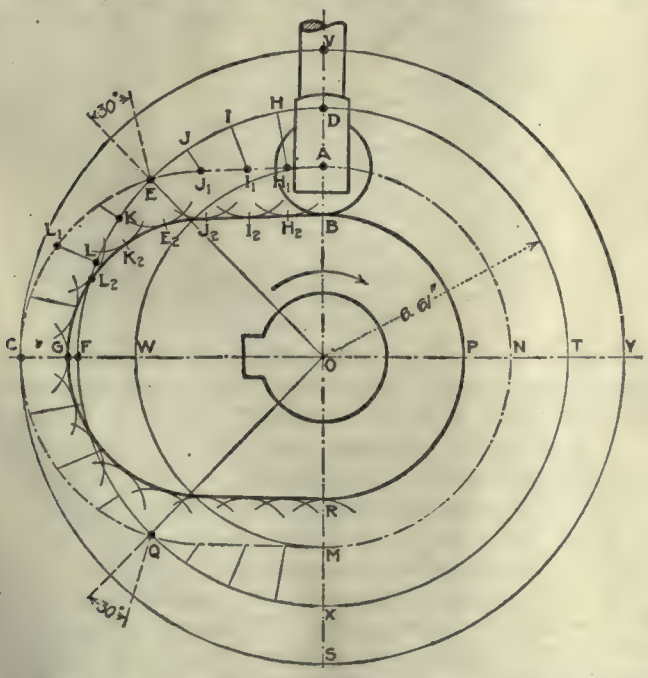


FIG. 31. PROBLEM 3, CAM LAID OUT FROM CAM CHART

Omission of Cam Chart—When the relation between pressure angle, chart base and pitch lines, and cam pitch and surface lines is understood and fixed in mind the actual drawing of the chart for the graphical construction of simple cams and particularly of single-step cams may be omitted with full confidence when the elementary base curves are used. For example, the problem in the previous paragraph is shown completely worked out in Fig. 32 without any reference whatever to the chart of Fig. 30. The radius OD of the pitch circle, Fig. 32, is obtained directly from the formula, $r = 57.3 \frac{hf}{b}$ given in Article II. Substituting the data as given in the previous paragraph $r = 57.3 \frac{3 \times 3.46}{90}$ $= 6.61$ and is laid off at DO. The assigned motion of the follower is laid off symmetrically on both sides of the pitch point D, as at AV, and the distances AD and VD are divided into the desired number of unequal parts, as at 1, 4, 9, 16. The quadrant DF is divided into the same number of equal parts as at H, I, J, . . . and indefinite radial construction lines drawn through the points. Circular construction arcs are next drawn through points 1, 4, 9 . . . until they intersect the radial lines, thus obtaining points H_1 I_1 J_1 . . . on the cam pitch surface. In general a neater construction is obtained by omitting the full length of the construction arcs, as from V to C . . . and simply drawing short portions of the arc at the intersecting radial lines as shown in the lower left-hand quadrant between C and M.

Problem 4. Required a single-step radial cam in which the center of the follower moves in a radial line, the maximum pressure angle not to exceed 30 deg. on the outstroke nor 50 deg. on the return stroke and the follower to move: (a) Out 2 units in $\frac{5}{16}$ revolution on the crank curve; (b) in 2 units in $\frac{3}{16}$ revolution on the crank curve; (c) at rest for ½ revolution.

The diameter of pitch circle of the cam that will be necessary to fulfill the requirements on the outstroke will be:

$$d_a = \frac{2 \times 2.72 \times 16}{3.14 \times 5} = 5.54 \text{ units}$$

from formula in Article II, or

$$r = 0.159 \frac{2 \times 2.72 \times 16}{5} = 2.77$$

and the diameter of pitch circle required for the instroke will be

$$d_b = \frac{2 \times 1.32 \times 16}{3.14 \times 3} = 4.48 \text{ units}$$

Inasmuch as there can be only one pitch circle for a cam the largest one resulting from the several specifications must be used. In this problem then the diameter SD of the pitch circle in Fig. 33 equals 5.54 units. The

follower's motion of two units is laid out at AV and the pitch surface $AECMN$ constructed. The working surface of the cam BKG, etc., is then drawn. Since a larger diameter of pitch circle had to be used for the return stroke than the requirements called for it follows that the pressure angle will not reach 50 deg. on

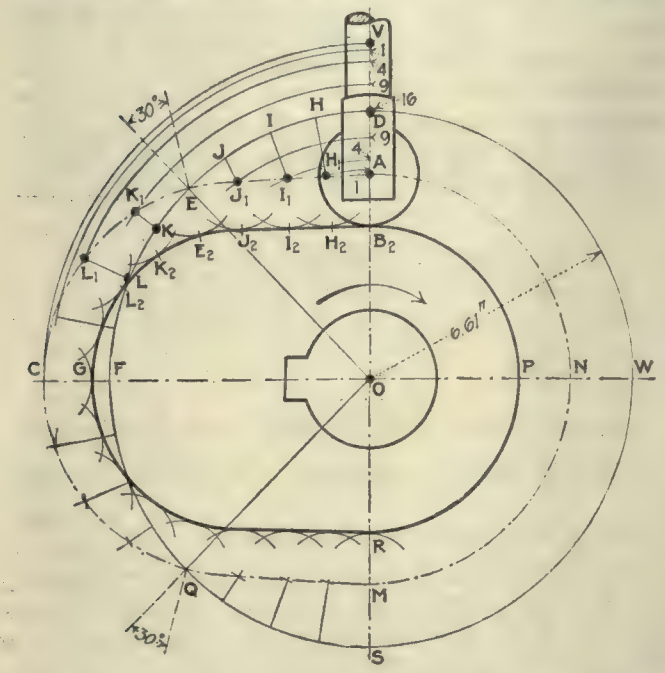


FIG. 32. PROBLEM 3, CAM LAID OUT INDEPENDENTLY OF CAM CHART

that stroke, and it may be of some interest to determine what the maximum pressure angle on the return stroke will be. Substituting the diameter used, 5.54, in the formula $d = \frac{hf}{\pi e}$ and solving for f, f is found to be equal to 1.63. From the chart in Fig. 21, Article II, it is shown that a factor of 1.63 for the crank curve corresponds to a maximum pressure angle of nearly 44 deg., and this angle may be drawn in its proper position at Q in Fig. 33.

Pressure Angle Increases as Pitch Size of Cam Decreases

This is illustrated in Fig. 34, where the large pitch cam represented by D_1 D_2 . . . gives exactly the same motion to a follower as the small pitch cam d_1 d_2 . . . . It will be noted that the pressure angle for the large cam at the start is HDG, while for the small cam it is increased to hdg. Likewise the maximum pressure angle for the large cam when the follower is near the end of its stroke is b_1 while for the small cam the maximum pressure angle is b, which is larger than b_1. From these observations it may be said in general that the larger the pitch surface of the cam the smaller will be the pressure angle. The size of the roller has no effect whatever on the pressure angle. Two cams of the same pitch size may be of totally different actual sizes for the same work, one cam having a large roller and the other a small roller. Therefore it is important to remember that in general the pressure angle may be regulated by changing the size of the pitch surface only and not the working surface.

The circumference of the pitch circle of the cam, it will be recalled, is equal to the length of the pitch line on the chart. It will also be remembered that the pitch line may be at various heights on the chart, depending on the nature of the base curve. It is now important to consider:

First, that the pressure angle at the pitch circle on the cam must be the same as the pressure angle at the pitch line on the chart.

Second, that the pressure angle at any point on the pitch surface of the cam outside of the pitch circle will be less than the pressure angle of the corresponding point on the base curve of the cam chart.

Third, that the pressure angle at any point on the pitch surface of the cam inside of the pitch circle will be greater than the pressure angle of the corresponding point on the base curve of the cam chart.

These statements, which are theoretically true for all cases, except the crank curve, are demonstrated in the following paragraph. For the crank curve the statements are true within a fraction of a degree for any ordinary case.

Cam Considered as a Bent Chart—Consider that the cam itself is the cam chart bent in its own plane so that

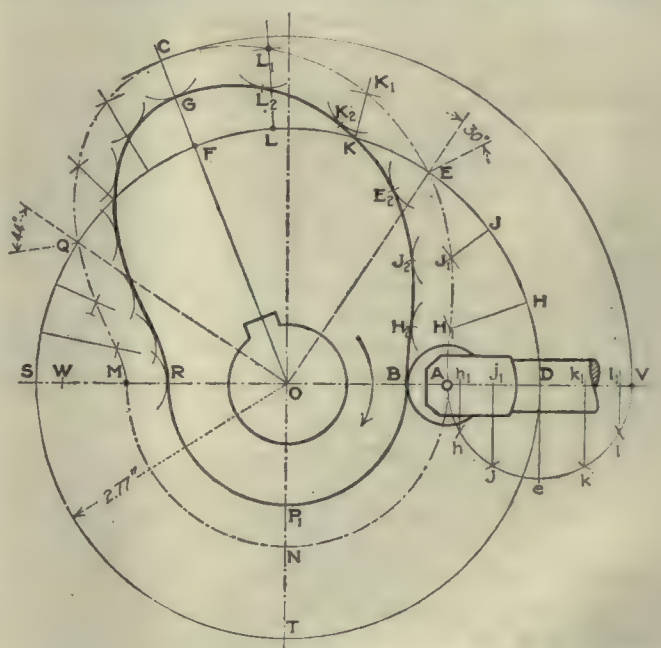


FIG. 33. PROBLEM 4, MAXIMUM PRESSURE ANGLE DIFFERENT ON THE TWO STROKES

the pitch line becomes the pitch circle without being either stretched or compressed. Then the line DD', Fig. 30, becomes the circle $DFXT$, Fig. 31; the line VV' is stretched to become the circle $VCSY$, and the straight line AMA' is compressed to become the circle AMA. This means in a general way that the rectangle $DVV'D'$, Fig. 30, is so distorted that if a straight diagonal line had been drawn from D to V' it would have an increased length and a decreasing slant after the bending had taken place. With a decreasing slant of the pitch surface the pressure angle will decrease. Likewise a diagonal drawn from D' to A in the original rectangular chart would be decreased in length and would have an increasing slant in the cam and the pressure angle would be increasing toward A. This is illustrated in detail in Figs. 35 and 36.

Base Line Angles, Before and After Bending—The

pressure angle of 30 deg. at *E* in Fig. 35 is reduced to 23 deg. in Fig. 36, and the 30 deg. at *D* are increased to 41 deg. Fig. 35 represents a cam chart with a straight base line *DE*, and Fig. 36 is a corresponding cam sector with *DE* as the pitch surface. If

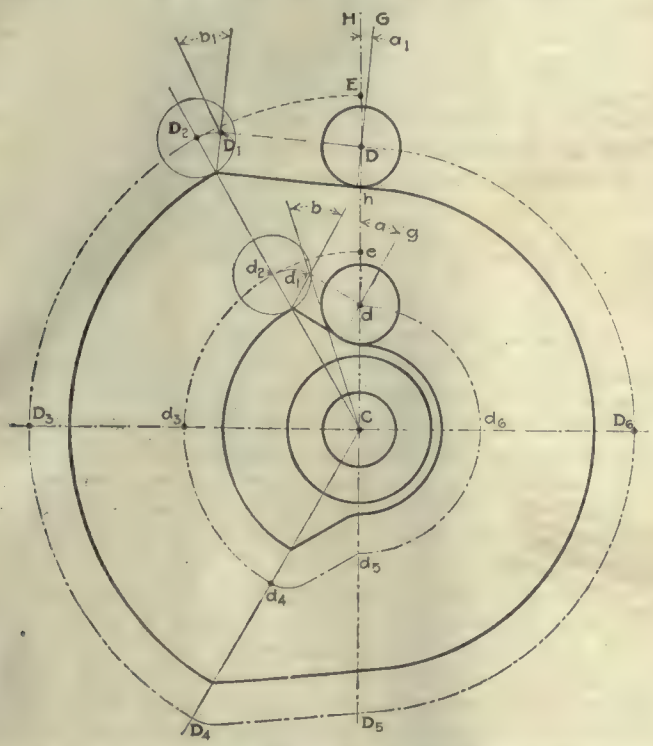


FIG. 34. SHOWING RELATION BETWEEN PRESSURE ANGLE AND SIZE OF PITCH CAM

BC, Fig. 35, is taken as the pitch line, *BC*, Fig. 36, will be part of the pitch circle. The uniform pressure angle of 30 deg. from *A* to *E*, Fig. 35, will grow smaller beyond *A* in Fig. 36 for the reason that the radial components of the tangential triangles remain constant, as illustrated at *LM* and *NP*, while the tangential components grow longer as illustrated at *EL* which is longer than *AN*. These tangential components are equal respectively to the arcs EL_1 and *AY*. The radial components are all equal as shown at L_1M_1, etc. Consequently, the angles grow smaller from the angle *NAP* to *LEM*. Similarly the angles grow larger from *NAP* to *QDR*.

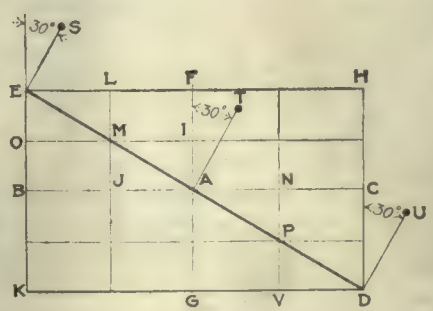


FIG. 35. SECTION OF CAM CHART BEFORE BENDING

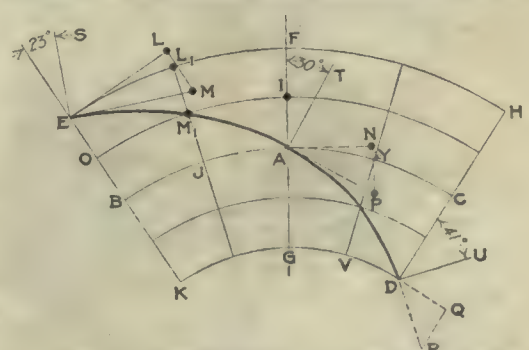


FIG. 36. SECTION OF CAM CHART AFTER BENDING

LIMITING SIZE OF FOLLOWER ROLLER—The radius of the follower roller may be equal to but in general should be less than, the shortest radius of curvature of the pitch surface when measured on the working-surface side. If the radius of the roller is not so taken the follower when put in service will not have the motion for which it was designed.

Case I. Radius of roller equal to radius of curvature of pitch cam—In Fig. 37, *ABEFA* is the pitch surface of a cam; *GA* is the radius of curvature at *A* and *AG* is the radius of the roller. In this case both radii are equal and the working surface has a sharp edge at *G*.

Case II. Radius of roller greater than radius of curvature of pitch cam—From *B* to *C*, Fig. 37, the radius of curvature of the pitch surface is *HB*, which is less than the roller radius. In this case the working surface will be undercut at *I* in generating the cam, and if the cam is built the center of the roller will mark the path $B_1J_1C_1$ instead of *BJC*, and the follower will fail to move the desired distance by amount JJ_1.

Special application of Case II. Effect of an angle in the pitch surface outline—This is illustrated at *RFQ* in Fig 37, and is a special application of Case II, in which the radius of curvature of the cam's pitch surface is reduced to zero. Undercutting is here illustrated by considering that a cutter represented by the dash circular arc is moving with its center on the pitch surface arc *EF*. It then cuts the working surface *MS*. As the center of the cutter is moved from *F* toward *A* the part *WS* of the working surface which was previously formed is now cut away, leaving the sharp edge *W* on which the follower roller will turn when the cam is placed in operation. The center of the follower roller will then move in the path *RTQ* instead of *RFQ* and the follower will fall short of the desired motion by the amount *TF*.

Case III. Radius of roller less than radius of curvature of pitch cam—From *D* to *E*, Fig. 37, the radius of curvature of the pitch surface is *KD*, which is greater than the roller radius. In this case, which is the practical one, although close to the limit, a smooth curved working surface is provided for the roller from *L* to *M*.

Radius of roller not affected by radius of curvature on nonworking side—From C_1 to *D*, Fig. 37, the radius of curvature of the pitch surface is less than the radius of the roller, but this short radius is not on the working side of the pitch surface, and therefore the roller will roll on the surface *IL* while its center travels on the pitch curve C_1D.

Rollers for positive-drive cams—When the largest roller for a positive or double-acting cam is being determined the radius of curvature on both sides the pitch-surface curve must be considered and the smallest radius used. For example, in Fig. 37, if *AJETA* were the pitch surface for a double-acting cam *NC* would be the maximum roller radius, whereas *HJ* would be the maximum radius if it were for an external single-acting cam.

Radius of curvature of noncircular arcs—In illustrating the above cases the pitch surface was assumed as being made up of straight lines and arcs of circles in order to show more effectively and more simply the limits of action in each instance. Where the pitch surface contains curves of constantly varying curvature, and they generally do in practice, the shortest radius of

curvature of the pitch surface may be found with all necessary accuracy by trial with the compass, using finally that radius whose circular arc agrees for a small distance with the irregularly curved arc. For example,

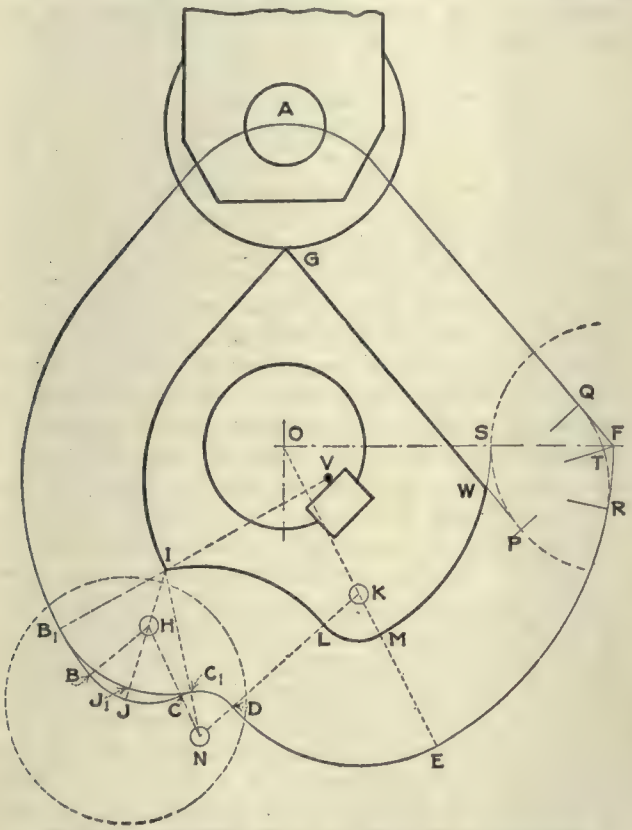


FIG. 37. LIMITING SIZE OF FOLLOWER ROLLER

in Fig. 38, let *GHDJB* be a portion of a pitch surface made up of noncircular arcs. The shortest radius of curvature on both sides is found by trial to be *FH*.

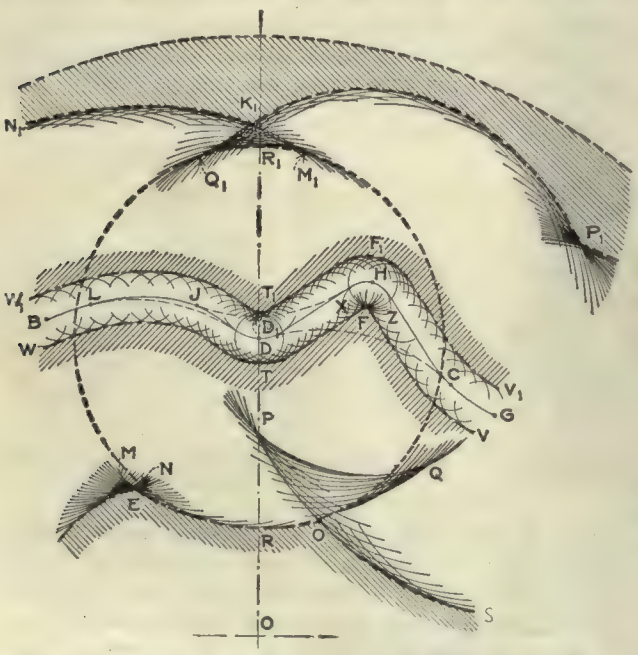


FIG. 38. LIMITING SIZE OF FOLLOWER ROLLER WORKING ON NONCIRCULAR CAM CURVES

The center *F* is marked and the osculatory arc *XHZ* drawn in. Then *HF* is the largest possible radius of roller for a double-acting cam, and with this roller the working surfaces will be *VFTW* and $V_1F_1T_1W_1$.

If a large roller is used with a radius *DR*, for example, the working surfaces of the groove will be *SOE* and $P_1K_1N_1$ and the new pitch surface, after cutting the cam, will be *GCDLB* if the roller is kept always in contact with the inner surface of the groove. If it is kept always in contact with the outer surface of the groove the original pitch surface will be changed to $GCHD_1JB$. In either case the original desired follower motion is not obtained if the roller is too large, and if a positive-drive cam is run with the larger roller the follower's motion will be indeterminate, the center of the roller having any possible position between *CDL* and CHD_1JL.

Checking Out Tools From the Crib

ROBERT M. HAYES

The brass-check system of keeping track of the shop tools which are supplied to workmen from the tool crib is in almost universal use, but it has inherent faults, not the least annoying of which is the occasional loss of a check and the consequent suspicion directed toward the unfortunate individual whose number it bore. A modification of this system which has come under the writer's observation has resulted in the elimination of most of this trouble.

A board having a numbered hook for each employee is hung in the crib, and at the window is kept a stack of cards about 2 in. square, each with a small hole pierced near one corner. When a man wants a tool he writes its name and his number on two of these cards. The keeper then hangs one card on the correspondingly numbered hook and puts the other in place of the tool which he hands to the workman.

When the tool is returned the workman gets back his two checks, which he destroys. Thus the keeper can tell by a glance at the board whether or not a workman has any of the company's tools, and if he has, can easily determine what they are.

The only chance a workman has to beat this system is to sign another man's number to his checks, but the keeper soon gets to know each man by number and such dishonesty becomes impossible.

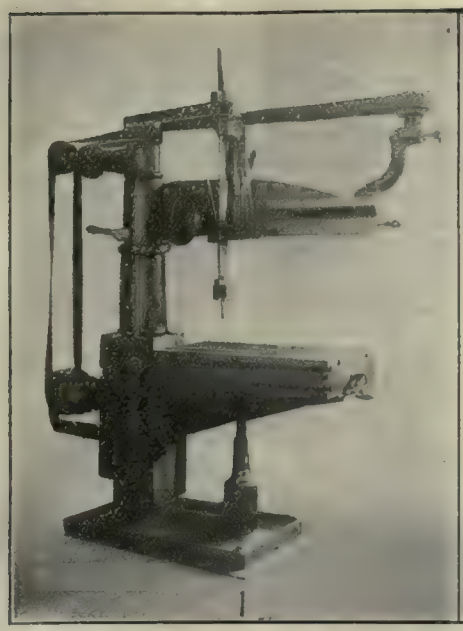
Carbon Paper in the Drafting Room

BY JOHN S. CARPENTER

Carbon paper is usually associated with the click of typewriters and the odor of *eau de cologne*, but if given a trial in the drafting room it will be found to lend itself readily to some details of the work that without it would require more time, and thus it becomes an aid to efficiency.

Sometimes one has a tracing of a machine part that he desires to transfer to a drawing. This can be done very easily by positioning the tracing upon the drawing and then slipping the carbon under it. The lines of the tracing are then gone over with a smooth pointed pencil or other suitable tool, leaving a clear and sharp reproduction upon the drawing.

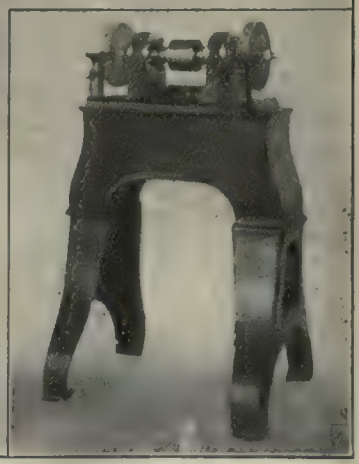
If small drawings are needed for salesmen or for the shop, they may be made on thin paper under which is a sheet of carbon paper that may be used as a tracing to secure neat white prints on blueprint paper. With a good quality of carbon paper the time necessary for printing is not greatly in excess of that required when using tracing cloth.



GOVERNMENT MACHINERY IN SCHOOL SHOPS

BY R. W. DERBY

This article presents tangible evidence of the work done in the machine shops of some of our preparatory schools and indicates what might be accomplished in such schools if the bill proposed by Mr. Caldwell in the House of Representatives should pass and make available for use some of the machine tools standing idle in army supply depots and shops.



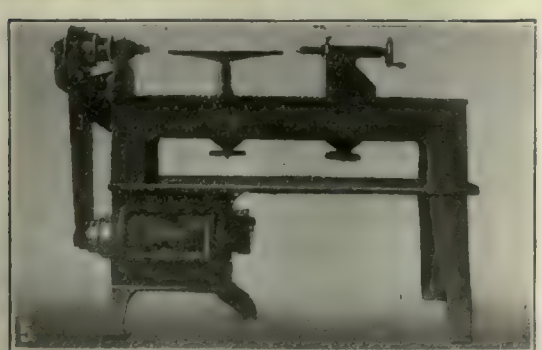
APROPOS of the bill pending before Congress to lend to technical and manual-training schools the surplus of machine tools owned by the Government and of no use to it now that peace is practically assured, it might be well to call attention to some of the work that has been done and the kind of work that is undertaken in these schools.

Many people have the erroneous idea that all school shops are merely playgrounds where pupils may while away an hour or so each day, more for recreation than for profit, and that these machines could be put to a better use than simply serving as toys. It is to correct this idea, so far as possible, and to arouse sentiment in favor of Congress passing the proposed measure that this article is submitted. In the University School, Cleveland, Ohio, which is a college preparatory school embodying manual training as a necessary preparation for a technical course, there is a woodworking shop, a machine shop and a forge shop, in each of which, so far as conditions will permit, practical shop work on a shop basis is undertaken. As it is the machine shop that is of most interest to those concerned in the pending bill, I shall direct attention to the things done there.

The school is equipped with two 14-in. engine lathes of the old type—no taper-turning attachment, no power cross-feed, and the change gears being changed by hand. There is also one 22-in. lathe of the same type, save that it has power cross-feed, a 24-in. planing machine, a 14-in. shaping machine, an 18-in. drilling machine, a sensitive drill and five hand lathes. In addition to these are the following machines which were made in the shops of the school: One 3-ft. American radial drilling, 1 grinding, 1 buffing and 2 centering machines and three motor-driven lathes. The illustrations will show more clearly than words what has











FIGS. 3 TO 7. PRODUCTS OF THE UNIVERSITY SCHOOL MACHINE SHOP

Fig. 3—Buffing machine. Fig. 4—Centering machine. Fig. 5—Motor-driven machine. Fig. 6—Drawing table and stool. Fig. 7—Lantern at dormitory entrance.

been accomplished. The castings and drawings for the radial drill, Fig. 1, were furnished by the American Tool Works Co., Cincinnati, but all the machining, finishing and fitting was done by boys under 19 years of age.

Machining the Castings Required a Great Amount of Scheming

When the machine equipment of the school is considered it will be realized that machining these castings required a large amount of scheming, and had the base been but ¼ in. wider it could not have been planed; the setting and boring of the radial arm in the 22-in. lathe was no small matter. It should also be remembered that while there was a teacher to advise and suggest, the work was all done by the boys and many of the awkward machine operations were engineered entirely by them.

The grinding machine, which in Fig. 2 is shown without guards, was designed and made here, as was also the buffing machine, Fig. 3. Both are equipped with SKF ball bearings and both have been set on some old machine legs that were on hand. The heads, it will be noticed, are solid, and the spindle caps have grooves turned in them for felt dust washers. While it may look as though the assembling of the head was difficult it was in reality quite simple.

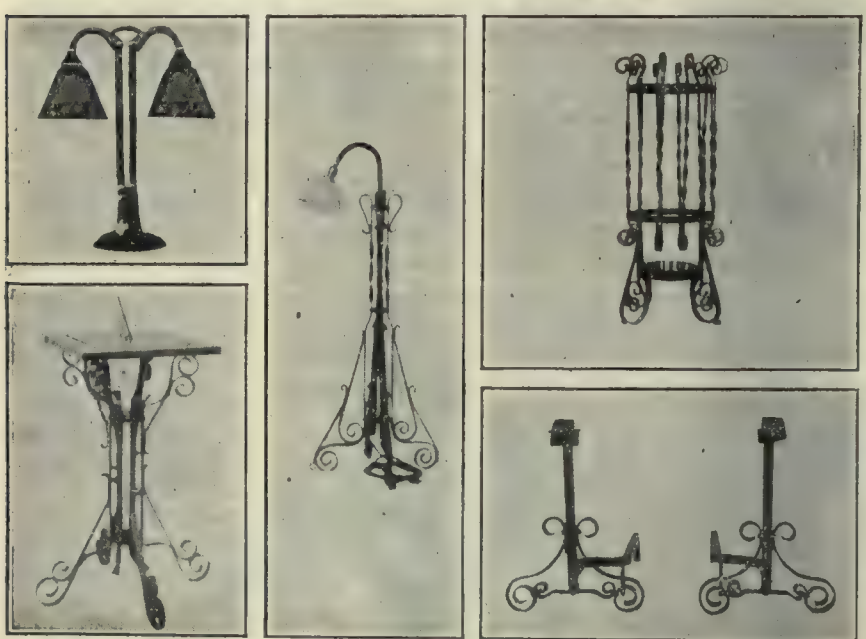


FIG. 8. EXAMPLES OF BRASS AND FORGE WORK

The motor-driven lathe, Fig. 5, is another of our products which we are very proud of. I think the picture will speak for itself. The centering machine, Fig. 4, was the first of these machines to be made in the shops and has been in service for about 15 years.

In addition to the machines mentioned the school has made 30 drawing tables and tools, Fig. 6, a description of which was published on page 131, Vol. 49, of the *American Machinist*, and it is now working on an adjustable school desk.

The bronze lanterns at the entrance to the school and the copper lantern at the entrance to the dormitory, Fig. 7, were designed and made by the boys.

This year the school is repairing and completely rebuilding a 1914 Ford touring car, which was undertaken because of the scarcity of metals for other work, and it has been found to be an excellent and helpful study. The drop light and, sundial show some brass work while the sundial and umbrella stands, andirons and floor lamp give an idea of the forge work, Fig. 8. The school has in its possession pictures of many other things that have been made by the boys in its shops, ranging from brass bookracks to gas and steam engines, but I think the foregoing will serve to show that it is worth while to put some of the idle equipment owned by the Government at the disposal of good schools where the purpose is serious and the results significant.

Easy Method for Calculating Decimal Equivalents

By Harvey Mead

One may with a little practice find the decimal equivalent of any common binary fraction of an inch almost instantly by the use of the method here outlined.

For convenience the fractions are divided into two groups, viz., major and minor. The major fractions are: $\frac{1}{8} = 0.125$; $\frac{1}{4} = 0.250$; $\frac{3}{8} = 0.375$; $\frac{1}{2} = 0.500$; $\frac{5}{8} = 0.625$; $\frac{3}{4} = 0.750$; $\frac{7}{8} = 0.875$. The minor fractions are: $\frac{1}{16} = 0.0625$; $\frac{1}{32} = 0.03125$; $\frac{1}{64} = 0.015625$; $\frac{3}{64} = 0.046875$. To find the decimal equivalent of any fraction take the nearest major fraction and add or subtract the nearest minor fraction. For example, to find the decimal equivalent of $\frac{7}{16}$: The nearest major fraction is $\frac{1}{2}$ or 0.500, and the nearest minor fraction is $\frac{1}{16}$ or 0.0625; subtracting the minor fraction we have as the decimal equivalent, 0.4375. To find the decimal equivalent of $\frac{25}{32}$: The nearest major fraction is $\frac{3}{4}$ or 0.750, the nearest minor fraction is $\frac{1}{32}$ or 0.03125; adding these we get 0.78125. To find the decimal equivalent of $\frac{53}{64}$: The nearest major fraction is $\frac{7}{8}$ or 0.875, the nearest minor fraction is $\frac{3}{64}$ or 0.046875, subtracting we find the decimal equivalent to be 0.828125. From this it will be seen that the most one will have to add or subtract at any time is the equivalent of $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, or $\frac{3}{64}$. Since everyone knows the decimal equivalents of the major fractions it is an easy matter to learn the equivalents of the minor fractions. Four places is all one needs and three in most cases will be sufficient.

[The foregoing method involves memorizing 11 equivalents and, in addition, performing four distinct mental operations every time any one of the remaining 52 is required: viz., determining the nearest "major fraction"; determining the nearest "minor fraction"; ascertaining whether the computation is to be addition or subtraction; and making the calculation. In the days of our youth we were required to memorize these equivalents and repeat them from memory exactly as in our pinafore period we were taught to recite c-a-t cat, d-o-g dog, etc. We still believe that these equivalents should be taught to all students and apprentices. There is no royal road to learning in either the school or the machine shop; the real mechanic must know the a-b-c of his trade.—Editor.

AUTOMOTIVE CONSTRUCTION

The Manufacture of Marine Gas Engines

By J. V. HUNTER

A demand has recently been made manifest for powerful gas engines of comparatively light weight for marine and other powers. This has enabled one manufacturer to adapt his machines and fixtures to handling heavier work of this class than has been usual in quantity production.

THE manufacture of marine gas engines has been interestingly developed in the shops of the Van Blerck Motor Co., Monroe, Mich., which has specialized in the manufacture of heavy marine gas engines of from 4 to 12 cylinders each. Rather than build such special machine tools as are found in many automobile-engine plants the management has constructed numerous jigs and fixtures to adapt standard machine tools to the rapid production of its work.

Standardization has been carried out in the construction of this engine to as great an extent as possible, the cylinders being all of the same bore and stroke for all sizes of engines. Different engine powers are provided for by varying the number of cylinders. Many parts can thus be made standard for all sizes of engines, the necessary variations being confined to crankshafts, engine bases, etc. The capacity of the shop is gaged to produce a certain number of finished cylinder parts weekly, and this rate of production is maintained regardless of the number of other parts which are required to make up whatever quantity of engines may be under construction.

Special jigs and fixtures have been constructed for machining the gas-engine cylinders that are different from those generally found in this line of work. One of these, shown in Fig. 1, holds the cylinders while the flanges for connecting intake and exhaust manifolds and water circulation are finished on an Ingersoll milling machine. The cylinders are made in pairs, or two cylinders to each casting, and in this view two such pairs are shown in place while a third section is empty. The points *A* are small plugs which fit into drilled holes in the base of the cylinders to align them in the same position that they will occupy on the engine bed and insure that the flange surfaces will be milled correctly. The opening on the side of the cylinder shown in this view is the circulation water outlet, and a cutter on the opposite side of the machine finishes the inlet at the same time.

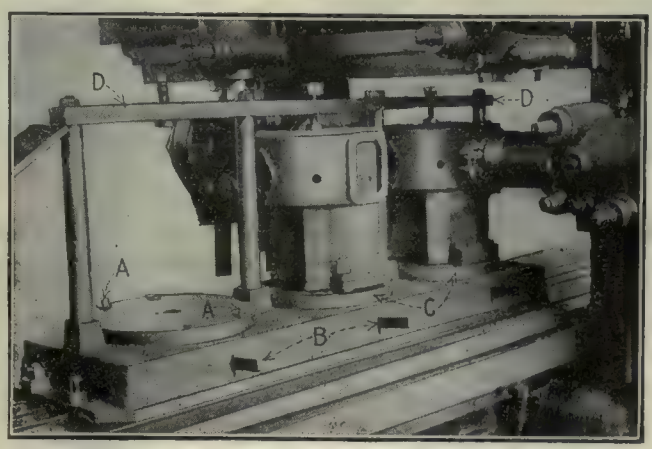
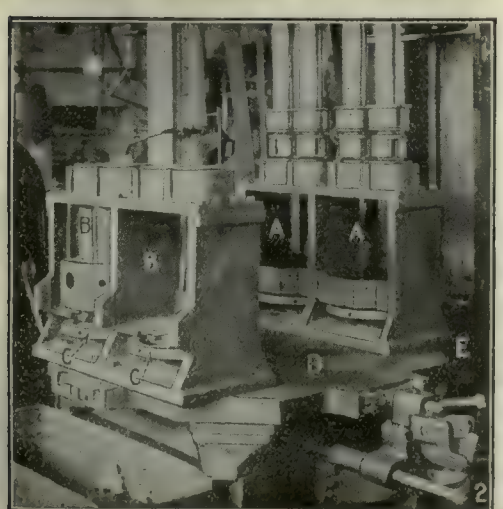


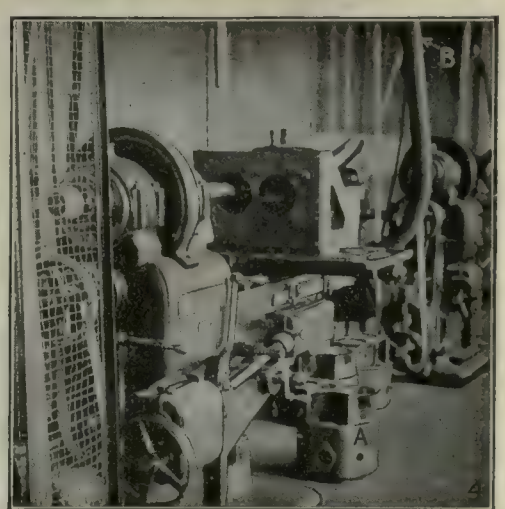
FIG. 1. MILLING SURFACES FOR MANIFOLD AND WATER CONNECTIONS

The levers *B* control the latches which locate the turntables *C* on which the castings are clamped, and when the work in this position is finished the tables and castings are turned 90 deg. to bring the intake and exhaust-manifold connections in position to be operated upon. To insure added rigidity while in the fixture, the cylinders are clamped down by a heavy set-screw and centering device which passes through the top bar *D*.

Fig. 2 shows the fixture and a portion of a special Beaman & Smith boring mill which was built for boring the cylinders. The center distance of each pair of boring spindles, being determined by the corresponding measurement on the cylinders themselves, is necessarily







FIGS. 2 TO 4. OPERATIONS ON CYLINDERS

Fig. 2—Special machine for boring cylinders. Fig. 3—Indexing jig for drilling valve holes. Fig. 4—Fixture for grinding cylinder bore.

AUTOMOTIVE CONSTRUCTION

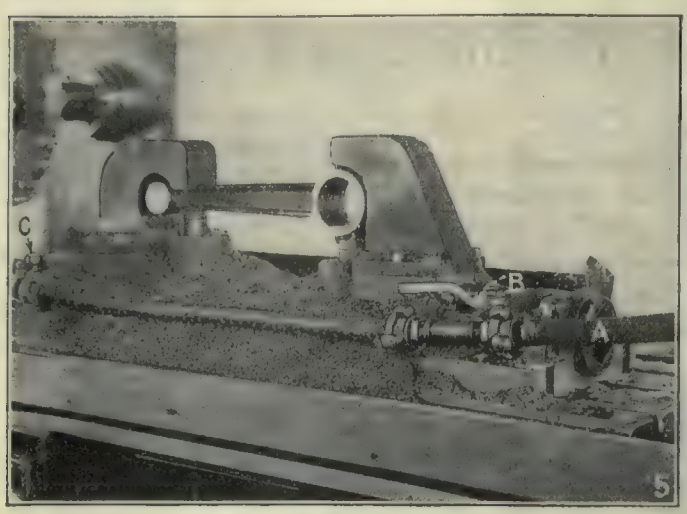


FIG. 5. THE PNEUMATIC HOLDING FIXTURE

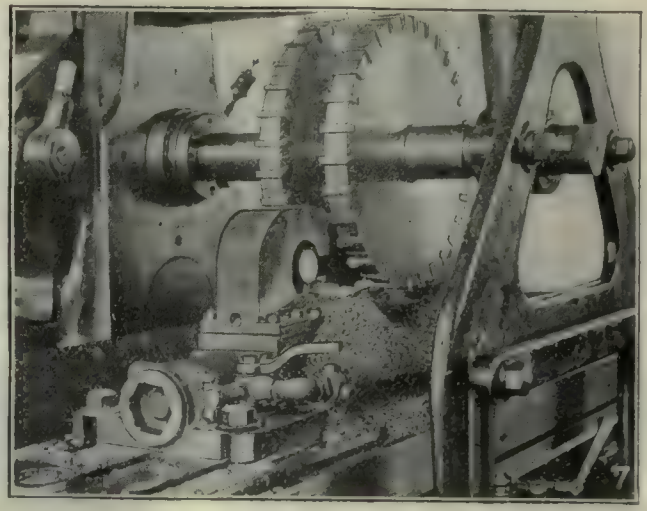


FIG. 7. SHOWING THE SET

small. The four spindles work simultaneously, and while the boring operation is going forward on two cylinder units at *A* two other units are being set in place at *B* in the remaining portion of the boring fixture.

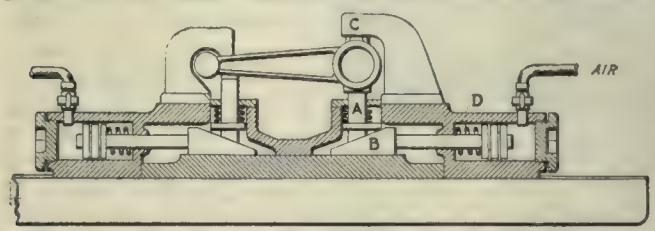


FIG. 6. DETAILS OF THE PNEUMATIC HOLDING FIXTURE

In this view one of the cylinder units is in place in the fixture at *B*, the other three positions being unoccupied. Hardened-steel bushings are provided to guide the boring bars and insure accurate alignment of the bores. The boring tools and reamers used are made by the Kelly Reamer Co., Cleveland, Ohio. The work is clamped by screws and handwheels *C*, which exert pressure on the head of the cylinder to force its previously milled base firmly against the top plate of the fixture. The turntable *D* rotates about a central stud, the indexing levers and stops for locating it being shown at *E*.

An indexing jig, Fig. 3, is used for drilling the valve chambers forming the valve seats and drilling for the stems. The cut does not show the jig in working position. The valve-stem reaming bar *A*, with reamer, is shown above the jig, and bushings in the latter serve to align it by means of a hardened-steel collar on the bar. By tripping the indexing lever *B* the jig may be turned to bring the next hole in line with the boring bar. This movement will not be an equal distance in each case, but the index plate takes care of this according to the spacing of the holes. A Hoefer gang drilling machine was used to replace the jig.

Another Holding Fixture

Another special holding fixture is used on a Heald internal grinding machine to hold the cylinder units during the grinding of the cylinder walls. Fig. 4 shows this fixture in place on the machine and one of the cylinder units on the floor at *A*. A flexible suction pipe *B* is connected to an exhaust fan for the purpose of carrying the dust of grinding away from the work. This pipe is suspended from the ceiling, and makes a

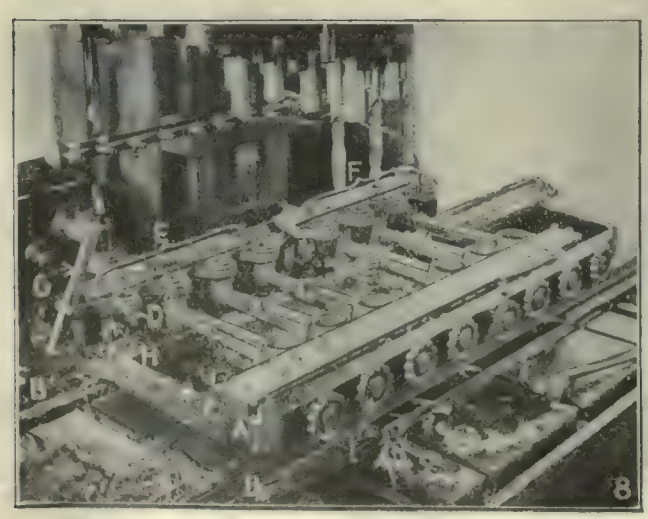


FIG. 8. JIG FOR DRILLING CONNECTING-RODS

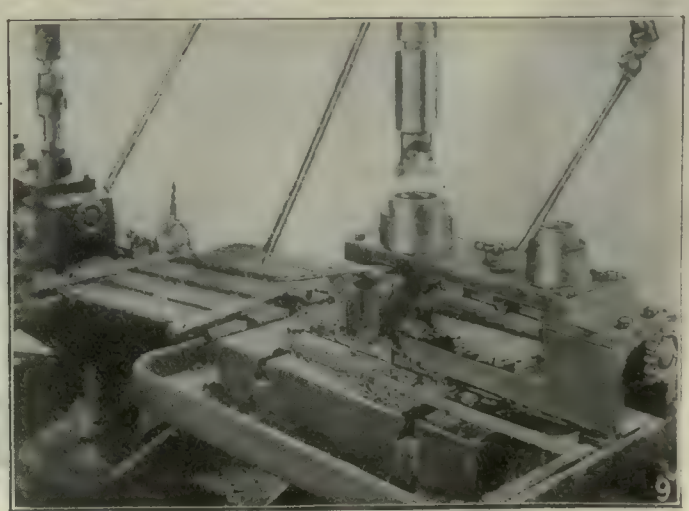


FIG. 9. BORING AND REAMING THE RODS

AUTOMOTIVE CONSTRUCTION

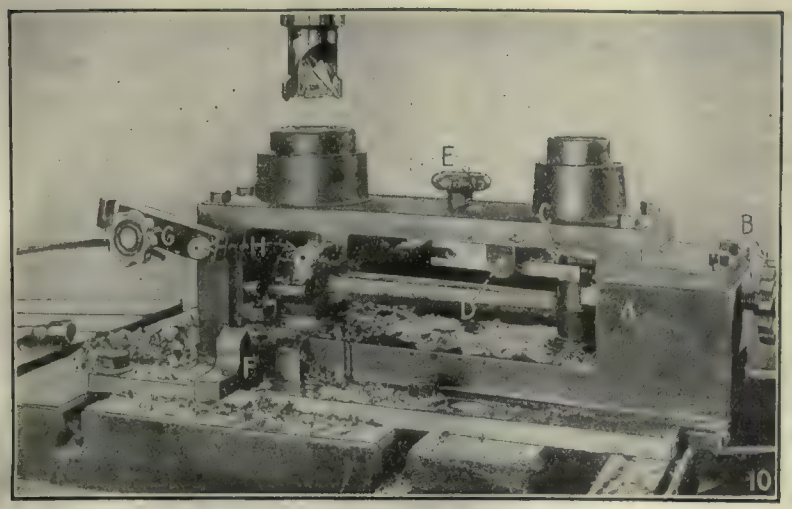


FIG. 10. A COMPENSATING JIG

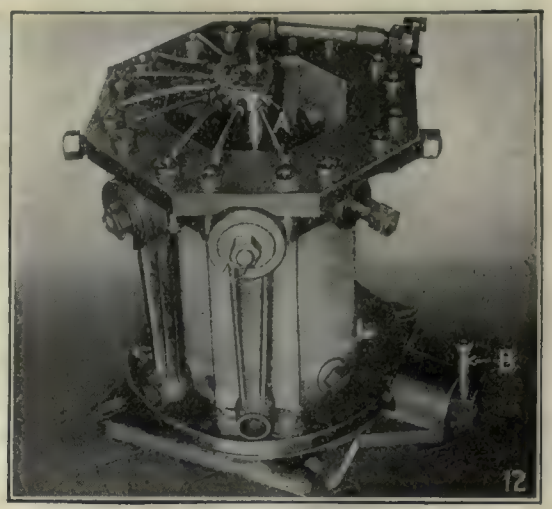


FIG. 12. INDEXING JIG FOR DRILLING

convenient arrangement, as the machine can be easily and conveniently operated without interfering with it.

In machining the connecting-rods it is necessary to guard against possible distortion caused by clamping them in their fixtures and thus throw the bores and finished surfaces out of line. A thorough study was made of the different methods which could be employed for holding them.

The first operation is the straddle-milling of the two parallel faces, and for this work the pneumatic holding fixture shown in Fig. 5 was designed. A cylinder is located at each end of the device to insure independent gripping and eliminate the possibility of leaving one end loose, as could easily occur from variation in the size of the forgings if but one cylinder was used to operate both ends. The air pipe *A* feeds both cylinders through the cocks *B* and *C*. The operation of this device may be better understood from Fig. 6, which shows how the air piston thrusts a wedge beneath the plungers *A*. The hardened tool-steel wedges *B* have a working angle of 20 deg., which exerts a pressure on the plungers, gripping the work firmly between the upper ends of the latter and the overhanging brackets *C*. When the air is released the springs *D* withdraw the wedges and release the work. Another view of this fixture in Fig. 7 shows the air cylinder for the small end of the connecting-rod and the two large inserted tooth mills.

The small ends of the connecting-rods are forged solid and a preliminary drilling operation removes the major portion of the stock before the final boring and reaming operation. A jig, Fig. 8, is provided for this work, which holds four connecting-rods undergoing the drilling operation, while four more are being inserted in the opposite end. The main body *A* of this jig slides on the track *B* so that it may be pushed to the right or left to bring it beneath the drills. As here shown, three connecting-rods *C* are in the jig, while the fourth space is empty.

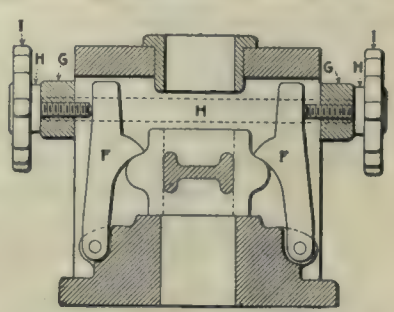


FIG. 11. DETAILS OF THE COMPENSATING JIG

The drill bushings *D* are carried on movable sliding pieces, *E* and *F*, each of which has four bushings, and

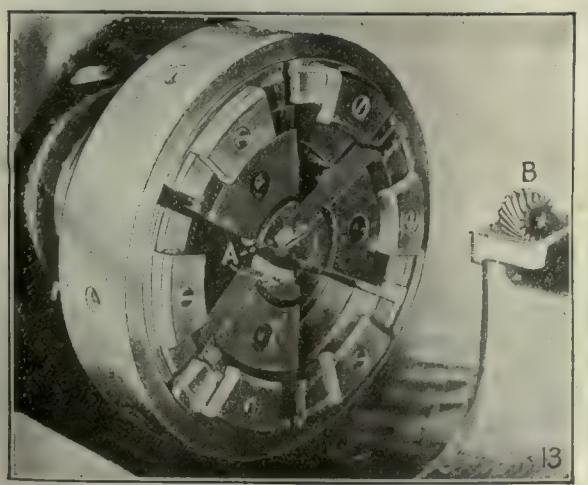


FIG. 13. CHUCK FOR GRIPPING SPIRAL GEARS BY THE BASE OF THE TEETH



FIG. 14. COMPENSATING FIXTURE FOR HOLDING OIL PANS

AUTOMOTIVE CONSTRUCTION

when one section is in line with the connecting-rods, as at *E*, ready for drilling, the other four are spaced halfway between, permitting the ready removal and insertion of work in that half of the jig that is idle. The bushing holding parts are moved back and forth between fixed stops by means of the hand levers *G*. The small end of the connecting-rods fit into V-blocks *H* which are firmly attached to the casting *A*. Movable V-blocks at the other end of the rods are backed by the screws and small handwheels *I* by means of which the work is clamped in the jig.

The final boring and reaming operations on the connecting-rods are done in the Colburn drilling machines, Fig. 9. The machine at the right bores and reams the large hole, and then the jig is moved across to the other machine. The wooden platform *A* serves as a bridge to assist the workman in making the transfer.

It is very necessary to avoid springing the work when clamping, for reasons before noted, and in Figs. 10 and 11 may be seen in detail the method by which this is accomplished.

The rod is held by endwise pressure of the V-block *A* backed by the screw and handwheel *B*. The small end is prevented from lifting by the forked end of lever *C*, which is fulcrumed at *D*, and its opposite end drawn up by screw and handwheel *E*.

To hold down the large end of the rod the jig is provided with the latches *F*, Figs. 10 and 11, which get a grip on the heavy rib, or lug, which forms a portion of the section of the connecting-rod at this point.

When these latches are raised into the position shown in Fig. 11 the links *G* on either side of the fixture are swung down to a horizontal position, the ends hooking back of the shoulders on stud *H*. Both this stud and its mate pass clear through the jig casting, in which they are a sliding fit, and entirely support the links *G*, so that when pressure is put on the backs of the latches *F* by the handwheels and screws *I* the pressure is balanced between the two sides of the work. Thus a compensating hold is secured which has no tendency to distort

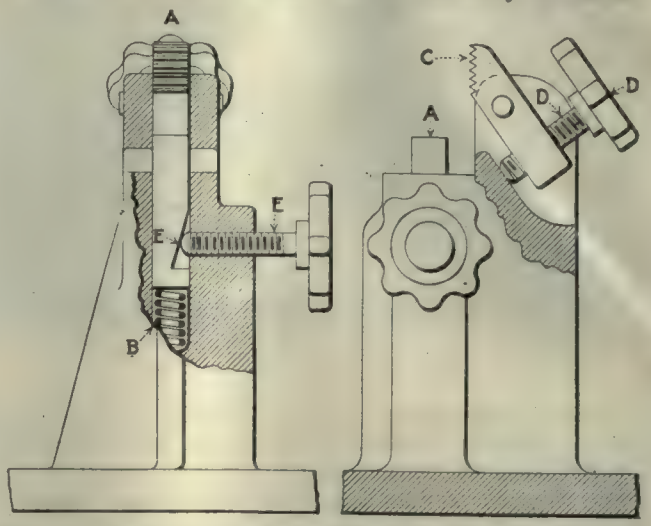
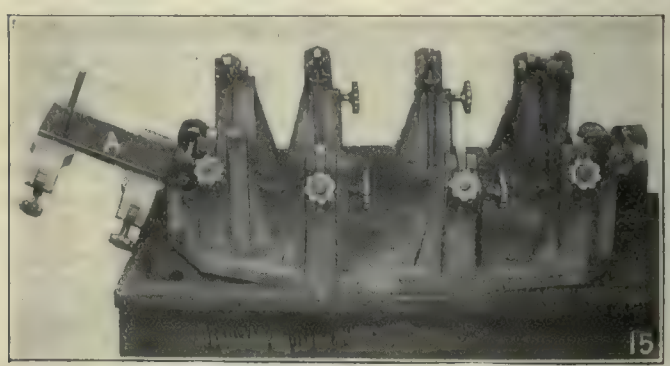


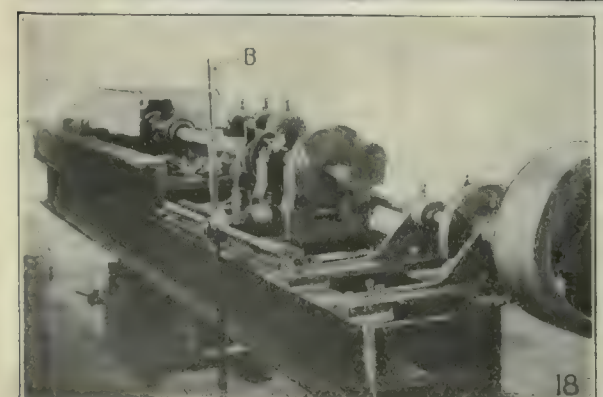
FIG. 16. DETAILS OF THE COMPENSATING FIXTURE FOR HOLDING OIL PANS

the forging. Kelly drills and reamers are used for removing the stock and several are shown in the illustrations.

Another indexing jig, Fig. 12, is used for drilling the holes for the cap bolts on the rod ends. This jig is so constructed as to permit the operator to unload and reload one-half the number of sections while the drills









FIGS. 15, 17, 18 AND 19. FIXTURES AND SOME OF THE MACHINES USED FOR THE WORK

Fig. 15—Fixture for holding oil pans while milling. Fig. 17—Old lathe improvised for boring bearings in the oil pan. Fig. 18—New machine for the same purpose. Fig. 19—Line reaming machine for camshaft brackets.

are working in the opposite half. A multiple drill is used, operating on four rods and cutting eight holes at a time. Distributing pipes for cutting compound serve that half of the jig in which the drills are working, the leads being fastened into the stationary head *A*. When the drilling is finished on the loaded half of the jig the locking pin is withdrawn by means of the handle *B* and the jig turned 180 degrees

All of the spiral gears used for the timing equipment of the gas engines are machined on a Fellows gear-shaping machine, and after hardening it is the practice to grind the bore on a No. 6 Bryant chucking grinding machine. The chuck used for this work, shown in Fig.

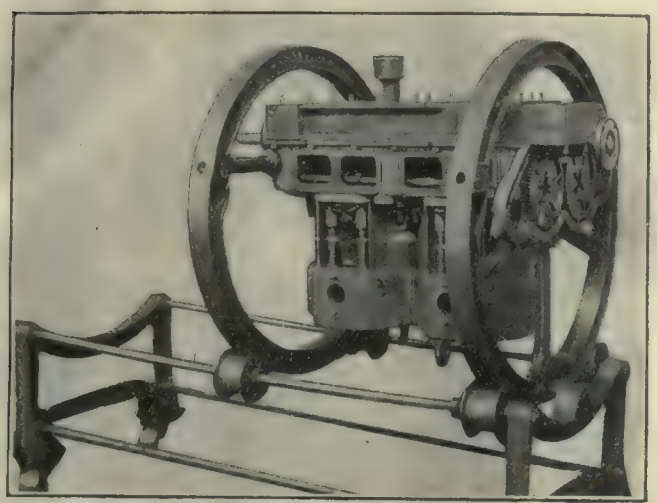


FIG. 20. A CRADLE FOR ERECTING ENGINES

13, is interesting because it grips the gears at the base of the teeth in order to insure perfect alignment and prevent crushing or distorting the tooth shape. The chuck jaws each have a projection *A* corresponding to the shape of a tooth space, and these projections, or "teeth," mesh with the teeth of the gears, thus gripping them at their base. One of the spiral gears is shown at *B* in this illustration.

The machining of the engine bases and oil pans present some peculiar problems. They are made of bronze and aluminum in order to combine strength with lightness, and the nature of these materials has necessitated the design of special holding fixtures that may be securely clamped for the different machining operations without danger of distortion. An instance is found in the design of the fixture which has been constructed for holding the oil pans during the milling operations on their top surfaces. A heavy and rapid cut is taken over a wide area and it is imperative that the work be securely held, yet all stresses must be carefully balanced, to prevent springing and distortion of the thin aluminum sections. The holding fixture is shown, Fig. 14, with the oil pan in position, and in Fig. 15 one of the holding plates has been swung open and the pan removed, disclosing the internal arrangement.

Each of the columns (of which there are eight) that support the work is arranged as shown in Fig. 16. The work when laid on the fixture rests on the studs *A*, which are supported by the springs *B* which hold them against the face of the casting, thus insuring a support at each of eight points. These springs are so designed that they are not sufficiently strong to sustain the weight of the casting, and the latter settles until it comes in contact with fixed stops which determine its height in the fixture. The serrated lever jaws *C* are then brought to bear by means of the handwheel and screw *D*, insuring that the casting will stay down. The operator then turns the adjusting screws *E* beneath the spring-actuated supporting studs *A*, causing them to become fixed stops capable of sustaining the thrust of the cut. In order to insure that there shall be no slipping of these studs they are beveled, as indicated at *F*, and the end of the holding screw bears on this bevel and prevents the stud from slipping down. On completion of the work when the jaws are released and the piece lifted off, the spring *B* raises the studs until the bottom of the notch catches on the end of the screw *E*, which prevents it from coming out of the hole.

The inside holding plate *A*, Fig. 15, is also provided with serrated jaws, and serves to stiffen the inside of the forward end of the oil pan, which is not provided with a cross-web at this point.

The boring of the bearing seats was originally done on the fixture shown in Fig. 17, which was mounted on the bed of an old lathe and which supported both the casting and the boring bar. A new horizontal boring machine has just been completed, Fig 18, on which the casting is turned upside down, and a long boring bar reaches the length of the machine and is supported at both ends. The same bar can be used for boring castings for all lengths of engines, which, as previously noted, vary from 4 to 12 cylinders each. The boring bar is carried by a geared-drive head *A*, which slides in ways and is moved lengthwise of the machine bed by a rack and pinion under control of the capstan wheel *B*. The bar has no lengthwise movement relative to the head, and consequently movement of the latter provides the feed.

A large four-bar line-reaming machine, Fig. 19, was also designed and built by the Van Blerck Motor Co. for reaming the crank and camshafts of the cylinder-base castings. Two of the bars are shown in place; they are slipped through the bearing brackets and individual reamers are slipped onto this arbor-like bar, being spaced between the series of bearing brackets shown. In all there are four bars used in line-reaming this casting, because, as the cylinders are of the T-head type, there are two lines of camshaft bearings in addition to the crankshaft, and the fourth boring bar takes care of the bearings of the timing shaft.

During the assembling of the motor the peculiar-shaped framework, Fig. 20, is used for rolling the motor units over in order that the operators may readily get at the under side of them. Throughout most of the assembly the sector of the circle shown uppermost in the view is at the bottom and carries the motor base and cylinders, but when ready to put on the oil pan and adjust the bearings the larger sector is put in place and bolted up, and the machine is then rolled over into the position shown. When in the reversed position the short sectors are removed to place the oil pan; then replaced and the motor rolled back into an upright position. It will be noticed that the base of this framework is mounted on wheels, which allows it to be moved freely about the shop.

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

Community Guarantees for Piece Prices

By JOHN C. SPENCE
General Superintendent, Norton Grinding Co., Worcester, Mass.

This article points out very clearly the high cost of unskilled labor and the economy of real producers even at high wages; it shows how the man who doubles the output of his machine adds greatly to the shop equipment without increasing plant investment; that double wages are cheap in comparison to the shop efficiency and the profits. The suggestions for the establishment of training schools, of suitable personal relations and the guaranteeing of agreed wages by the manufacturers of the community, are all worth careful consideration.

TRAINING in industry is a very broad subject and the idea conveyed to one's mind by the word depends almost entirely on the occupation or experience of the individual. Because of the great demand for workers of all sorts during the past four years, every essential industry has been compelled to train people, either consciously or unconsciously.

This training ranged all the way from the very simplest possible performances to those requiring extreme skill. I have seen a former inhabitant of the Balkans absolutely stuck when the two-wheeled freight truck he was pushing steered over against the wall of the factory. Nobody had taught him what to do in such a contingency, and he had not enough intelligence to back the truck away from the wall, cramp it around and go ahead.

I have a friend who operates a foundry. He was compelled, finally, to accept common laborers of such low intelligence that they could not, without training, steer a wheelbarrow down a foundry lane 4 ft. wide without smashing the molds that defined the lane.

The form of training that concerned us during the past four years and especially during our own participation in the war had to do principally with the item of productive operations only. We had no time to enter into the training of executives. These we created by the simple process of filling the gap with whatever we had on hand, being fortunate if the candidate had anything beyond his manual skill to recommend him. No organized, definite movement had been made to better these conditions, and, in fact, the question did not receive the serious attention of either the Government or of industrial organizations until we ourselves entered the war. The common practice from August, 1914, and on, was to go out and get your neighbor's workers away from him by hook or by crook—mostly by crook.

Stealing Labor From Each Other

The common method was to send a representative to establish himself at a hotel in a busy community, to study local conditions as to wages and hours and to advertise for certain specified types of workers at rates that would attain his object. Most of us have been guilty of either this method or the similar though less public and more efficient one of sending a man, who knows his business, to a community and using no publicity whatever except the passing of the word from one workman to his fellows. A smart man can, by this method, if backed by a generous corporation, absolutely skin a small community of all its best workers. I know this to be so because I have done it and could easily do it again. Too many of us had a "community conscience" in labor questions that had been created by social contact with executive neighbors, which did not extend outside of our own town. In the end, however, the effect was the same whether we hurt our immediate neighbor or a remote labor competitor. We were all trying to put six pieces in seven places and each of us wanted all six for himself.

Employment managers held expensive and unsatisfactory conventions where people told how they had obtained thousands of new employees without injury to their neighbors by means of this nostrum or that; by group insurance, by all kinds of bonuses, by speech making, back clapping, hand shaking, and by making it a point to daily ask Jack or Jim: "How are the wife and kids today?" These things are all fine when they come from the heart instead of the head. I believe in them and know that they were common practice before the days of these conventions and will be long after; but those of us who knew exactly what was going on, realized that either the speakers were entirely theoretical men whose integrity we did not question or else they were men too busy with affairs of management to have learned the exact details of how the job was being done.

Making the Start

After a time certain executives realized that someone would have to start the movement of training the unskilled into skilled or semi-skilled workers. Those who attempted to revive the scheme of training realized that it was more or less of a philanthropic effort, as, unless practically all took hold of it, the addition to the supply of workers would be of small consequence. However, someone had to make the start hoping that, if the plan was worth while, others would see the light.

In 1915, the Norton Grinding Co. started a training department because of the drain in skilled help caused by the vast increase in munition work, tool work, etc., in Worcester and neighboring towns. Our work consists in making high-grade grinding machinery. We use all of the machinery in use in any machine shop or automobile shop. Hence, our problem with workers is similar to that of a great many firms.

We found that the regular foreman in charge of production did not have the necessary time to give to the breaking in of green help or of help that had obtained only a partial training at other shops. We believed it would pay to have a separate training department to which all beginners would be sent and remain there long enough to learn the rudiments of machine-shop practice. We do not pretend to turn out skilled machinists from this department, although in the cases of those who have shown a natural gift for mechanics, it has been a revelation to see with what rapidity they have learned.

Our training department is in a gallery of one of

our mills and is 23 ft. wide x 264 ft. long, an area of 6072 sq.ft. The department has its own tool crib operated under the same system as those in the regular production departments, its own washrooms, and toilets separate from the rest of the plant. The general opinion in the shop is that the department is a good scheme. The shop foremen have orders not to hire any unskilled help to be used as producers without first consulting with the supervisor of training.

Keeping In Touch With New Men

The supervisor is furnished with a list of all new employees, so that he can check this item and get into immediate touch with new men, who may have come in under a misunderstanding concerning their ability as workmen, and who might make good if given some further training. This assures the learners in the training department of obtaining the opportunities to get into the shop and at the same time, does not prevent the foreman from getting anyone, in whom he is interested, into training. When an opening in the shop presents itself, the supervisor selects from the school the person he thinks will best fill the place.

The length of time the worker has spent in training has practically no bearing in the case. Some workers, in a few days, due to natural intelligence and ability, or due to the fact that their judgments have been matured by years of experience in some form of mechanical work, are better fitted to take shop jobs as operators than are other men not so fortunate.

After a worker leaves the training department and takes a job in the shop, the supervisor still continues to keep in touch with him for several weeks. This often saves workers from discouragement, due to strange surroundings and the feeling of incompetence we all have when in contact with a proposition that bewilders.

In addition to the teaching of the purely manual side of the job, we try to instruct the beginner along the lines of what we expect from him as a man in relation to his fellow employees and the owners of the business. Rather than let him find out by haphazard contact, he is instructed how to conform to our time-keeping system; how to get tools from the crib; his responsibility with regard to these tools; the necessity for decent care on his part to coöperate in our sanitary and safety arrangements; his right to a square deal both with regard to advancement and to protection against injustice in connection with piecework.

Now that the war is over we are using our training department to take care of men who are returning from the service and to whom we have guaranteed jobs, as well as a means of placing employees who are convalescing from either sickness or injury. The future usefulness of our training department will lie partly in the training of a few beginners, enough to maintain the supply of skilled labor, but also as a means of producing inspectors, group leaders, foremen, rate setters, engineer beginners, demonstrators and salesmen.

Changed Ideals of Management

I believe we all acknowledge that the ideals of management, as a whole, have changed very much for the better in the past 30 years and especially in the past 10 years. This has been due not alone to pressure of public opinion or fear of organized labor, or drastic legislation, but to the fact that through business associations we have all become acquainted with each other and have gradually learned that narrow-minded management in our own particular factory eventually means trouble to other factories.

Granting that most managers have at heart the absolutely square deal with employees and even go so far as to organize good employment departments, health and sanitation departments, make the factories safe from hazard, desire to have the men earn more money than ever before, provided an adequate output is given: granting all this, of what avail is it unless the staff officers, the line officers, the sergeants and the corporals of the establishment are intelligently taught not only to understand the exact policy of the firm, but to actually carry it out? How are we providing ourselves with foremen, inspectors, engineers, etc., when we have the misfortune to lose a man we have considered satisfactory, or when we create a new department or expand an old?

We are, as a rule, simply promoting somebody whose only known quality besides his skill as a workman is his probable loyalty to the firm. Both of these qualities are necessary and oftentimes, by luck, the man has many others of value, but it is no credit to our ability as executives that he possesses them.

How is a man, who has spent all of his working life as a lathe operator or general machinist, going to be of much value to you unless you deliberately set about training him for his new job?

The Men In Contact With the Workers

Men in industry who have the duty of making decisions, whose functions are those of an executive even in the slightest degree, even the straw-boss, represent the corporation in the mind of the worker, and your success or failure in carrying to your workers the ideals of management that your higher intelligence dictates to be good business depends in the main part on these men. Every corporation, no matter what the size, should deliberately set about the selection and training of a group of young men, adding to this group each year as in any school, with the purpose in mind that out of this group, whenever possible, shall be selected the men to fill vacancies in places of responsibility. Sons of present employees, of known soundness of character, graduates of high schools, trade schools, and technical schools can be interested in such a plan.

Not only the manual side of the business should be taught as in the case of the old apprentice system, but much attention should be given to the understanding of the shop systems, costs, ideas of efficiency, public questions having to do with industry, etc., and above all, particular attention should be paid in the case of all those who show evidence of having sufficient merit to finally become executives, to the proper understanding of those questions that we group under some such heading as "employees' relations."

A good foreman should not only know his job, from the production side, but should also make his job his profession and should know everything possible about his men. He should be a source of a lot of facts that you would not care to record as statistics. A visit to the home of a sick employee will often do more to make a different man out of a foreman, or out of a manager for that matter, than a whole lot of reading and lectures. A foreman should have a sufficient understanding of economic questions to help in the molding of the opinion of his men. The management of the business

should make it a part of management duty to see that the foremen obtain instruction of this nature. This can be accomplished by supplying good reading matter and by meetings.

This is an especially opportune time, as many industries have been forced by business conditions to operate at least one hour per day less than during the war. Why not use at least one of these hours per week for a foremen's meeting? There is plenty of talent in every community for a supply of good common-sense speakers on subjects that your men ought to hear about.

What the foremen can do was well illustrated in the various national drives of the past two years. How would industrial establishments have made such a wonderful Red Cross and Liberty Bond showing, if the foremen had not taken hold of the work? Why not get the power of their united effort in helping to intelligently handle the questions confronting us that have their strength in ignorance? We can get great results along these lines if we deliberately organize for it, but it will take an open-minded management willing to work. It cannot be done by hiring somebody to create a department for the handling of this kind of work and then forgetting all about it. This sort of thing, to be successful, requires the interest and time of someone who has the welfare of the business and the workers in his heart, and who has authority to make decisions and to spend some money that will not actually show money dividends.

Another great field for training is among the old employees of our firms, the men who have been with us for a considerable period.

Maintaining Wages

How can we maintain wages at the present standard, if conditions return to normal and world trade is again without the restrictions forced by war? There is only one way and that is by means of increased output at normal unit prices.

The problem of increased production from workers already supposed to be skilled to some degree is so big that I will touch on only one phase of it, that part of our production that is performed under a piece-rate or premium plan. To my mind the day-work shop is almost a hopeless proposition from an efficient standpoint unless the goods are made in such quantities that a daily stunt can be readily established and then the plant really becomes a piece-work shop paying day wages as in the case of the Ford company.

The main causes for inefficiency in an open shop are, (*a*) insufficient equipment and facilities, (*b*) failure to supply material, (*c*) insufficient training, (*d*) lack of proper instructions even though the worker is trained, (*e*) intentional restriction by the worker. Management, in my opinion, is responsible for all of these. In the attempt to eliminate them lies the greatest opportunity for industrial training that exists today, because the process of attempted elimination involves the training of the worker already somewhat skilled and also the training of the management.

In attempting to make clear this statement let us consider the present conditions of the piece-work system in our industries. You can find plenty of proof, if not in your own firm certainly in many others, that men have increased their hourly earnings during the past four years by as much as 100 per cent. without any change in working conditions or in price per piece. Gradually, as the cost of living and the going wage of the community went up, these men produced more and more. There are examples of machines built before and during the war on a piece-work basis whose net labor costs have not increased in percentage anything like the increase in the cost of living or the cost of labor paid by the hour.

I believe that unless some action by the management were taken to prevent it, the hourly earnings of these same men will gradually drop again in unison with the cost of living and going wages. If anybody doubts these statements, he either does not need any further training himself, having already perfected his entire system of doing business, or else he has not, as I have by personal experience, learned the constitution and by-laws of the piece worker.

Let us frankly inquire into the reasons for these conditions. In speaking of restricted production most people give the impression that it is wholly the fault of the worker. This is not so, except in the case of certain closed shops where output is dictated by shop committees. In other shops it is mainly a fault of management of the past, and the management of the present has not, as yet, done anything worth while toward permanently eradicating it.

Why Men Hold Back

The worker has two main reasons for holding back. First, the price may be cut if he earns what the understanding in his particular shop says is "too much." Second, although his firm has stated that prices, once set, will not be cut, even if he believes it, he has brains enough to know that excessive earnings will result in lower rates being set on new work of a similar nature. This line of reasoning applies to the shop where rates are set from time-study methods as well as to the shop that sets rates based on a long record of past performances of a given operation.

The worker uses the same common sense that keeps you from winning the 2.20 trotting rate in 2.10, provided the prizes in both classes are exactly equal, or those in the 2.10 class are not enough better to pay for the extra effort.

Almost without exception, any present-day manager will tell you that it is the policy of his firm not to cut piece rates, but you have not, as yet, convinced the worker that this is so. He has only your word for it. Individually, he will probably believe you, but collectively he will not really believe, and the traditions of his training created by the history of the not very recent past will forbid him to "kill the job." As long as he can restrict production and get along with you, he is going to do it, and you are not going to get the full measure of his efforts until you establish some form of guarantee that eliminates his fear of your power over his earnings.

This reasoning applies in great measure to day work also, since in addition to the fact that there is not even the incentive of piece work, the worker is more or less conscious of the fact that piece rates may be set. How then can these faults be in great measure overcome and in such a way that the results will be just and permanent?

I believe this one question of piece work, properly adjusted, would be a big stride toward the settlement of many of the troublesome problems that today exist in American industry, at least. To begin with, in the

proper handling of this question, management must train itself or be trained by associations like this to cease to have in mind any sum that is "too much" for a worker to earn. So-called "efficiency experts" must cease talking about "exorbitant" rates or "unbalanced" prices. There is not a man in the industry who would set a figure that is "too much" for him to desire in return for his services to the world.

The manager who sublets parts of his work to an outside jobber and is content to get the goods at what he considers fair prices, without knowing how much profit the jobber has made by ingenuity or increase in production, should certainly rejoice to learn that he has the ingenuity and increased effort in his own plant and should be doubly glad to know that one of his own people, instead of a stranger, got the benefit.

In attempting to eliminate the causes for reduced output, each factory must solve all for itself with the exception of restricted production on the part of the worker. This you cannot solve as an individual for the reason that you have inherited the sins of your predecessors, and your men, in great part, are trained for you by someone else. It will require the united action of the employees of a community or of associations to accomplish much toward gaining the complete confidence and with it the coöperation of the workers.

Therefore, I put forth the following proposition based on the assumption that managers may be ready to try any reasonable plan that might perhaps help to convince the public that our particular kind of industry does not need any form of public control or intervention.

Establish Minimum Standard Rates

Let some local association of manufacturers decide that its members will each establish *minimum* piecework hourly rates, varying with the kind of work if you wish; that each firm stands ready to prove the rate on each job through the performance of an authorized employee, skilled in the operation; and that henceforth there will be no such thing as a maximum that an operator will not be expected to exceed. Let the association decide that it is detrimental to the community as a whole for any firm to cut piece rates, or to establish rates so low that an operator cannot make at least the established minimum for that class of work. Let it be understood that each corporation will be entirely free to change its methods of production at any time without reference to anyone, but that the resulting operations will also be rated at not less than the minimum rate for the class of work involved.

Each firm would have the privilege of raising any or all of its minimum prices whenever it saw fit, but once published it could not lower any of its minimums, except by the consent of the association, that consent hinging on the decrease in the cost of a certain list of necessities of life. This should not be put into effect until about a month after the decision, together with reasons for it, had been published at least to the employees of the firms affected and preferably also to the public.

Give publicity to this entire agreement and print the names of a committee appointed to receive complaints of the violation of the rules of the agreement. Let the committee be composed of owners, managers and workers, all of whom own real estate in the community and have been connected with their firms for, say, three years. I believe that where a single corporation could not gain the utmost confidence of its employees, that the publicity of such an agreement would not only hold reluctant firms to the practice thus established, but would, at once, get the coöperation of the more intelligent of the workers. This is not a minimum-wage scheme because it does not guarantee a definite wage, but holds out the pledge of a community that any worker, capable of earning as much or more than the management is satisfied to call a day's work, will be permanently protected even to the utmost use of his skill.

What has this to do with training? If your piece rates are intelligently set by skilled operators, you will find that many workers will fail to earn up to the established minimum. These are the men who heretofore have been getting their training by the "hire and fire" school. They learned a little from one shop and were fired when conditions made them no longer usable, then they caught on somewhere else and got a little more experience, but never were they intentionally given intelligent attention.

If, under the plan outlined above, you also keep a record of the performance of each individual worker, you will find those who fall more than a certain predetermined amount below the minimum, and know that it is not economical to have them continue to tie up your investment. These are the workers who should receive the attention of your instructors, who should preferably be the same men who help you to set the rates. The result ought to pay its own way, if our experience along these lines during the war is any criterion.

High Wages Increase Your Profits

If, by reason of long practice and skill, a worker earns a great deal more than what satisfies you as a day's work, pay attention to this event also, but not the old-fashioned kind of attention that has helped to foster restricted production and distrust. Rather, let whoever is now the equivalent of the "old man," or at least someone in authority whose notice of a worker has heretofore been an event talked about in the shop, go out and congratulate the winner and let him actually know that you are grateful to him for enlarging your establishment free of charge. Here is another opportunity for management to train itself. It may come a little hard at first. Certain under-developed portions of the business anatomy may, like an athlete's muscles, be a little lame, at first, notably the pocket nerve and the square-deal impulse; but like the athlete's muscles, these parts will soon develop so that the harder and rougher the game becomes the more you will enjoy it.

After a short time you will get to a point where you will not try to hinder anybody from enlarging your plant as much as he pleases, provided they still continue to do it free of all cost to you and, in fact, actually insist on paying you something for the privilege. For this is what happens when you increase output from the same plant investment.

If this plan as outlined does not suit, at least that part of it that deals with the training of those workers supposed to be skilled, but whose records show them to be poor producers, should be carried out. To do this will involve also the establishmnet of what you consider a day's work. This requires men skilled in the operations under consideration and since no one likes to ad-

mit that his firm cuts prices, the only remaining part of the plan is a community pledge.

Compare this with plans dictated to industry by the War Labor Board and see which you prefer, remembering of course that a great many people, with votes, are saying that industrial management, to date, is a failure. Compare the effect on the reputation of any association of manufacturers in trying to do something like this, as against the present reputation of such associations with the workers, because to him they stand for belligerent organizations, even though he may be wrong in his belief.

I would like to see the name of the associations of manufacturers synonymous with progress, community spirit and prosperity for all in the minds of workers.

Automatic Tapping Machine for Pipe Fittings

By J. H. Vincent

The large quantities of pipe fittings required to meet the present demands of the trade have necessitated the invention and design of machines for their rapid production. In the smaller sizes the work to be done is limited to tapping the threads that receive the pipe ends, and special machines capable of producing a large number of fittings, completely tapped, with a small relative expenditure of manual labor, have been built for this purpose.

The machine in Fig. 1 was designed and built in the shops of the Jarecki Manufacturing Co., Erie, Penn., for tapping elbow fittings, commonly known as "ells," and is so constructed as to deliver two finished pieces at each cycle after the turret is filled.

How the Work Is Held

The work is held in the square turret *A* which rotates upon a horizontal shaft *B* carried in bearings in the upper ends of two arms, one of which is shown at *C*. This enables the turret to be swung back from the working position to be rotated much the same as the well-known turret of a screw machine.

The arrangement of the turret is shown more clearly in Fig. 2. Two clamping fixtures *D* upon each of the four faces hold the ells, two of which may be seen at *E*. The clamping jaws are operated by a wrench that fits on the square-headed screw *F*. Two castings are tapped at a time, but as there are two operating positions there are four operations going forward. The turret is shown in tapping position in Fig. 1, but in Fig. 2 it has been partly turned to display the detail to better advantage.

The cycle of operation will be better understood from the diagram, Fig. 3, on which the parts have been lettered to correspond with the other views. The clamping fixtures shown at *H* are ready to be emptied and refilled by the operator.

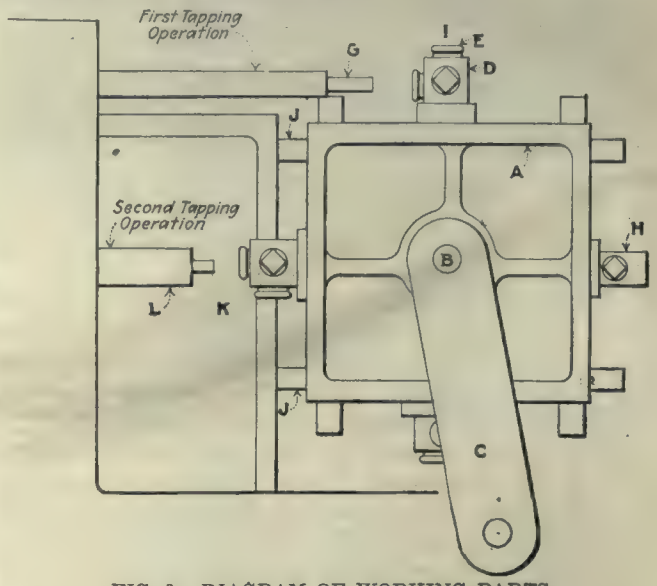


FIG. 3. DIAGRAM OF WORKING PARTS

The arm *C* swings the turret sufficiently to the right to clear the corners during its rotation. This brings the previously filled fixture and work into the position *I*, and the arm *C* returns the turret to the left until the stops *J*, of which there are four on each face of the turret, come to a bearing against the main frame of the machine. The spindle *G* then comes forward until the casting is tapped to the required depth and the tap withdrawn. The frame is then swung to the next position, bringing the pieces first tapped into the position *K*, where the other end of the ells are presented to the second set of taps *L*. In the meantime a freshly filled fixture has swung another pair of castings to the first tapping position, so that from now on two sets of taps

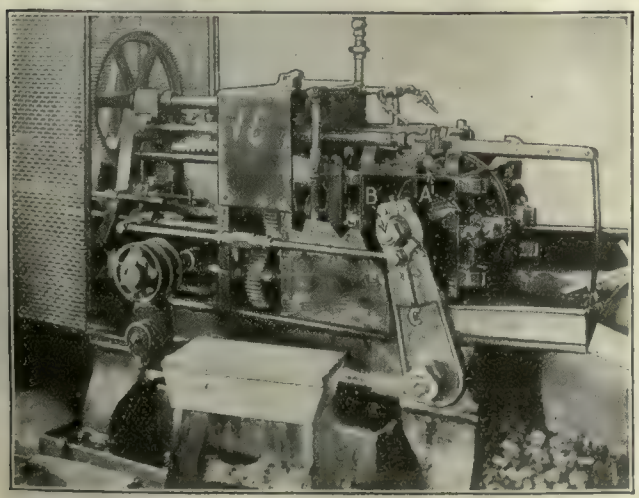


FIG. 1. MACHINE FOR TAPPING ELBOWS

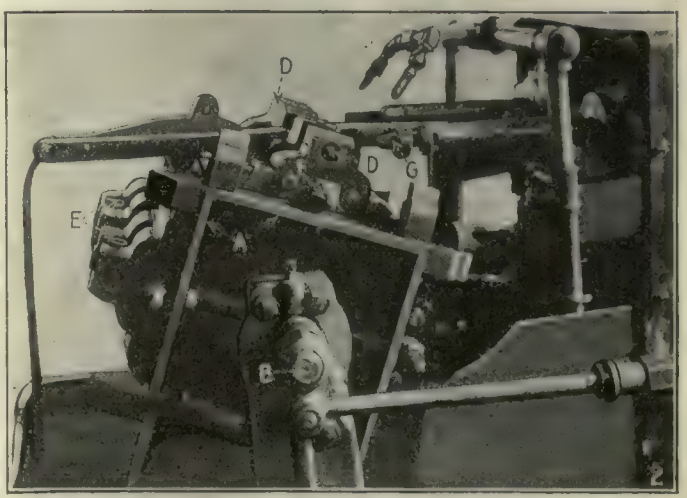


FIG. 2. NEARER VIEW OF TURRET

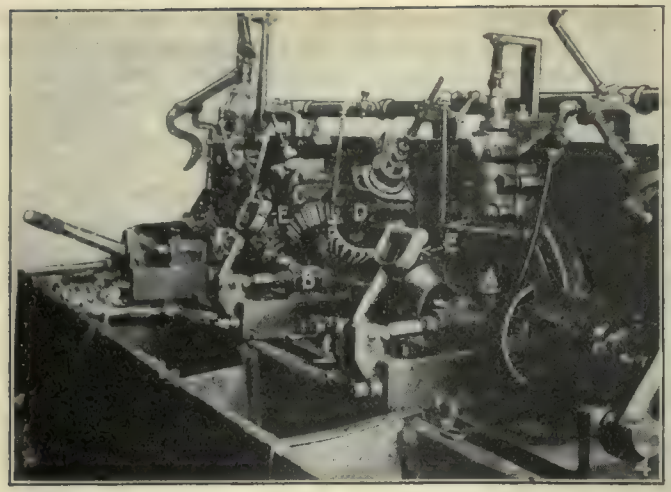


FIG. 4. DIFFERENT FORM OF TAPPING MACHINE

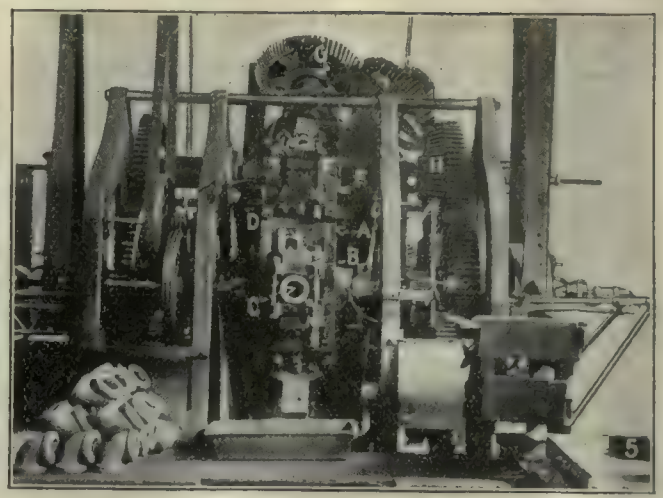


FIG. 5. MACHINE FOR TAPPING LARGE FITTINGS

are continually working and two complete elbows are finished at each movement of the turret.

It will be seen that from the nature of this arrangement the two ends of the elbow will be tapped at right angles to each other within the limit of accuracy of the machine, therefore the trouble often experienced by pipe fitters, caused by inaccurate tapping, is eliminated.

Another type of machine extensively used for tapping pipe fittings is shown in Fig. 4. Owing to its position only a portion of the machine, about one-half of its total length, is illustrated, but the remainder consists of similarly constructed units which are so arranged that they may be handled by one operator. Several of these machines are in service in this department of the plant, and are used for tapping larger sizes of fittings than the machine shown in the preceding illustrations.

The Operations

The unit *A* is tapping the three outlets of a tee. The other unit *B* is operating on an elbow, which is clamped into position to receive the taps on the two spindles *C* and *D*, which are set at an angle of 45 deg. either side of the vertical. The pieces are clamped and the taps started by means of the handle *E*, but as the pressure required for operating these handles is considerable they are now being replaced by air cylinders which will reduce the amount of manual exertion required, and the machines will then be suitable for operation by women.

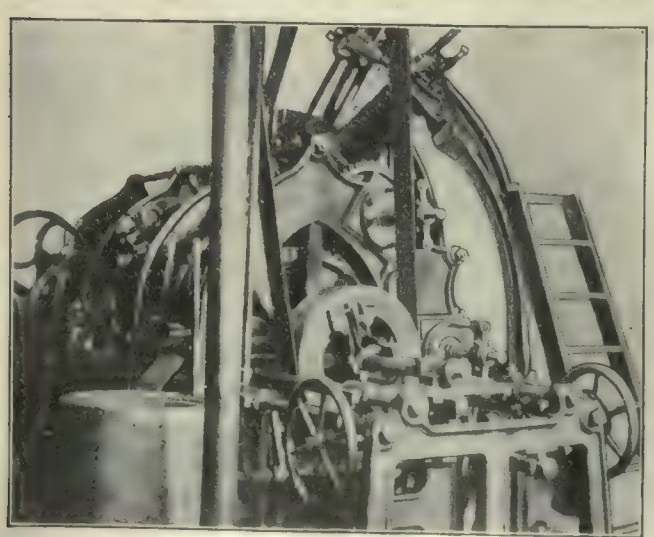


FIG. 6. DETAILS OF ITS MECHANISM

The machine shown in Fig. 5 is capable of handling 6- and 8-in. pipe fittings. It is similar in principle to the machine shown in Fig. 1 in that it has a revolving turret, or center frame *A*, upon which are mounted the fixtures *B* which hold the fittings to be operated upon as at *C*.

As the turret is turned upward and toward the back of the machine the work is brought into alignment with taps carried on the spindles *E* and *F*. These spindles are driven by the large bevel gears *G* and *H* and are automatically fed forward, tapping into the casting to the proper depth and then withdrawing. The turret of this machine has six positions.

Another view of this machine, Fig. 6, shows some of the operating mechanism, an idea of its size being gained from the fact that it stands about 14 ft. in height. The operator who places the work in the turret stands on a platform about 2 ft. above the floor level. The machine has three spindles and may be used for tapping tees as well as elbows.

Drill With Lip of High-Speed Steel

By F. R. Irwin

The sketch shows a drill which the writer has used for a year with excellent results. The body of the drill is chrome-nickel steel, heat-treated and ground. The cutter is of high-speed steel held in the end of the body with taper pins. The body of the drill always has plenty of clearance and never binds in the hole; it

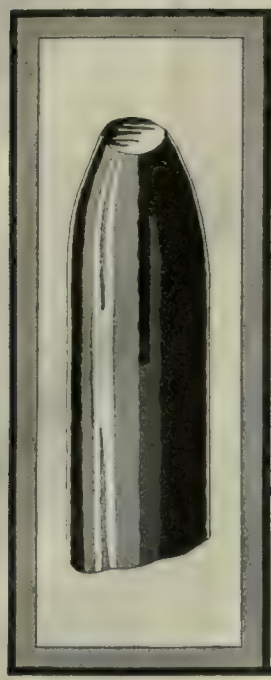


INSERTED LIP DRILL

also has the advantage of an oil channel through the center. When the cutter wears small it can be replaced at a very small cost; the body of the drill will last indefinitely and thus retain its capacity for drilling deep holes. The first cost is much less than any other oil-tube drill.

Following are some records which the writer has made: $1\frac{7}{16}$-in. hole, 180 ft. in 40-point carbon steel at the rate of $1\frac{1}{2}$ in. per minute; $2\frac{1}{4}$-in. hole, 140 ft. in 40-point carbon steel without regrinding.

ARMY ORDNANCE NEWS







Manufacturing the 9.2-In. HOWITZER SHELL

By S. A. Hand,
ASSOCIATE EDITOR, AMERICAN MACHINIST

Part I. Machining Operations

This article describes and illustrates the operations in manufacturing the 9.2-in. howitzer shell, Mark IX. It includes cutting off the open end, drilling the nose, rough- and finish-boring and rough-turning. Drawings of some of the gages used are also included. Further operations will be taken up in articles that are to follow.

THE data and illustrations for this article were obtained during a visit to the plant of the American Brake Shoe and Foundry Co., Erie, Penn.

The forgings from which the 9.2-in. howitzer shells are made are furnished to the manufacturers by the Government and are the product of three forging plants. They weigh about 380 lb. in the rough, and the specifications state that the steel from which they are made shall contain: Carbon, 0.45 to 0.63 per cent.; manganese, 0.50 to 0.90 per cent.; sulphur, not over 0.06 per cent.; phosphorus, not over 0.06 per cent.; silicon 0.10 to 0.35 per cent. Test pieces taken from the forgings shall have a tensile strength of not less than 89,000 lb. nor more than 110,000 lb. per square inch of section. The forgings are conveyed to the shop by a traveling crane equipped with a magnet. From shop door to first operation they are rolled along the floor by means of a pipe shaped as shown in Fig. 1. After machining operations have been begun nearly all the handling is done by light chain hoists running on overhead rails and by rolling along benches placed between machine rows from one operation to another.



FIG. 1. HANDLING FORGINGS ON THE FLOOR

All machines are located so as to avoid any back tracking between operations. Nearly all work-gripping devices, both internal and external, are hand operated. All cutting oil used is mineral lard oil, and all cutting compound is 20 per cent. Damascus soluble oil and 80 per cent. water.

Every shell is inspected between operations. This keeps the operators constantly informed as to the amount of their work passing inspection and the number that they will be paid for. This avoids disputes on pay day. The output is from 1200 to 1500 shells per day of 24 hours.

Fig. 2 shows the outlines of the forging and the finished shell and Fig. 3 shows finished shell and details.

Each shell is stamped with a serial number as soon as it reaches the shop and a record is made of the heat number. If this number will be obliterated in cutting off the open end it is stamped on the shell body. The first machine operation is to drill the nose. This is done on a Colburn upright drilling machine, Fig. 4.

On the base of the machine is fitted a two-station turret *A* carrying two upright expanding mandrels that fit the interior of the shell nose at *B*. In the illustration one mandrel is shown empty and the other is covered by the shell shown in the operating position. The shell is gripped near the base by three serrated buttons, one of which may be seen at *C*, spaced equidistantly around the mandrel and forced outwardly by the lever *D*. On this lever, near the bottom, there is a pawl which

ARMY ORDNANCE NEWS

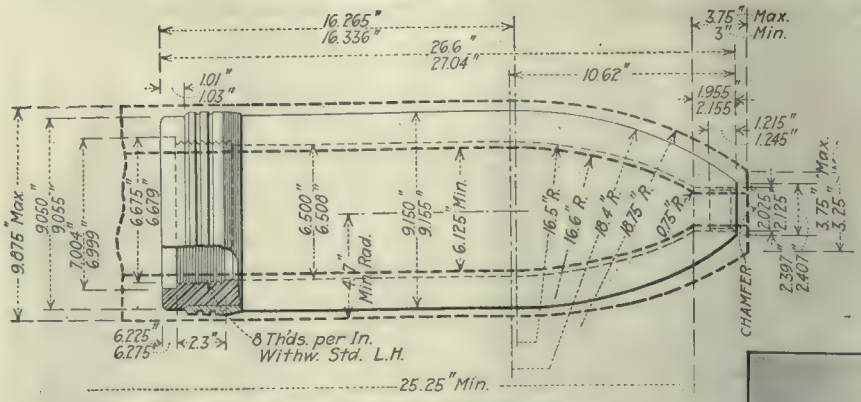


FIG. 2. OUTLINES OF FORGING AND FINISHED SHELL

engages in a ratchet segment (not shown in the illustration) and locks the buttons when in their expanded position. The whole arrangement holds the interior of the shell concentric with the mandrel. When the locking device is released the buttons are forced inwardly by the flat springs *E*.

SEQUENCE OF OPERATIONS

501.	Drill nose.	512.	Finish nose.
502.	Cut off open end.	515.	Turn copper band.
503.	Rough and finish bore and face base.	514.	Fit base plug (see operations on base plug).
504.	Rebore nose.	517.	Weigh.
505.	Rough-turn.	516.	Wash.
506.	Finish-turn and trim nose.	518.	Rivet base plug.
507.	Score, undercut and turn for wave.	519.	Weigh (check).
508.	Wave.	522.	Final shop inspection.
509.	Press on copper band.	520.	Varnish inside.
510.	Rebore, rough counterbore and round corner at base.	521.	Bake.
511.	Mill thread and finish counterbore.	523.	Government inspection.
		524.	Varnish outside.
		525.	Ship.

Over the shell shown in operating position will be seen a jig *F*, the base *G* of which is fastened to the face of the drilling-machine column while the jig proper is pivoted at *H* and fastened in place by a screw attached to the handwheel *I*. The lever *J* raises the turret from its bearings, enabling it to be more easily revolved, and a locking pin (not shown) locks it in either of its two positions. In practice a shell is placed on the outer mandrel, the turret revolved to bring it into the operating position and locked. The buttons are then forced out to grip the shell and drilling commenced. As soon as the drill has started to cut, the operator places a shell on the empty mandrel ready to be swung into operating position when the first shell has been drilled. A repetition of the former cycle is gone through, the drilled shell

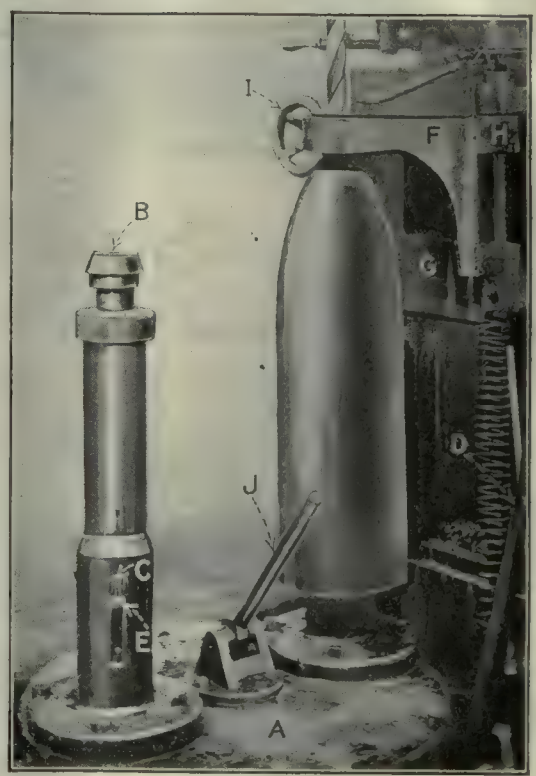


FIG. 4. DRILLING THE NOSE

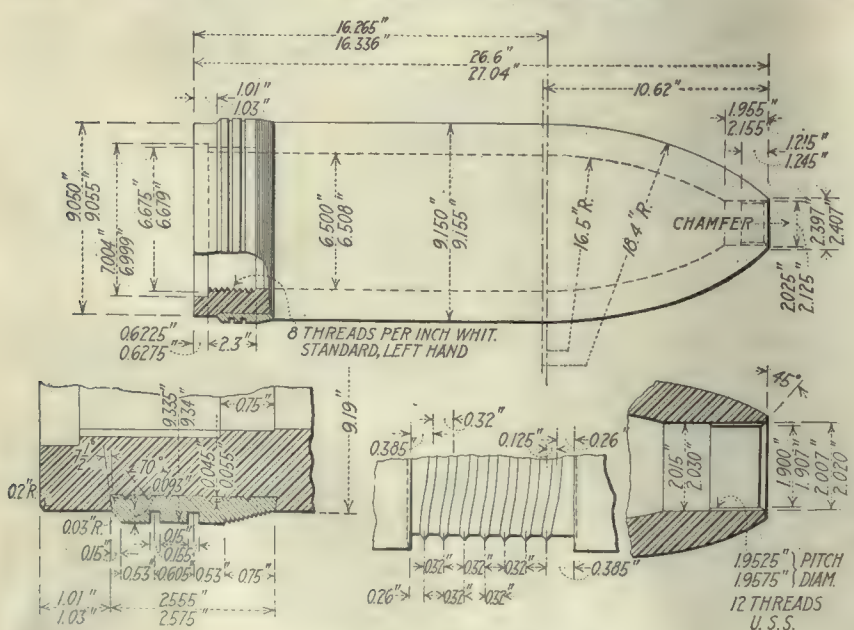


FIG. 3. DETAILS OF FINISHED SHELL

removed and another put in its place. By this arrangement drilling is almost continuous.

As the forgings are ragged at the open end and vary in length it is necessary to cut them off to true up the end and to bring them to a specified length. This length is measured from the bottom of the hole, so that in boring the amount to be removed by the end of the hog-nose drill will be uniform or nearly so. For this operation, Fig. 5, a Williams cutting-off machine is used. The shell is placed nose first within the hollow spindle of the machine and clamped by four heavy set-screws just behind the cutting-off tools. At the back of the spindle is a plug center which enters the drilled hole in the shell nose, centering it at the nose end. The base end is centered approximately by the four clamping screws, exact centering not being

ARMY ORDNANCE NEWS

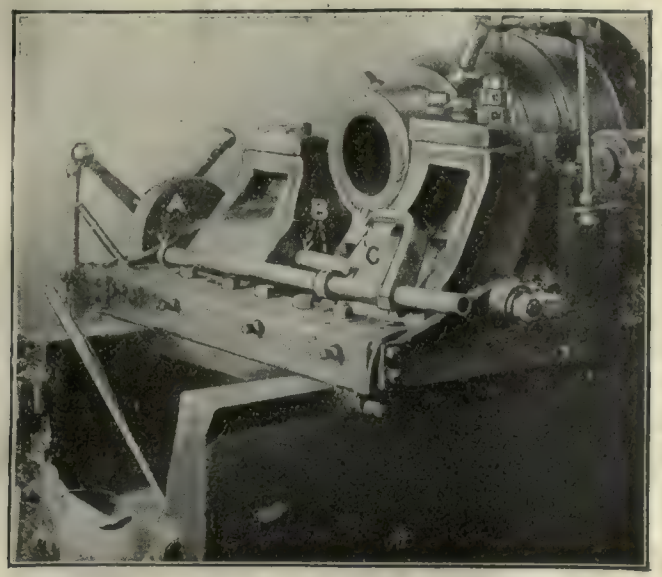


FIG. 5. CUTTING OFF THE OPEN END

necessary as there is an after-operation on the base after boring. Two high-speed cutting-off tools set in heavy tool blocks are used. One tool is at the front and one at the rear, both being simultaneously fed toward the center. The tool at the rear has the cutting edge at the bottom, as is necessary in machines of this type. A gage for setting the cutting-off tools the proper distance from the bottom of the hole in the shell is shown on the front of the machine. The end *A* is bottomed in the hole, where it is centered by the tapered sides of the nose interior. A two-legged spider *B* rests on the side of the hole near the base and centers the gage at the outer end. The front tool is set to the proper position by bringing the rear edge against the rear side of the notch *C*. Fig. 6 is a detail drawing which shows the construction of this gage, in which corresponding parts are lettered the same as shown in the half-tone illustration, Fig. 5.

The next operation is to rough and finish the bore

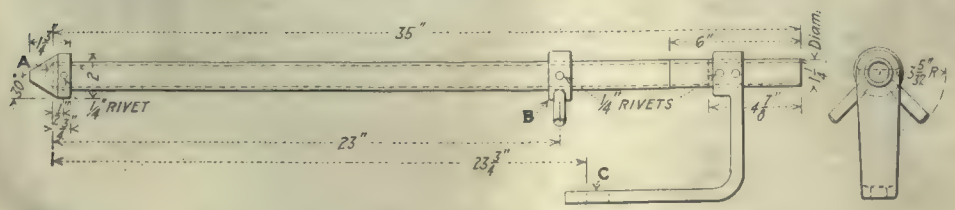


FIG. 6. GAGE FOR SETTING CUTTING-OFF TOOLS

and face the base, Fig. 7. This is done in a No. 23 Amalgamated boring lathe and the shell is held in a pot chuck, the outer end of which is run in a steadyrest that is an integral part of the machine. The shell is centered at the rear end by a plug center which enters the drilled hole in the nose in the same manner as in the cutting-off operation. The base end is centered by the hole. For this purpose a plug center is mounted in the end of the boring bar and brought up until the end enters the hole and is held tightly therein. While so held the shell base is clamped by the heavy setscrews seen at the mouth of the chuck.

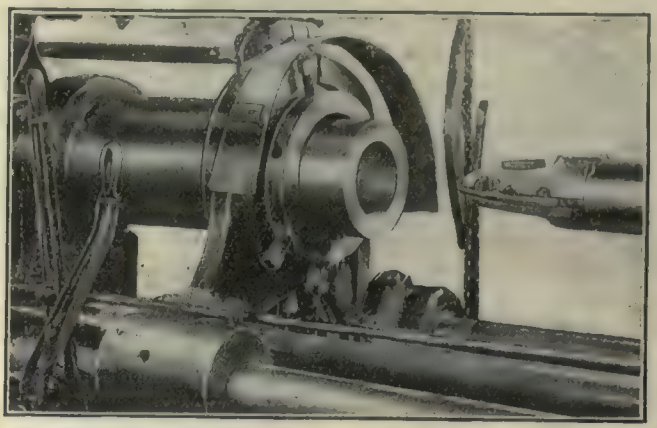


FIG. 7. ROUGH AND FINISH BORING AND FACING THE BASE

First a roughing reamer is used to remove the surplus stock. This is followed by a finishing reamer to bring the hole to the proper size and profile. Both reamers are fed by power while cutting the straight part of the hole, but when they reach the interior profile the power feed is thrown out and hand feed is used for the rest of the operation. This method has been adopted because of the liability of the reamers to hog in when cutting on the profile. If power feed were used there would be danger of breaking the reamer or twisting the boring bar before the machine could be stopped or the feed thrown out, but hand feed obviates this danger, it being sensitive and quickly controlled.

(This Article Will Be Continued in the May 1 Issue.)

PERSONALS

Second Lieut. Robert B. Kirkpatrick, who enlisted in June, 1918, and has been on duty at Camp Meade, has left the service. He was formerly employed by the Victor Talking Machine Co., Camden, N. J.

* * *

Capt. Edward F. McCrossin, of South Birmingham, Ala., who has served in the Nitrate Division, has been discharged. He is a mining engineer and a graduate of Ohio State University. While in the service Captain McCrossin has made some important mining investigations in the coal fields of Alabama.

* * *

First Lieut. Fred W. Lycett, whose home is in Hartford, Conn., and whose work in the service has been in connection with the Browning machine gun, has been discharged. He attended Trinity College and has been connected with the Charter Oak Motor Co., which is located in his home city.

The Use of Solders for Aluminum

Bureau of Standards Circular No. 78

The Bureau of Standards of the Department of Commerce has just issued under date of Jan. 28, 1919, Circular No. 78, which discusses the subject of solders for aluminum and gives the result of some tests with them.

The ever-widening use of aluminum in the industries has brought with it the question of how to make repairs. A permanent repair oxygen-gas welding is entirely satisfactory in many cases but there are some in which it is not desirable to heat the parts as much as is necessary with this process on account of the attendant distortion. In such cases a means of joining the parts at a lower temperature is sought and various so-called aluminum solders have been patented and put on the market for which extravagant claims are made. To determine the feasibility of soldering aluminum and the merits of the various soldering compositions a series of tests were made by the Bureau, the results of which together with those of previous investigations and current experience are given in this circular.

Resolved Into Two Questions

Whether aluminum can be successfully soldered resolves itself into two questions: (1) Whether the solder can be applied and made to adhere to the aluminum, and (2) whether the joint thus made is stable and does not deteriorate. The factors of strength, ductility, etc., are also to be considered.

The aluminum solders are usually mixtures in widely varying proportions of zinc, tin and aluminum and are applied by rubbing them into the heated surface of the carefully cleaned material, the process usually known as "tinning." The joint may then be made in the usual way with a soldering iron and the solder without the use of a flux which the Bureau tests showed to be useless.

The efficiency of the joint evidently depends upon the adhesion between the tinning coat and the aluminum. To test the efficiency of this adhesion, strips of alloy and sheet were carefully cleaned and coated with the various solders which was easily done in all cases. The tinned strips were then soaked in water for various periods of time and the results observed. Within 48 hours little blisters from one-half to two or three millimeters in diameter appeared in the soldered layer on all specimens. When the blisters were broken it was found that the metal beneath them had not alloyed with the solder. Within a period of 7 to 14 days the blisters increased until most of the tinned surface could be stripped off. In these tests it was noted that the solders which had the highest melting points gave smaller blisters and a better bond. This was attributed to the alloying effect of the higher temperatures. In addition to these symptoms the aluminum adjacent to the tinned layer was rapidly attacked and a gelatinous layer of oxide of aluminum was formed. Zinc-base solders were themselves attacked while tin-base ones were not. This action is hastened by the electrolytic action between the aluminum and the various elements in the solders all of which are electro-negative to aluminum and set up galvanic action in which the current flows from the aluminum to the solder.

Strength and ductility tests showed little variation in the former characteristic but a great deal in the latter, tin-base solders being exceedingly ductile while zinc-base ones were very brittle. The presence of copper or antimony or an excess of aluminum also produce brittleness which should be avoided as far as possible.

The strength tests indicated that the soldered joints were rarely as strong as the solder in a cast form. Failures occurred both in the bond and through the solder itself.

General Conclusions

1. All metals or combinations of metals used for aluminum soldering are electrolytically electro-negative to aluminum. A soldered joint is therefore rapidly attacked when exposed to moisture and disintegrated. There is no solder for aluminum of which this is not true.

2. Joints should therefore never be made by soldering unless they are to be protected against corrosion by a paint or varnish, or unless they are quite heavy, such as repairs in castings where corrosion and disintegration of the joint near the exposed surface would be of little consequence.

3. Solders are best applied without a flux, after preliminary cleaning and tinning of the surfaces to be soldered. The composition of the solder may be varied within wide limits. It should consist of a tin base with addition of zinc or of both zinc and aluminum, the chief function of which is to produce a semi-fluid mixture within the range of soldering temperatures.

SUGGESTED RANGES OF COMPOSITION

Tin-Zinc Solders:	
Tin	remainder
Zinc, per cent.	15-50
Tin-Zinc-Aluminum Solders:	
Tin	remainder
Zinc, per cent	8-15
Aluminum, per cent	5-12

4. The higher the temperature at which the "tinning" is done, the better the adhesion of the tinned layer. By using the higher values of the recommended zinc and aluminum percentages given above, the solder will be too stiff at lower temperature to solder readily and the workman will be obliged to use a higher temperature, thus securing a better joint. A perfect union between solder and aluminum is very difficult to obtain.

5. The joint between previously tinned surfaces may be made by ordinary methods and with ordinary soft solder. Only the "tinning" mixture need be special for aluminum.

6. There is no reason why a good solder for aluminum need be brittle as several commercial varieties are, and it is very undesirable that it should be.

7 The tensile strength of a good aluminum solder is about 7000 lb. per square inch. The strength of a joint depends upon the type and upon the workmanship. Much dependence should not be placed on the strength of a joint.

How Do You Prevent Oil From Discoloring Finished Surfaces?

When a machine tool comes from the builder its finished surfaces are things of beauty and shine with a mirror-like polish. If you do not oil these surfaces they will become scratched and marred, and if you do oil them they will before very long take on a molasses-colored hue that is far from being attractive.

How do you prevent oil from discoloring the finished surfaces of your machine tools? We would like to have an expression of the experiences of our readers on this point.

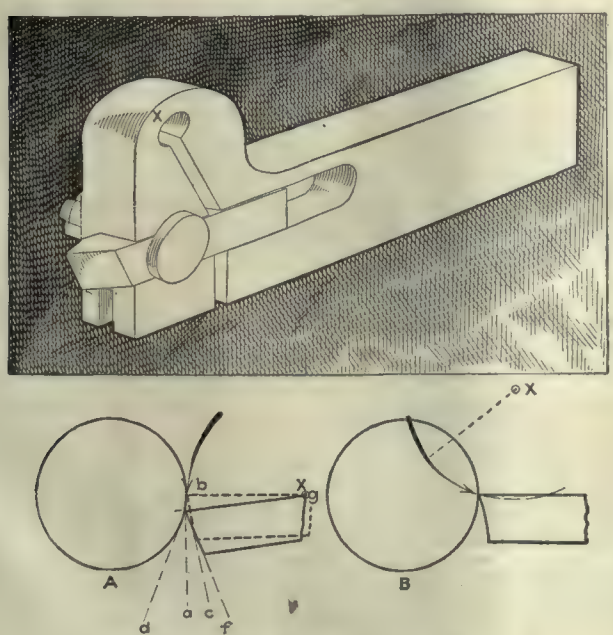


Elimination of Chatter Mark

By William S. Rowell

Mr. Bach's remarks on the elimination of chatter marks, page 307 of *American Machinist*, can all be agreed to, but the two spring tools shown in his Fig. 2 do not conform to his ideas. The fault lies in the relative position of the cutting edge of the tool and the pivot about which it turns.

Fig. 2 of the article alluded to shows two common forms of spring tool, each holding a threaded-chasing bit or similar cutting tool. As spring tools are probably more often employed to obtain smooth cutting



PROPER FORM OF SPRING TOOL

in chasing threads than in all other work combined a little study of their action in such work might be time well spent.

It is plain that the spring of such a tool, may at the same time that it is giving a smooth cut, be the cause of serious defects in form. These defects are difficult to detect except with the most refined means of inspection most thoroughly and skillfully applied.

It is impossible to say just where the pivot point is in any spring tool, but it is plain that in form *B* it is not much above, and is far back of, the cutting edge of the tool. As the pressure on the cutting edge is almost wholly downward the movement of the tool will be in that direction. It may truly be said that a downward movement of the cutting edge will cause a lighter and probably a smoother cut to be taken, but the effect on both cutting edge and form of thread is much worse than if the pivot point were higher and not so far back from the cutting edge. A moment's inspection of diagrams *A* and *B* in the drawing herewith will make this clear.

We painstakingly grind our chasing tool to the correct angle for the thread to be chased, and we as carefully set the top face in the plane of the work center, all to obtain a correct thread angle. Now, if the tool is sprung below the plane of the work center, the thread angle is changed, and while it may be said that the finishing cuts will be so light and the consequent spring so slight that this may be neglected, another and very important point must be kept in mind, which is this:

While taking the heavier cuts before the finish cut, the tool is sprung below the center and is rapidly dulled because of increased clearance (see diagram *A* for increase of clearance angle caused by relatively slight deflection of the tool from *b* to *e*). Angle *abc* represents the clearance of the tool when its top is in the plane of the centers, as shown by the dotted lines. Angle *def* shows the enormously increased clearance angle when the tool is sprung to the line *eg*. This greater clearance causes rapid dulling and consequent loss of correct thread angle, which, once lost will not be corrected when a lighter finish cut allows the tool to return to the plane of the centers.

It should also be borne in mind that all springing of the tool tends to-out-of roundness. If the pivot point is as nearly directly above cutting edge as possible (see diagram *B*) the movement will be nearly straight back, thus avoiding any change of clearance and also tending toward a more accurate thread angle.

Much more may be said on this subject but I will only add that a spring tool as here shown has given excellent results and may be made at small cost. Pivot point *X* is above the cutting edge sufficient to insure almost a straight-back movement as the tool springs from cut.

Dial Feed Arrangement Used in Grinding Piston Rings

By J. J. McIntyre

A quick method of feeding piston rings by means of a dial attached to a machine for grinding them on the side is shown in Fig. 1, with a sketch of its arrangement in Fig. 2.

The machine used is a Persons-Arter rotary grinding machine equipped with a magnetic chuck. The feeding dial is mounted as clearly shown in Fig. 1, so that it just clears the surface of the chuck.

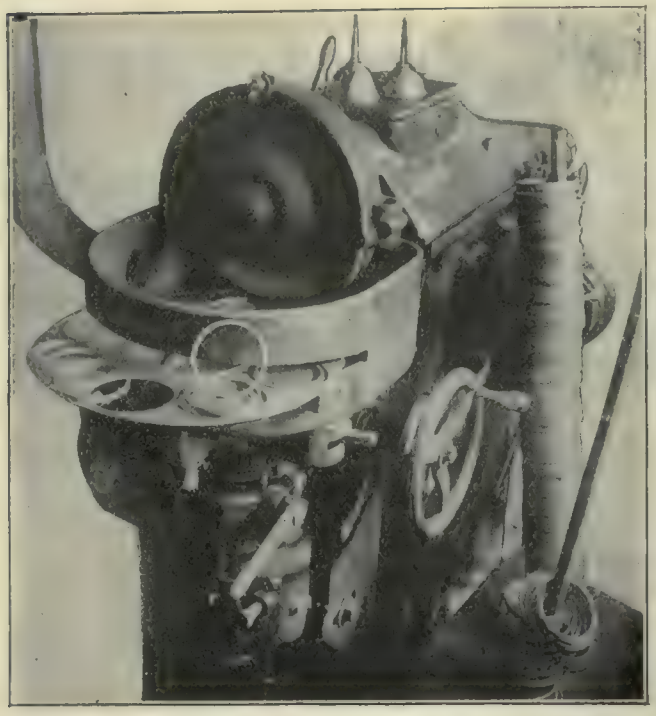


FIG. 1. PISTON-RING GRINDING WITH DIAL FEED

The rings are laid in the first hole to the right as the operator stands in front of the machine. The dial is turned by hand each time, the electric current being switched off and on the chuck at the proper time to release the finished ring and grip the next one.

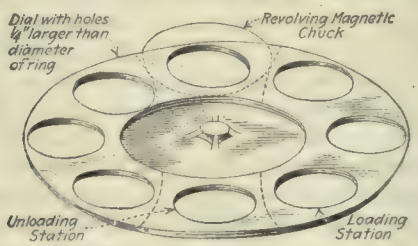


FIG. 2. DIAGRAMS OF THE DIAL

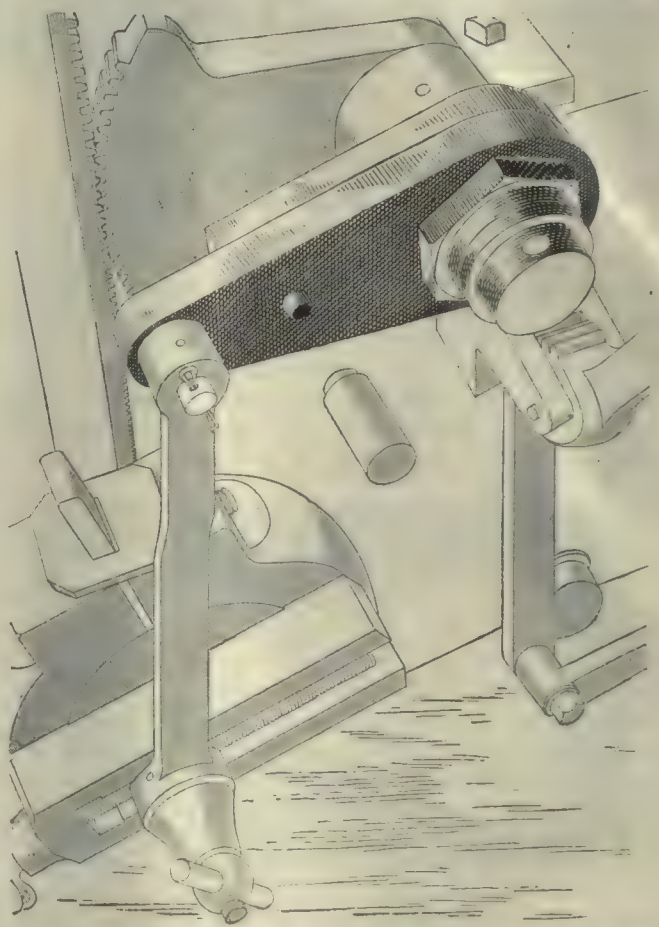
The holes in the dial are about ¼ in. larger in diameter than the outside of the rings to be ground, and it is an easy matter to bring each ring to a central position. As the finished rings reach the front position of the dial they fall through the hole and stack themselves on properly placed rods, two of which may be seen at the right of the machine. The rate of production is 200 an hour.

Safety Devices for Feed Mechanisms on Planing Machines

By E. Ferber

The device shown on page 309 of *American Machinist*, providing a breaking point in the feed mechanism of a planing machine to protect other and less easily repaired parts from breakage, is good to the extent of its limited ability, but when made in the manner shown it serves as a safety valve only in one direction. If the conencting-rod had been shortened ½ in. and a bushing put over the joint, pinned to each part of the rod with the ends of the latter separated by the amount cut out of the rod, the device would have worked equally well either way.

The picture with this letter shows the same idea applied to a Whitcomb double-head planing machine, the construction of which lends itself admirably to this purpose, and the device prevents damage by reason of overrunning, or collision of the heads. The rock lever that operates the gear segment which is a part of the feeding train is made in two parts, the inner one keyed to the sleeve of the gear segment and the outer one, which is connected directly to the friction box, turning idly upon it. A number 10-32 iron hexagon-head machine screw joins these two parts together and



A SAFETY DEVICE FOR FEEDS OF PLANING MACHINE

offers sufficient resistance to operate the feeds under normal conditions, but shears readily under any unusual strain. This device has a great advantage in that its effective resistance can be increased or diminished by merely changing the radial position of the screw in the levers.

Salvaging Spoiled Work

By Peter F. O'Shea

In these days, when attention and money in large quantities are put on salvaging material to make by-products, a little intensive attention put on salvage within the confines of one's own factory is apt to pay very good dividends.

The special tap plant of the Greenfield Tap and Die Corporation, Greenfield, Mass., makes most of its small special orders out of pieces which have been spoiled in the course of manufacturing large orders. For instance, a large order of 1½-in. taps goes through the works. The pieces which fall by the wayside are saved and collected, and sent into a scrap stock. Out of an order



SALVAGING SPOILED WORK

for 1000 taps of the size mentioned there may be 20 spoiled pieces. When a small special order of a dozen 1¼-in taps is received the blanks for them are not cut from bar or rod stock, but instead, 12 or 14 of the spoiled 1½-in. pieces are picked out and sent along as blanks for the 1¼-in. taps. If the thread has been turned on these pieces, the lathe man turns the blank down until the thread has disappeared and then cuts a new thread of the proper diameter. If the spoiled piece already has a squared end and a polished shank, it is probable that this squared end will do for the squared end of the new size and thus save an operation or two, besides saving the steel which would otherwise be thrown away.

These spoiled pieces are assigned as blanks for small special orders because these small orders have to be tinkered with anyway, the dimensions being irregular, and requiring a special machine set-up. This makes it practically job work. It would not pay to route these spoiled pieces as blanks for large orders of regular dimensions, mixing them up with bar stock, because the machines used on these orders are naturally set up for quantity production. Each small order, therefore, in this plant, has a requisition for steel routed to the man shown in the illustration. He looks over his pile of scrap, and almost always succeeds in picking out enough blanks for the order. If he does not succeed, he then passes a requisition along to the regular stock man, who takes the necessary material out of the bar stock shown in the background. The salvage man, as he is called, makes it a point to pass along very few orders to the regular man. He much prefers to poke around and discover pieces enough that can be cut off to the proper length with the cutting-off saw. In this way he has made himself a valuable man for the company.

A Handy Stock Rack

By W. S. Hayden

A temporary stock rack being required that could quickly be assembled, dismantled or moved led to the design of the one shown in the sketch. It is composed of the pipe *A*, the foot *B*, the crosses *C* and the stretchers *D*. All except the pipe are iron castings, and all holes except that in the cross for the setscrews are cast in.

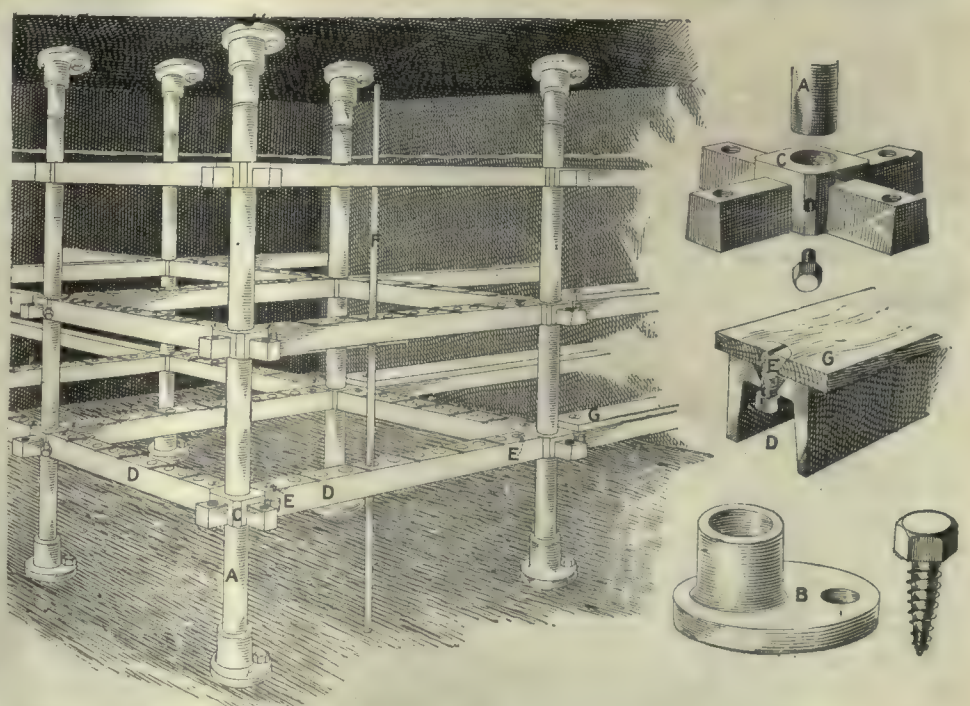
The use of the racks grew beyond the original intention, owing to their adaptability to any space, which led to their being placed in small areas for holding work during the processes of fitting and assembling. A lot of waste 1-in. pipe on hand was probably the main reason for determining the size of the standards.

For a low rack the pipe standards are cut to length, a foot and the requisite number of crosses slipped on each, and the rack is ready for assembling. The stretchers are cast in 18-in. sections with a sharp notch every 3 in. apart, making it possible to break them into multiples of the full length to accommodate even the most limited space. The stretchers are joined to the crosses by small countersunk head screws as at *E*.

When a rack is permanently placed, the feet are lag-screwed to the floor, and if a high rack is needed the pipe standards are cut long enough to reach the ceiling and a foot used on each end.

Where there are quantities of small stock of various diameters to be stored, requiring small bays, these are quickly provided by dropping a rod through the holes in the stretchers at intervals, as shown at *F*.

Where stock such as long bars of steel is stored on end the longitudinal stretchers are left out except for one at the top and one at the bottom, and both ends



A CONVENIENT FORM OF STOCK RACK

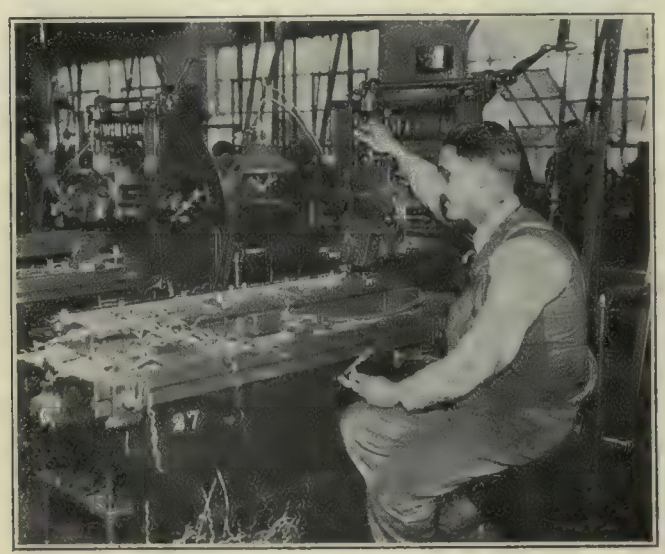
of the standards are secured. Such racks are of course placed next to a wall or other permanent backing, and when stock is put in or removed it is necessary only to lift out the top front stretcher, which is not bolted in. If it is desired to store finished stock or parts on these racks, strips of hard wood are secured to the tops of the stretchers as at *G*.

Although some of the bays of this rack have been at times apparently overloaded there has never been a break of the stretchers or slippage of the crosses, so the ultimate load capacity of the design is not known.

Magnetic Chuck for Holding Broach Blanks

By James McIntyre

Instead of holding broach blanks with clamps when planing, the J. N. Lapointe Co., of New London, Conn., uses magnetic chucks. Broaches made by this company average 40 in. long, and in holding them the old way there was always a tendency to spring. By substituting



USING MAGNETIC CHUCKS ON A PLANING MACHINE

two magnetic chucks of the Heald type, this difficulty was overcome, also this method of holding parts to be planed is much quicker, and the work comes off the machine perfectly straight. Of course a stop must be used for the flank to butt against or it would be pushed off the chuck. Side stops are also necessary to keep the work in proper alignment.

Repair Kink for Worn Connecting-Rod Bushing

By Charles Lindberg

In overhauling internal combustion engines, it will often be found that the connecting-rod bushing is worn but the wristpin is almost true. By pressing the bushing out and knurling it (coarse) on the outside and pressing it back again, the hole will compress itself enough to be fitted over again. If the wristpin is worn a little but not enough to warrant making a new one, then by having it a driving fit, the bushing will move free when it gets to the centre.

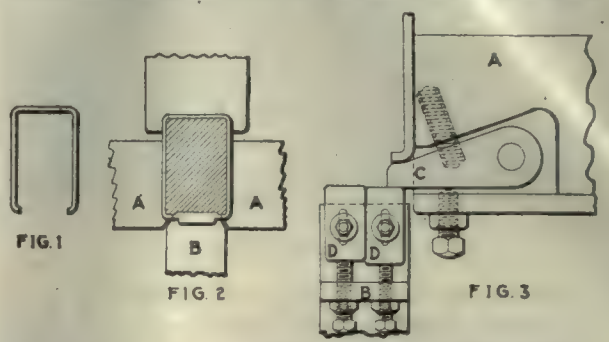
I have used this kink for years and found it satisfactory; saving quite a few pounds of bronze by the method. Of course it doesn't work on steel bushings.

Short Ends in Wire Forming

By S. B. Royal

Difficulty is usually experienced in bending short ends in articles, as shown in Fig. 1, in the wire-forming machine. The reason for this is shown in the tool layout, Fig. 2. As will be seen the side tools *A* must pass a little beyond the side of the wire to give the first bend to the ends. Then if these ends are real short the back tool *B* has no chance of giving them their final bend into place.

A tool, as shown in Fig. 3, should be used if this bend has to be at right angles or less. Its operation is obvious, the side tool *A* carries the swivel jaw *C*



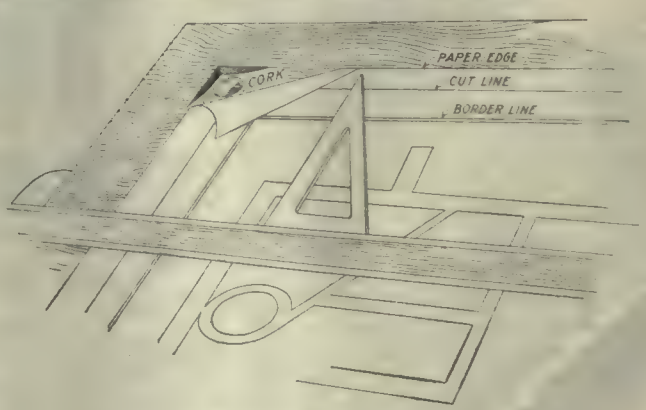
FIGS. 1 TO 3. BENDING SHORT ENDS OF WIRE
Fig. 1—The piece to be bent. Fig. 2—The uusal manner of bending the short ends. Fig. 3—A better method

which is held against the adjusting screw by the spring. When the side tool moves forward the jaw bends the wire as shown by the dotted lines. The back tool *B* has two adjustable pieces *D* which act on the jaws and bend the ends to whatever angle is desired.

Thumb-Tack Kink

By J. J. McIntyre

Raised thumb tacks on the drawing board are a source of annoyance. Where the standard sizes of detail paper and tracing cloth are used the following method of securing the paper has been found advantageous.



FLUSH-HEAD THUMB TACKS

Lay off on the board the points where the thumb tacks enter. From these points a recess is chiseled out, as shown, enough so that the head of the thumb tack is below the surface of the board.

At the point where the thumb tack enters the board, holes are drilled to receive pieces of cork, so that as the holding power of the tacks is diminished new pieces of cork may be inserted.

Advances in Industrial Management*

By JOHN CALDER, M. E.
Director of Modern Production Methods, Business Training Corporation, New York City

THE invitation to address the editorial conference on an industrial topic is much appreciated. No nation is so well served by its business publicists as the United States and in none are they so readily taken into the manufacturer's confidence. The policy of the "open door" to industrial journalists has been of great value to our plants and factories and we are increasingly aware that the only secret therein of any consequence is the open one of ability—of doing it first.

How is that ability now developing? In what direction is it branching out? What contribution is the engineer in industry making toward the common good? I will not dwell upon the material improvements. Progress in appliances, devices and systems is constantly in evidence. Nor will I devote any of your time to consideration of the problems of the worker on the threshold of industry, the apprentice, the vestibule-school and the employment manager, ranging from a mere registry of labor to the full-fledged official overseeing all industrial relations. I will deal rather with progress in studying the reactions of the workman himself to the machine we call industry in which he is vaguely conscious of many things which seem contrary to his interests and aspirations.

The distinguishing feature of the eighteenth century was the advancement of pure science and of its application to inventions. Yet a greater gain to the world than all the growth of scientific knowledge has been the diffusion of the scientific spirit, with its method of scrupulous verification, with its courage and serenity, its disciplined conscience, its intellectual morality and its habitual response to any disclosure of the truth.

Fifteen years ago the empiricism and rule-of-thumb which characterized to a large extent the manipulation of materials and equipment in the production of wealth were invaded by the deliberate application of the scientific method, hitherto confined largely to the laboratory and designer. Since then standardization, specialization and elimination of waste—features always characteristic of American industry—have gone on apace and have been extended from the material things of industry to the sphere of the worker, in health and disease, in safety and accident, in recreation and education and in all of his economic and civic relations. Not a few lessons on the scale of industry have been learned recently. Large scale production and distribution have been fully recognized as not only economically desirable but also as socially imperative for a nation of 110,000,000 steadily raising its standards of living. Extensive concentration of material resources in able private hands has been fully justified by the results and, whatever the future may hold of controversy as to the division of the wealth created, American labor is in no doubt as to the indispensableness of the ability of management and the necessity for continually attracting and holding it.

Mere bigness of individual plants is now under question. It is felt that they may become too big and that each unit should be restricted to a size well within the capacity of its management to impress itself directly upon the staff and upon the individual worker. Some of our largest plant units today, though wonderful examples of engineering skill and organization, are doubtful ventures from the point of view of successful handling of the human factors. Poor judgment as to the most desirable scale of operations in some of our war-industry ventures resulted in spreading out supervising ability so thin as to cause much inefficiency. We also learned while passing through the discipline of war times that the mere machinery of business may receive from the enthusiastic specialist a meticulous attention out of all proportion to the benefits it can confer, compared with a corresponding amount of effort and understanding directed toward the handling of the human factors.

> *In no other country in the world is industrial journalism so warmly received by the business interests as in America and the policy of the "open door" in this respect will be of inestimable value in bringing about and maintaining the condition of understanding and coöperation between employer and employee that is to constitute one of the most important subjects of scientific research in the next decade. Advantage must be taken of every factor that will tend toward social and industrial harmony; misdirected energy and sentimental incompetence eliminated from the study of the problem; schools established to educate the foremen and minor executives coming directly in contact with employees; and every effort put forth to establish the relations existing between the two principal factors of industry upon a sound and democratic basis.*

The spread of theory and practice in the matter of applying the scientific method of accurate observation, verification, analysis and inference to industrial problems has been greatly aided by our trade journals. Yet the mass of our plants is still little influenced, partly owing to the lack of intelligent participation by owners and in the larger degree to the fact that many promising proposals have been presented to industry by specialists in terms which greatly exceeded the intelligence of those who must ultimately carry them out. Here we have demonstrated again and again that we never really *know* anything which we cannot *do*. Now in the aftermath of the war, with the urgency of demand temporarily removed, with many consumers on the fence, certain labor problems only temporized with during the strife are coming up for settlement and many questions call for answers.

Shall we courageously apply the scientific method? Shall we view them in the light of the truth, the whole truth, and nothing but the truth about all the people and things concerned in industry? Have we any policy in the premises? Have we any considered program to meet them? Can industry now resume its normal course? Can the "economic urge," removed in so many cases by war policy, be imposed once more upon employer and employee alike? Can our Government be now content to regulate, not to control or operate business? Can the complicated phenomena vaguely termed "labor troubles" be taken out of politics? Can they be faced and solved in man-to-man fashion in each of our plants? And can the scientific method be applied to men and human instincts in industry as successfully as it has been to things?

To all of these questions we believe the answer is in the affirmative. Across the Atlantic organization of labor and of capital is already so complete and is represented by such high intelligence that what is practically an industrial parliament has been sitting for weeks in London and has just announced unanimity of opinion as to how eleven million of workers and thousands of employers shall live and work together hereafter. It is a great event without the slightest implication of revolution about it and is worthy of the best traditions of the English people. Political sanction cannot be much delayed with such a clear mandate from all classes of industrial and social thought.

*An address before the Industrial Conference of the New York Business Publishers Association, April 11, 1919.

But *we* have no immediate prospect of any such solution nor have we any such situation as characterized the war-weary, working people of Great Britain, who have surrendered for several years hard-won and long-cherished rights to the exigencies of the great conflict. Our industrial unrest, such as it is—and it has been somewhat exaggerated—requires an American solution which, we believe, will not come from the White House or any state house. Forty-eight sovereign states rightly jealous of their constitutional privileges make any such present solution as that proposed in Great Britain impossible, but the details of that solution are bound to modify our thought on social possibilities.

Here we must act in the spirit of that Chinese proverb: "If you want to keep the town clean, let every man sweep before his own door." It was this spirit, in which the Steel Corporation took a commendable lead, which put safety engineering on the map in our plants and socialized the idea—not statutes and inspectors; and it is the same spirit of liberal initiative which is opening the way for closer relations between capital and labor; relations which must necessarily at first be local and particular to each industry and plant until organized labor is as truly representative as it is abroad. But organized to amicable ends these relations must finally be and they will always prove most satisfactory where the highest intelligence is actively representing both.

Better Understanding of the Worker

Our chief gain recently in management has been a better understanding of the worker, his fears, ambitions, attitudes and achievements. Most scientific studies of industry have dealt essentially with purely mechanical elements, the employees being regarded chiefly as so many hands available at all times, as a matter of course, to carry out the will and intention of the inventor, designer and business planner on schemes for using them effectively; schemes sometimes quite meritorious but with no provision for obtaining the consent of the governed.

About these schemes the workmen were expected to have no opinions at all. It was assumed that at all times they would respond to a large money inducement alone and there was both surprise and chagrin when opposition was encountered in which earnings were not involved in any way, and even where no open resistance was offered high earnings were not always accompanied by satisfaction on the part of the worker. Yet economic friction is to be expected. It is an inevitable factor in democratic industry. Wherever men think, they will differ in opinion and reconcilement can never be forced. Vaguely and unsatisfactorily termed "labor trouble," economic friction is really the growing pains of industry and there is a close connection between it and the inherent tendencies we call human nature.

The strongest of these tendencies is curiosity and the outstanding fact that the industrialist must keep constantly in view is that *the workman instinctively suspects everything he does not understand.* What a vast number of things there are in which we leave him to find an incompetent or prejudiced tutor! The workman wants to know why things happen, how they happen, how his work can be adjusted to his circumstances, how these circumstances can be reconciled with the claims and keenly felt limitations of his personality, and how he can, with least effort, attain the results he aspires to. So what we have to concentrate upon in the near future is not the extension of mechanical facilities—that is going on almost automatically, forced indeed by the growing needs of peoples. We have to ask ourselves, Can people in industry be educated for freedom and individual self-expression? Or, are we still to consider, as has been done, that huge group enterprises should educate for and aim at a quite docile organization of human units? The answer undoubtedly is that the self-assertion and self-direction increasingly vocal and operative in workers make the latter course impossible and that all policies leaning in that direction will be barren and futile.

If we fearlessly take the open road we will find that thinking will lead the workman into much truth at present hidden from him. He takes much boldly proclaimed error on trust. He has no chance to examine it competently and the truth about many things is not spoken or written in language he can understand. Thought, we must remember, requires leisure; it needs vitality and it must have energy and clear social purpose in view and be pursued as a habit and through method. The tired, the lazy, the indifferent, the ignorant work people cannot or will not organize their thought. Yet in a true existence the elements of plan and will and intention must enter in and modern business changes now impending and involving industrial democracy are simply due to the strong conviction that a place *must* be found for human personality, that we must somehow, in spite of large scale efforts, come back to "folks."

To put it in a single phrase the desirable, social and economic program for us is simply this, "to make goods plentiful and men dear." There are people engaged today in stressing one or the other of these things, but there is no satisfactory economic future for any of us without both. To attain it we must embark on a program of education distinct from and supplementary to the many forms of mutual interest now in action.

We now know that human engineering, tackled in spots only, such as safety, welfare and employment, has been, as a whole, neglected in industry where it counts most. We have discovered that human conduct tends to become more intelligible and also more responsive to the control necessary in industry, the more we view it in the light of our understanding of the primary motives of human action. Not all of our failures in industrial relations have been due to poor handling of men, but wherever they have been, we have found an unconscious but not less real repression of the employee and his aspirations. If these are now liberated and wisely guided there is no telling what we may accomplish.

Motives Misunderstood

We also find misunderstanding of the motives of employees and we see sentimental incompetence busy dealing out what it calls social justice without any close knowledge of the facts. This has merely confused things. Plans for obtaining the fullest democracy in industry for self-expression and self-determination are under way, but these should not crystallize in programs for giving the workman what he does not want or what he is not entitled to. Backing these up by statute or administrative order settles nothing in the end. Only through enlightened and energized employers and their foremen in industry will a permanent advance be made. The foreman's education has been sadly neglected and yet he is the man, and the only man in authority, who makes contact with our workmen through a half of their waking hours. To apply the scientific method to the people in industry as well as to things is the problem of the third decade of the twentieth century—a problem of wonderful possibilities. Not only must we cultivate more intensively in every plant and industry the modern production methods now highly elaborated, but we must set about to greatly enlarge the intelligence of those who must carry out these methods, namely, the non-commissioned officers of industry, the foremen. This is of great importance. No ideas are of much lasting benefit in any plant unless they are well sold to the foremen and only a mere fraction of the present-day literature on how to analyze and handle the human factors in industry is intelligible to the foreman who must do this work in detail. Without simplification and interpretation and personal contacts these men who were selected essentially for technical proficiency will never become adepts at making men as well as at making things and we may be certain that enlightenment which does not reach the foreman will never reach the workman.

Begun in the closing months of the war courses of instruction for foremen and heads of departments now cover several thousand men grouped together chiefly in numerous private corporation classes. This instruction is necessarily different from that offered to adolescents or to men lacking in experience in industry. The classes embrace men from 25 to 65 years of age; men of responsibility who have ceased to study but who are ready to respond to texts specially prepared for them, combined with lectures and open discussions on their problems. The

courses are on the Plattsburg method, covering only three months, for that is the limit of efficient attention and interest at any one time of groups of this character.

Liberal, forward-looking ownership and management inviting self-expression and self-determination on the part of the labor in its plants is everywhere handicapped today by the unenergized and unenlightened foremen and minor executives who make the intimate contacts with the workmen.

Individual organizations sincerely aiming at democracy in their industrial relations must insure that their foremen are instructed and willing coöperators, and the particular technical competence for which they were originally selected is no guarantee of this. The number of things which are simply taken for granted about the man once he is ranked as a foreman is surprising, particularly in relation to knowledge and analysis of himself and of the human factors in his daily work.

In this latest and far-reaching movement in industrial management to raise the standard of executive intelligence and sympathy it is the uniform experience that no foreman or assistant is too young or too old to benefit greatly from a renewed intellectual interest in his task and in the people he has to handle, and it is found that the essential elements of the educational and inspirational program necessary are equally applicable to men in responsibility in every kind of industry.

Sending the foreman back to school at the expense of the employer is a new idea to most owners, who have been willing to spend money on many other things much less worth while. But if that school is held in the employer's own plant, aims at a definite objective and makes a family party of the occasion, it is found to be a most fruitful source of enlightenment and enhanced good will. Such a meeting has nothing in it of a business gathering with a sense that the executives are being worked over time. It is taken up with consideration of self-analysis, team work, organization, plants and their requirement, the records of industry, and the management, direction and control of the working force as an efficient team. On all of these we find the foremen in industry of every kind eager for information and participating willingly in the discussions.

The art of management and supervision has been well worked out to date, so far as the chief executives are concerned, and it calls for an ever increasing and high order of ability. It has sometimes been inclined to belittle the foreman and at other times to ignore him. Yet we have a fair supply of good managers today and are calling loudly not for them or for advisory engineers but for competent foremen, not merely to criticise, but to supervise successfully and to "deliver the goods" with the only kind of help now available, at a cost that makes good business and with due regard to the aspirations and interests of labor.

It is to discover this man in each plant, to develop him where known, to create an interest in his job and to retain that interest, both in it and in his employees, that this educational movement has been specially prepared and offered as something new and necessary at this epoch in our industrial history.

This teaching which the Business Training Corporation of New York has instituted for all kinds of plant executives under the supervision of experienced managers, is an absolutely necessary preliminary to success in the introduction of industrial democracy, which depends as much upon atmosphere and education as upon conferences and rules of procedure.

Worms and Worm Gears*

By G. W. CARLSON
Timken-Detroit Axle Co.

The author of this article tells of the application of worms and worm gears to automotive construction. The two forms of worms—the straight and the hour-glass form—are discussed and the points of each are touched upon. The application of this form of gearing is also suggested for other purposes than automotive drives.

THOUGH the principle of worm gearing has been known for centuries, it is not until recent times that it has been employed as a form of power transmission in the full sense of the word. It was confined to such uses that called for a great reduction of motion rather than transmission of power, and even until late years it was not resorted to except for electric elevators, winches, etc. It was commonly assumed that it should be of high reduction and irreversible. The efficiency was of necessity extremely low—often less than 40 per cent.—and therefore not an economic power transmission. The developments later toward the involute form of tooth, and lower reductions proportionate to the pitch and centers, have brought the worm gear to a state of mechanical efficiency where it competes successfully with the spur and bevel gear.

It is not the writer's intention, however, to recount the ancient and modern history of the worm gear, nor try to encompass the subject as related to its many and varied forms and uses, but rather to, so far as is consistent, keep within the confines of his past experience with this form of power transmission. This involves, therefore, that particular application of the worm gear which has, perhaps, more than any other agency, contributed toward its popularity and rapid development in recent years, namely, worm-gear axles. There is no one who can but acknowledge the success of the worm gear in this field. Its use here has become almost a necessity and, though the widely accepted supposition of its inefficiency brought on a siege of skepticism and criticism, it is today firmly established as a final drive for motor trucks.

It is true, that among axle builders at least, the worm gear—before the development of helical bevels—began to be recognized as the eventual successor to the bevel gear in passenger cars. This was mainly because of the difficulty encountered in producing gears that would pass the silence test. As the truck operator, and everyone in general connected with trucks, began to lose patience because of the everlasting noise of the chains, and the nuisance of frequent replacements, so did the passenger-car buyers begin to demand quieter gears in their cars. Many car builders had already installed worm gears, or contemplated so doing, when the helical bevels were introduced. These have since that time, at least in the United States, had a clear field except in the case of passenger electrics. It seems, therefore, reasonable to assume that, but for the introduction of the helical bevels, the worm gear would today enjoy a considerable popularity as a passenger-car unit. The

* Presented at annual convention of American Gear Manufacturers Association, Cleveland, Ohio, April 15, 1919.

low-gear reductions, then in use, for the time being at least, eliminated the worm gear as a competitor in this field. It is a question in the writer's mind, however, whether in this connection it will not again attract the attention of the automobile designer. The present tendency is decidedly toward higher-speed engines. The ratios are consequently increasing and with the present state of bevel-gear development, the limit in reduction requirements available in them is rapidly being approached. The change to smaller pitches is out of the question in face of the incessant cry for more power and more road clearance, and there does not seem to be any design yet in sight radical enough to permit of lighter-weight cars proportionally to the power. The above statements are made, leaving out of consideration such experiments as have been tried with high-ratio gears and coarse pitches, and which ostensibly meet the requirements, but, to the writer's knowledge, they have not yet reached a point where success or failure is assured.

As in any form of gearing, the worm gear in its present state undoubtedly leaves a great deal to be desired and ample room for further development. The high mechanical efficiency and the smooth and silent running are attributes of it which should form an encouraging basis for such development and research.

Two Types of Worm Gears

Fundamentally, there are but two types of worm and gear, though the principle involves a multitude of variations of minor detail. They are the straight or parallel and the hour-glass or, as it is commonly called, the Hindley. The relative merits of these two types have been the subject of many discussions. The parallel type is the oldest in practice, though the hour-glass type appears to have been the first introduced in motor vehicles. The former is today the one most used, nevertheless, in automotive-power transmission.

The straight, or parallel, type of worm is by far the easier of the two to produce, which fact has perhaps been indirectly the reason for its comparatively wide use, and made it the object of much study and many improvements in method of manufacture and mounting. It eliminates at least one adjustment which is now inseparable from the hour-glass type where there is wear on the worm thrust bearing. As this wear takes place the worm will travel in a fore-and-aft direction, in which case the hour-glass worm will eventually destroy itself, or if it is originally incorrectly aligned fore and aft. Assuming the merits of the two being equal, accuracy possible in manufacture is decidedly in favor of the parallel worm, particularly due to the fact that it can be ground after hardening. This is important, as distortion is attendant to any complicated form like a worm in hardening, and cannot be easily corrected by buffing. In fact, it is more the rule than the exception that where much buffing is required the irregularities in the worm threads are accentuated and the threads will vary in thickness. This will destroy smoothness of action, produce a hammering on the gear, and often cause considerable noise. An irregular surface of the threads will also cause the teeth of the gear to pit, and frequently this may be so great as to ruin the gear sometimes before it has had a chance to properly "wear in."

The principal aim in the modern worm gear is to reduce the rubbing action to a minimum and to increase the rolling action to a maximum; in other words, the main consideration in bevel or spur-gear design.

It is a common error to assume that in all worm gears the tooth action is mostly a rubbing action. It is a combination of rolling and rubbing. Recent developments in the parallel type have been productive of remarkable results in this direction. The actual rubbing velocity has been reduced to so much below that usually calculated that the motion is transmitted by a rolling action far in excess of the rubbing action.

The Worm Gear Has Its Limitations

The worm gear, like the bevel, so far as concerns current axle design, has its limitations as regards reduction. Though an excessively high ratio may be employed, the efficiency is reduced proportionately, due to the decreased lead angle, assuming, of course, that the center distance is constant. If the centers may be increased so that the lead angle remains constant, then the efficiency will not be appreciably affected. It decreases rapidly when the lead angle is less than twenty degrees; in other words, at the point where the rubbing action begins to rapidly increase proportionately to the rolling action. Developments have demonstrated that in order to maintain in all reduction a maximum efficiency, the lead angle must remain within a given limit. A considerable change in ratio, therefore, makes a corresponding change in centers or pitch necessary, which latter conditions would seem a check to the capacity due to tooth stresses set up by the use of a necessarily smaller pitch. In axle requirements, however, the reductions come so well within these limitations that for all purposes the efficiency may be assumed as constant.

The Efficiency of a Worm Gear

Many arguments have been advanced against the use of worm gears in axles from a standpoint of coasting qualities of the car. In speaking of the efficiency of a worm gear it is usually assumed that the power is delivered through the worm into the gear. It is true that where these conditions are reversed, as in coasting, the efficiency would be lower for the same power applied and where the lead angle is less than 45 deg., in which case the efficiency is the same. It will be seen, therefore, that because of this fact, the greater the rolling action of the tooth the less the effect will be on the efficiency when the power is reversed. It must be borne in mind, at the same time, that the lead angles in axle gears come fairly within the range where the reversing action has little effect upon the efficiency, also that in coasting the resistance of the worm is limited to that of turning the transmission gears, except when it is desired to use the engine as a brake, in which case the reduced efficiency is an added advantage.

In the gear adopted for axles, such as the David-Brown type, the allowable variation in pitch for constant load is considerable because of the tooth form peculiar to it. It is such that the load produces very little stress. A line drawn from the pitch line and at right angles to the pressure angle and through the tooth, will pass by the base of the tooth at the opposite face. It is obvious that under these conditions the tooth will not easily break, which experience has proved, and even a foreign object passing through the gear will not strip a tooth but rather break the gear in two.

The same obtains also in cases of overload. When the tooth pressures are too high the gear teeth will not,

as a rule, strip though the life of the gear will be reduced in proportion to the overload. The writer has personally observed cases where the worm and gear had been mismated, that is, a worm intended for one ratio and a gear for another, one of which had been in service approximately six months before the error was discovered. This remarkable showing was undoubtedly due to the grade of material in the gear. The teeth had actually assumed a contour conforming to the worm thread for the actual working depth, which was slightly in excess of ¼ in. The lead angles differed originally by approximately two degrees, but at the time the gear was examined the teeth had assumed the same lead angle as that of the worm, at the contact between them. The material commonly used in axle worm gears is a bronze generally 89 per cent. copper and 11 per cent. tin. This combination seems to give the best all-around result in that it presents a contact surface of great durability and a low coefficient of friction. The castings are chilled around the outside face. The hardness of the chilled portions is usually maintained at about 90 to 100 Brinell. The chilling has a number of advantages. It has a refining effect on the grain of the metal and prevents segregation of the tin from the copper, which is often the case in sand-cast gears. It also produces a much cleaner casting, which, because of the absence of sand pockets, greatly adds to the life of the machining tools and makes it generally a much better machining proposition. It has been found practicable in not a few cases to dispense with the operation of rough hobbing without in any way affecting the quality of the finished gear or decreasing production. There have been endless experiments made with other materials, but to date there does not seem to have been any generally accepted as having proved suitable to every form of duty, though in individual cases and under limited conditions some have proved satisfactory.



The strength of a modern axle worm gear, as has been stated before, is because of the tooth contour, more limited by the tooth backing than by the strength of the teeth proper. The current method in axles is to bolt the gear to the differential. It has often resulted in the gear breaking—actually pulling apart between the bolts. To prevent this, it has been necessary to make the gear extremely heavy, thereby incurring a considerable expense. An old design whereby the gear is made to mount on the differential and held by a number of small serrations, has been made use of with marked success. The improvement of this over the present method lies in the fact that the resistance to the rotating tendency of the gear is taken directly under the point of application of the load or, progressively, under each tooth at the moment of load application. It will be seen that since the metal, where this construction is used, cannot, except through inaccuracies of machining, be stressed beyond the load-carrying tooth, the gear itself may be made considerably lighter, thereby effecting a material saving of expensive bronze. An effort toward attaining this end, but by a different method, is made by a well-known tractor manufacturer. In this instance, the teeth are cast in the gear, allowing only a slight amount of metal for machining. The worm is usually made of an alloy steel carbonized and hardened to a scleroscope reading of 80 to 90. Though a good polish on the threads is desirable, it seems more essential to have an accurate contour of the wearing surfaces. As previously stated, a high polish can often be procured only at the expense of accuracy. It is therefore sometimes the practice to grind the threads twice. The first grinding is made for the purpose of removing the irregularities due to the hardening. The second grinding is made for the purpose of producing a smooth surface in order to reduce the polishing process to a minimum. This has an added advantage, inasmuch as it prevents the operator from taking off too much stock at one grinding which has a tendency to produce minute surface cracks.

The life of a worm gear embodying the characteristics as outlined is truly remarkable. This does not mean wearing out from any cause (because many gears have been ruined for lack of lubricant and other misuses), but for any defect inherent in the type or principle.

The efficiency of a worm gear is theoretically very high when properly designed. Among the great number of variables upon which the efficiency depends, the lead angle is the most important. Contrary to statements sometimes made, the small diameter worm gives the best results even though the angle may be great. The only feature militating against it is the question of deflection under load. A number of cases have been observed where the worm, however, has been subjected to a calculated deflection of 0.002 in. to 0.003 in. under continuous service without any apparent injuries resulting.

The fact that we have achieved so much and still know so little about this form of gearing should make it a doubly interesting field for exploration. It is not any longer a transmission of motion to be used, but an actual, highly efficient, and silent power transmission, taking its place beside the spur and the bevel.

∴ EDITORIAL ∴

Paying for Victory

THIS week ushers in the launching of the Victory Loan—not a Liberty Loan this time but something far better. It is an announcement, a reminder and an appeal to our readers to live up to their responsibilities. We are mailing with this issue a colored supplement typifying the Goddess of Liberty appealing to each one of us from the grave-dotted fields of Flanders.

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Hundreds of thousands of men have died in order that we might live to see victory come to pass. They have esteemed it a privilege to be able to die for this victory. The little part that we are asked to do is to pay the money cost of victory. *They* have paid the blood cost.

□ □ □

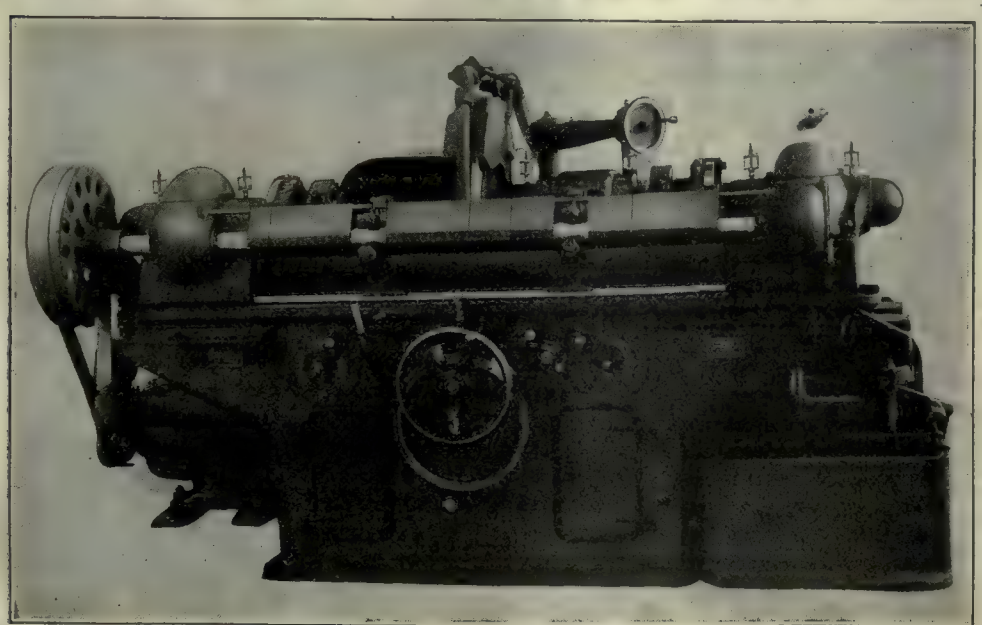
Knowing this, can anyone who has a heart or a mind or a soul fail to take up his little share of this burden?



SHOP EQUIPMENT NEWS

Landis Self-Contained Crankshaft Grinding Machine

The Landis Tool Co., Waynesboro, Penn., has just placed on the market the new type of self-contained crankshaft grinding machine shown in the illustration which is built for accurate crankpin grinding on airplane, automobile and other gas-engine crankshafts. No offset centers are required, the work being held in adjustable holders located at both ends. The work is driven from both ends, the two crankheads being geared together while the different throws are obtained by means of a sliding adjustment of the crank carrying fixtures which are mounted on the ends of the crankhead spindles. This adjustment is of the micrometer type and is operated by a screw having a graduated dial. For multiple-throw crankshafts in which two or more pins must be ground in exact relation with one another, one of the carrying fixtures is provided with a gaging block, made to suit the throw-angles of the crankshaft.



LANDIS CRANKSHAFT GRINDING MACHINE

If desired, the crank-carrying fixtures can be equipped with a swiveling index, instead of the standard gaging block, this swivel being graduated to give all of the regular throw-angles. Also if desired, fixed throw-heads can be furnished instead of the adjustable heads for use in the manufacture of a large number of crankshafts of the same throw. Alignment of the crank-carrying fixtures is secured by the adjustment of two screws carried in the hub of the bevel gear, mounted on the spindle in each head. A second function of these screws being to hold the gear in positive relation to the shaft, this construction takes the place of the key customarily used. These screws are accessible when the crankhead covers are removed. A special feature of the machine is the method of mounting the counterweights which are fastened to each side of the spindle gear between the spindle bearings. It is claimed that this construction reduces the overhang of the spindle to a minimum and places the counterweights for the work in such a position that they will not influence the end of the spindle. The crankhead spindles are large in diameter and are provided with long phosphor-bronze bearings which are adjustable for wear. The spindle gear is mounted on a tapered portion of the spindle between the spindle bearings, this arrangement permitting the mounting of the work-carrying fixtures directly on the end of the spindle and close to the bearing. The main drive shaft operates the crankheads through a steel sleeve carried in each head, this sleeve carrying the gear that meshes with the large spindle gear. The driving shaft and the sleeves are fitted together with taper keys, these being loosened by a screw adjustment when it is desired to slide the heads along

the shaft to adjust for different lengths of work. After adjustment the keys are again tightened by the screw adjustment to prevent any possibility of play between the shaft and the sleeve. These taper keys can also be used for securing a fine adjustment on aligning the two crankheads.

The driving sleeve is mounted in bronze bearings, one at each end of the sleeve and the driving gear is mounted on a taper between the two. The gear is held on the taper by a nut on the sleeve, the gear being fitted like the spindle gears with adjusting screws instead of a key for the positive location of the gear on the driving sleeve. The gears in the crankheads run in an oil bath to insure proper lubrication.

The work table swivels for grinding tapers and the changes of work speed are made by shifting a belt on cone pulleys by the movement of a single lever. The wheel head is mounted to slide on V- and flat-ways, the spindle being made of special steel, running in bronze bearings adjustable for wear. The driving belt is kept under uniform tension by an automatic tightener which also serves to take up the stretch of the belt. The feed of the wheel to the work is either by hand or automatic, it being possible to set the automatic feed to reduce the diameter of the work from 0.00025 in. tc 0.007 in. at each reversal of the wheel carriage. This automatic feed is only furnished when specified, hand-feed being regular equipment. A spacing-bar arrangement for locating the wheel to suit the various crankpin locations can be supplied if desired. This device is a great time saver when large quantities of duplicate shafts are to be ground, and where there are several types of crankshaft to be handled, the machine can be equipped with spacing bars to suit each type as the bars may be changed quickly to suit the work in hand.

A lever is provided for connecting and disconnecting the carriage traverse and when the spacing-bar arrangement is included, this lever has the additional function of engaging the plunger in the spacing-bar slots. A device is also incorporated that prevents the spacing bar and power-wheel traverse to be engaged at the same time. Whether or not equipped with a spacing bar, the machine is provided with a safety device for preventing the power traverse being suddenly thrown in, thus causing the side of the wheel to ram into the crankweb.

Wheel-truing fixtures are regularly furnished and are used for truing either the face or the sides of the wheel. A radius wheel-truing fixture, suited for truing the face of the wheel and also for forming the corners to an exact radius for grinding fillets up to $\frac{1}{2}$-in. radius can also be provided on special order.

Rests support the work at two points, in front and beneath, these being independently adjustable. The support adjusting screws have stops which can be set to limit the movement of the rest jaws.

The lubricant pump is of the centrifugal type, so arranged that the lubricant does not come in contact with the bearings. The rotor of the pump is immersed at all times and no priming is necessary.

Syracuse Precision Centering Gage

The precision centering gage illustrated is the product of the Syracuse Sander Manufacturing Co., Inc., Syracuse, N. Y., and is intended for the use of pattern-makers in locating centers and lines on plain or irregular surfaces, opposite the centers and lines obtained when work is laid out as on the cope or parting of pattern. In use, a centering point is pressed into the center on the pattern which is then placed on the base. This centering point fits in a hole in the base and the scribe in the arm is in alignment with the center of



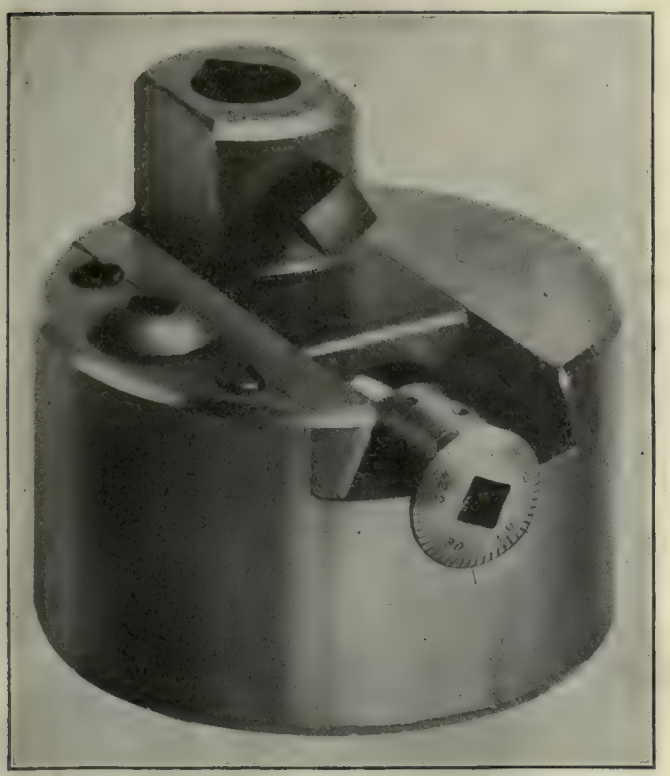
PRECISION CENTERING GAGE FOR PATTERN WORK

Over-all height, 16 in.; weight, 7 lb.; vertical capacity, 12 in.; distance from center hole in base to column, 6 in.; centering points furnished, 6.

this hole, so that when the arm is lowered a center is marked on the upper side of the pattern directly opposite the one on the lower side, this method being said to obtain accuracy and great saving of time. By placing the scribe horizontally in the arm the device may also be used as a surface gage on small patterns.

Detroit Offset Boring Head

The accompanying illustration shows the Detroit offset boring head. The body of the chuck is made from solid steel 4 in. in diameter and $2\frac{1}{2}$ in. long. The over-all length of the tool is $3\frac{1}{2}$ in. The toolholder is made from 20- to 30-point carbon steel, carbonized and hardened with the bearing surface all carefully ground. The lead-screw nut is machine steel, pressed and pinned in place, and then tapped true with the ways of the toolholder. The lead screw is $\frac{9}{16}$ in. in diameter and threaded 20 threads per inch, and graduated on the head end to show a movement of 0.001 in. The head of the screw has a $\frac{5}{16}$ in. square broached hole for the wrench. The toolholder has a $\frac{3}{4}$-in. hole with 90-degree angle V. This holder will hold any round stock from $\frac{5}{16}$ in. to $\frac{3}{4}$ in., and square or hexagon stock from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. Clamping of the tool is obtained by means of $\frac{3}{8}$ in.—16 x 1 in. tool-steel setscrews. The gib is carefully machined and

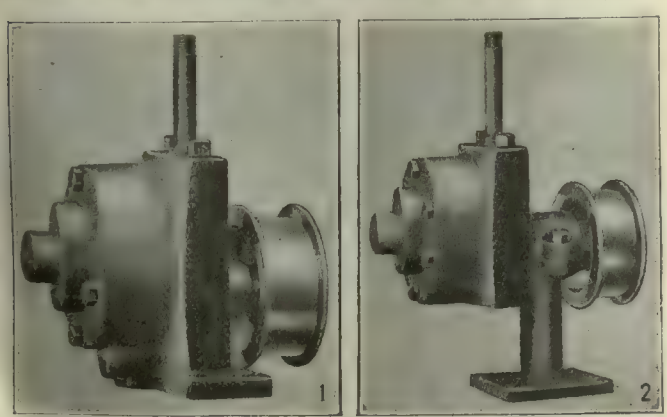


DETROIT OFFSET BORING HEAD

fitted and is held in place by means of two ¼ in. — 20 fillister-head screws. The locking screw is of machine steel, cyanided. The slide has a travel of a little over 2 in., enabling the operator to bore any size hole up to 4 in. Parts are machined in jigs to insure interchangeability of the parts. The head is primarily designed for use on a milling machine but it can be used to advantage on almost any kind of a screw machine, lathe, or drilling machine. The back of the body is bored to fit a No. 4 Morse taper shank. This tool is made by the Detroit Pattern Works, and distributed by the Great Lakes Sales Co., 924 Dime Bank Building, Detroit, Mich.

Matson Gear Pumps

The Matson Machine Co., 2 Beacon St., Concord, N. H., has recently added two new types of pumps to its previous line. Fig. 1 shows the style X pump which is a one-way machine built for ¼- or ⅜-in. pipe. It is intended for use on machines that run reversed part of the time and is equipped with valves that cause the liquid to flow in one direction regardless of the direction in which the machine is running. The pump is complete in itself and needs no check valve if placed within 3 ft. of the level of the liquid being pumped.

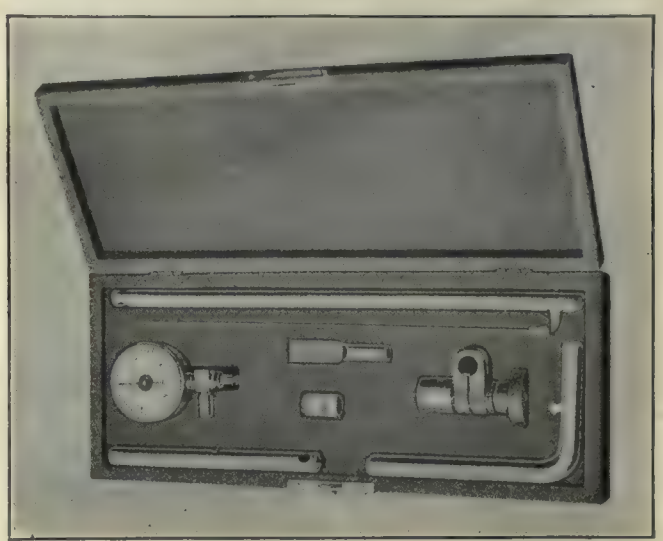


FIGS. 1 AND 2. MATSON STYLE X AND Y PUMPS

Fig. 2 shows the style Y pump, which is of the same construction as the style X, except that it has an adjustable base that can be set to suit any angle, this construction allowing the base to be fastened to a surface at any angle and still have the body of the pump upright. The pump is built in ¼- and ⅜-in. pipe sizes, and the holes in the base can be placed according to the requirements of customers.

Cornell Dial Test Indicator

The dial test indicator illustrated is being manufactured by the Cornell Tool Co., Detroit, Mich., and marketed by the F. Conley Co., 502 Book Building, Detroit, Mich. The instrument is made in two sizes,

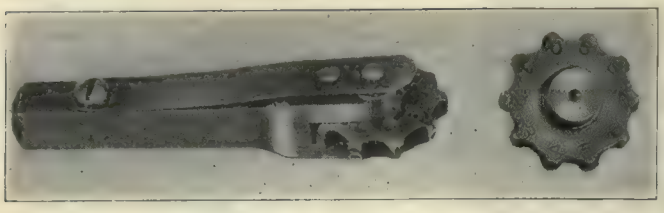


CORNELL DIAL TEST INDICATOR AND ATTACHMENTS

No. 1 for toolroom use and No. 2 for use in production work. A number of attachments are furnished with the indicator which is said to be very simple in construction having only 16 parts including screws in its mechanism. The feature of the indicator is that the dial works on a universal joint in such a manner as to enable the operator to always have the dial facing him, thus eliminating the use of a mirror. A number of attachments are furnished, one enabling the dial to be used as a height gage, another indicating the bores of holes down to ⅜ in. in diameter and to a depth of 8 in. A feature is that the indications on the dial are wide apart, enabling accurate readings to be taken. The No. 1 machine will indicate distances up to 0.135 in., while the No. 2 will indicate up to 0.235 in.

Helios Marking Tool

The Helios Metal Co., Inc., 437 Eleventh Ave., New York, is now marketing the numbering and lettering tool shown in the illustration. Instead of having an individual tool for each number or letter, small wheels carrying stamps, numbers or letters are made up, these being held in a holder as shown. One side of the wheel is stamped to show the number or letter on the corresponding projection, while the other side carries a number of impressions into which a locating pin drops, operated by the spring shown on the print. While hold-



HELIOS MARKING TOOL

ing the tool by the sides, the wheel can be easily turned so that the desired figure is ready for use, and while stamping, the spring is pinched between the fingers, holding the wheel rigidly in the desired position. The tool is put up in a set containing one holder and four wheels, one wheel carrying the numbers 0 to 9, while the other three carry a set of letters.

Waterston Time-Saving Tap and Drill Stand

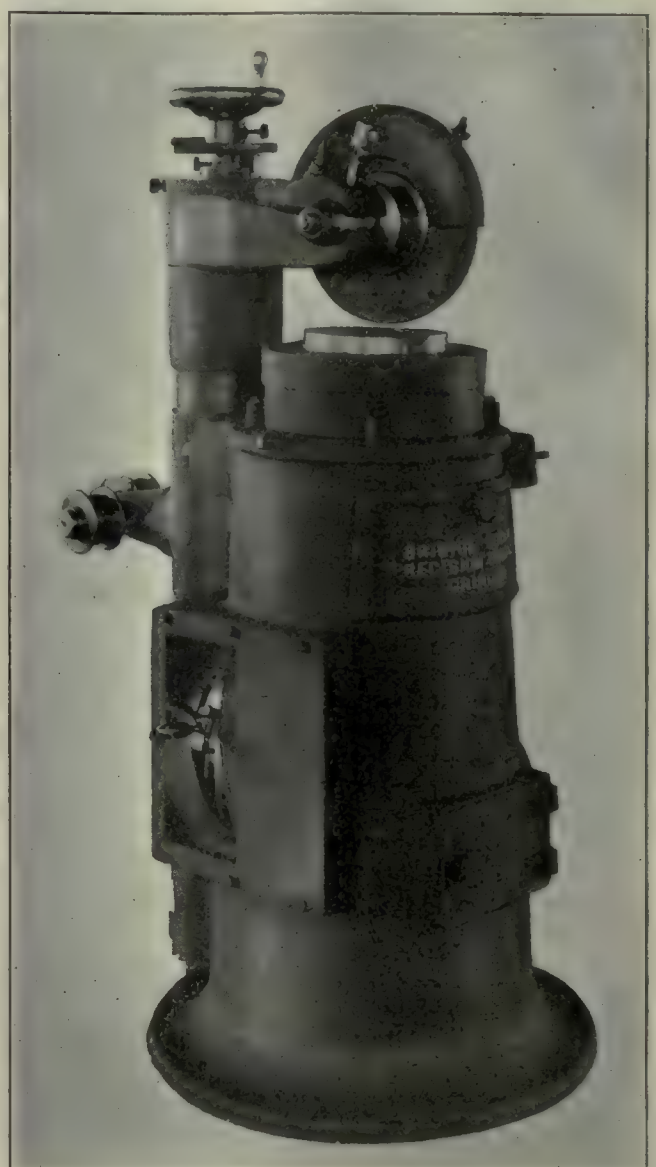
The ilustration shows a stand for taps and drills known as the Waterston Time-Saving Stand, and intended to aid the stockkeeper in picking out the proper size of drill or tap. Each stand holding up to and including $\frac{3}{16}$—24 taps has openings of the proper size to accommodate the body, drill, tap drill and two taps; the stands from $\frac{1}{4}$—20 to $\frac{5}{8}$—11 have openings for the body drill, counterbore, tap drill, and taper, plug and bottoming taps. The stands are made in 16 sizes with wooden tray to hold the whole set. They are marketed by J. M. Waterston, 77 Woodward Ave., Detroit Mich.



WATERSTON TIME-SAVING STAND

Bristol Piston-Ring Grinding Machine

The grinding machine shown in the illustration is made particularly for grinding piston rings up to 8 in. in diameter, and is the latest product of the Bristol Machine Tool Co., Bristol, Conn. The spindle is mounted in adjustable bronze taper bearings held in self-aligning boxes securely clamped to the head by removable caps. This method of construction facilitates the quick removal of the spindle for the wheel replacement. The oiling is by means of two sight-feed oilers. The head is supported and operated through the back column and the wheel oscillates from the center of the magnetic chuck to the left edge. The back column receives its movement through an arm attached to the base of the column, and the head is secured to the top of the column by a taper bushing and clamp nut directly under the ratchet wheel. Loosening this nut enables the head to be swung to any position over the chuck, but this should, of course, be securely tightened when work is being done. A suitable apron is provided on the head to protect the column bearings from grit or dirt. The feed may be by hand or automatic ratchet as desired, and an automatic stop is incorporated and can be set to grind any thickness desired. The ratchet wheel is graduated and one tooth movement lowers the head 0.0002 in. The elevating screw for operating the wheelhead passes through an adjustable split bronze nut, making it possible to take up any wear. The weight of the column and head is carried on ball thrust bearings which are also provided with adjustment for taking up wear. The arm that oscillates the column is held in place by a sliding key, and the movement is obtained by means of a connection through suitable universal joints to a crank provided with the necessary adjusting device for regulating the length of the stroke by a screw operating through the crankpin. This adjustment is by means of a socket wrench which is furnished with the machine, the screw being accessible through the lower door at the front. The crank is operated by means of bevel gears connected directly to a



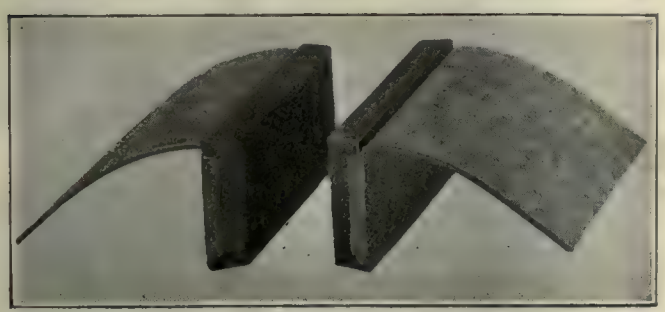
BRISTOL 8-IN. PISTON-RING GRINDING MACHINE

Chuck, 8-in. steel rotary magnetic; size of grinding wheel, 12 x $\frac{3}{4}$ in.; maximum distance from center of wheel to face of chuck, 9$\frac{1}{2}$ in.; vertical feed of wheel, 5 in.; largest swing of dry machine, 17 in.; largest swing of wet machine, 15$\frac{1}{2}$ in.; height of chuck from floor, 42$\frac{1}{2}$ in.; speed of grinding wheel, 1900 r.p.m.; speed of chuck, 180 r.p.m.; number of strokes per minute of grinding wheel across face of chuck, 4.8, 9.6, 14.4 or 19.2 per minute; revolutions of countershaft, 400; tight and loose pulleys on countershaft, 8 x 3 in.; floor space, 42 x 26 in.; over-all height, 63 in.; net weight, 1300 lbs.

four-speed change gear box operated through the lever at the left side of the machine. The chuck is mounted on a vertical spindle made of crucible steel and running in bronze bearings, the thrust being carried on hardened-steel friction rings, this method of construction automatically compensating for any wear. The chuck spindle is driven through a cone clutch and pulley placed between the main bearings, the clutch being operated by a lever placed at the side of the frame. The clutch pulley is driven by belting over idlers to the countershaft. The machine shown in the illustration is for dry grinding, but a machine for wet grinding can be furnished if desired.

Frey Fiber Vise Jaws

The fiber vise jaws shown in the illustration are being marketed by Henry Frey, 337 Gould Ave., N. S., Pittsburgh, Penn. Each jaw is made in two pieces,



FREY FIBER VISE JAWS

a pocket of galvanized iron fitting over the jaw and a fiber inset that can easily be removed and replaced in case of wear or in case it is desired to insert a face of some soft material, such as leather, for very delicate work.

Whiting & Comstock Semi-Universal Dividing Head

The semi-universal dividing head shown in the illustration is intended particularly for use on hand-milling machines and is a recent product of Whiting & Comstock, 32 Union Place, Hartford, Conn. The centers will swing work up to 8 in. in diameter and the head is shown tipped up slightly with a collet in place in the spindle. The device is intended for either manufacturing or toolroom needs, the head swiveling 180 deg. in a horizontal plane, 90 deg. each side of the center line, and from 30 deg. above the center line to 10 deg. below. The spindles are hardened and ground to size, and all parts subject to wear are heat-treated. The parts are made interchangeable so as to facilitate repairs in case of breakage. A keyway is cut in the under side of the base and open-ended holes are provided for fastening to the machine table. Standard equipment includes headstock, tailstock, head center, ⅜-in. collet, four binder bolts and index plate with 24 divisions.

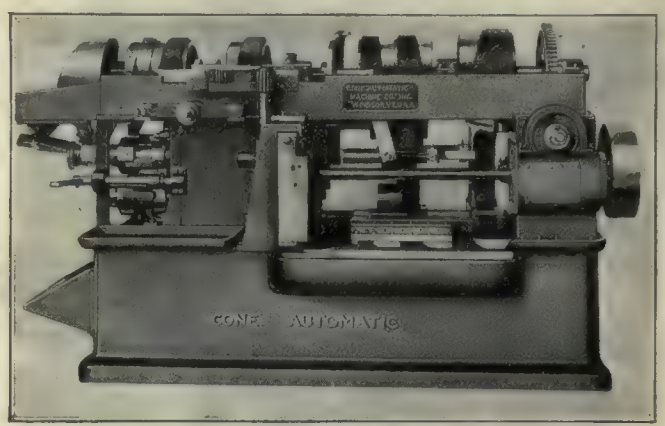


SEMI-UNIVERSAL DIVIDING HEAD

Swing on centers, 8 in.; swivel of head, 90 deg. each side of center line on base, 30 deg. above center line and 10 deg. below; maximum collect capacity, ⅜ in.

Cone 3½-Inch Automatic Four-Spindle Screw Machine

The Cone Automatic Machine Co., Windsor, Vt., has just placed on the market a new four-spindle automatic screw machine that is similar to the one described on page 741, Vol. 47, except that it will handle work of



CONE 3½-INCH AUTOMATIC FOUR-SPINDLE SCREW MACHINE

Capacity, work from 1½ to 3½ in. in diameter and up to 7 in. long; floor space, 11 ft. x 5 ft. 6 in.; height, 5 ft. 6 in.; weight, 15,000 lb.

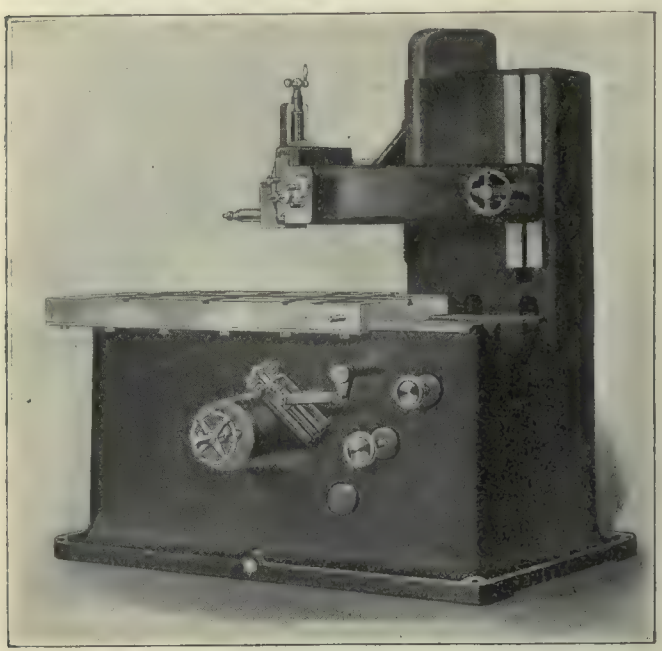
considerably larger size. The present machine is designed for work from 1½ to 3½ in. in diameter, with a length up to 7 in. On the smaller machine cutting off is possible on one spindle only whereas on the newer and larger machine, cutting-off operations can be carried on simultaneously on two spindles, a feature that is desirable on certain classes of work. The machine is of double-bed construction, one bed placed over the other and separated by spacers. The upper bed carries much of the mechanism which makes for accessibility, it being possible to remove the entire camshaft by simply removing the bearing caps.

Kinite Cast Tool Steel

Kinite tool steel, which can be cast to suit the shape of tool or die desired and which is said to possess the unusual quality of not changing shape or size during hardening is a new product that is now being marketed by the Kinite Co., Milwaukee, Wis. The steel is cast in specially prepared molds and it is stated that it does not elongate under tensile stress or decrease in cross-sectional area, retaining its shape and size until the breaking point is reached. The steel contains no tungsten, is said to be very uniform and close-grained, has high heat-resisting qualities, and does not scale in the fire. It is stated to be particularly desirable for punches and dies, and that a large percentage of the labor usually involved in die construction is obviated by the manner in which it is cast. Kinite can be annealed and rehardened many times, without losing its properties and is annealed and hardened at a temperature of about 1840 deg. F.

The Coulter Toolroom Open-Side Planing Machine

The coulter toolroom open-side planing machine illustrated has been placed on the market by the Automatic Machine Co., Bridgeport, Conn. It combines the features of a planing and a shaping machine and is particularly adapted for toolroom work and the manufacture of jigs. All driving shafts are equipped with



COULTER TOOLROOM OPEN-SIDE PLANING MACHINE

Table travel, 0 to 24 in.; table to crossrail (when up), 16 in.; crossrail traverse, 20 in.; vertical tool travel, 6 in.; length of table, 46½ in.; width of table, 17⅛ in.; thickness of table, 3½ in.; distance between pockets, 32⅛ in.; three T-slots for bolts, ⅝ in.; height from table to floor, 36 in.; length of bed supporting table, 53 in.; center to center of ways, 11 in.; length of saddle on crossrail, 14 in.; diameter of swivel head, 10 in.; speed changes for each stroke, 4; horizontal feeds up to ½ in.; vertical feeds, ¼ in.; high-speed gear ratio, 6 to 1; low-speed gear ratio, 24 to 1; revolutions of countershaft, 350; single driving pulley, 20 in. x 3 in.; weight, net, 4600 lb.; weight, crated, 5200 lb.; weight, boxed for export, 6100 lb.; dimensions boxed for export 50 in. wide, 76 in. high, 68 in. long; cubic feet, 150.

S.K.F. ball bearings and the sliding gears are easily shifted. The crossrail is raised by rack and pinion from the front, and is counter-balanced. The different speed changes make possible the choosing of the proper speed for the material to be cut and the open side adds to the convenience of securing and observing the work. It is claimed that construction, workmanship and material are well up to the standard required. The bed is cast in one piece and the platen is of liberal dimensions, well ribbed and scraped and gibbed to the bed. The vertical column to which the crossrail is fitted is of heavy section and the bearing surfaces for the sliding parts are ample in extent. Ease of operation and handling is claimed to be one of the strongest features.

Proposed Modification of Screw Threads

Numerous commentaries have been written on the advantages of standardization of engineering productions for domestic use. The theme has grown until today the topic is international standardization and the question becomes one involving the consideration of manufacture in all countries; also what changes may be made without disrupting business.

Those versed in screw-thread matters have from time to time expressed themselves regarding the shortcomings of the Sellers form of thread, particularly in the finer pitches. Among those are L. D. Burlingame, Elwood Burdsall, E. H. Ehrman, F. O. Wells and E. T. Bysshe. The consensus of opinion has been that the crests and roots of screw threads should be flattened to a greater extent than in the U. S. Standard thread.

Suggestions have been made for a form of thread flattened more than the U. S. S. thread and which might serve as a basis for an international standard. Fig. 2 shows a form suggested by E. Burdsall and Fig. 3 one suggested by Messrs. Bysshe and Uhrman. The strength at the root of the male member is the same in both.

The diagrams suggested are basic and do not include such details as crest or root clearance, depth of engagement, etc. They lend themselves well, however, to the application of liberal clearance and tolerance without reducing the depth of engagement below that in some of the existing standard profiles.

The Standard Pitch

Assuming a standard pitch it appears that the following conditions must be met: A standard thread profile must (1) not be greater in depth than the shallowest existing thread; (2) be equal or be greater in depth of engagement than the least depth obtainable in any of the existing threads; (3) specify a crest or root clearance adequate to provide for tool wear in manufacture and for service; (4) be equal or better than existing profiles in withstanding mistreatment; (5) permit a latitude in the shape of the tool crest; (6) not be more difficult of production in either tool, gage or product than in any of the present systems; (7) not make the pitch diameter less than does any existing thread profile; (8) the elements of the thread profile must be the same or the difference must be within the commercial tolerance allowed if internationalism is to be considered; (9) the screw must have equal or greater strength.

Having in view these axioms we must consider the principal systems now in use. There are the U. S. Sellers and Whitworth systems, both of which have admitted disadvantages, the leading ones are shown as follows:

U. S. S. Root.—This is admitted to be too narrow, especially in the finer pitches, and the truncation triangle too small to secure a stable crest in the tool or to obtain adequate root clearance in the product.

Whitworth Crest.—The depth of engagement is needlessly reduced by at least 0.9 of the height of the rounded crest. The apparent advantage of the rounded crest to withstand marring in handling is offset by the difficulty in accurately producing it in the tool, gage and in the product, and in varying it sufficiently to provide adequate clearance or even necessary tolerance without reducing the depth of thread bearing in a greater ratio.

Whitworth Angle.—An angle of 55 deg. is more difficult to reproduce than the U. S. S. 60-deg. angle.

U. S. S. Crest.—While this crest may not hold its theoretical shape in the tool so well as does the Whitworth crest the cause may not be entirely due to profile and in all probability it is due partly to its relative har-

rowness. On the other hand its production both in the tool product and the gage is attained and maintained with much greater facility than is the shape of the Whitworth crest.

The modified form of thread suggested by Mr. Burdsall has an increased area of 17, 19 and 24 per cent. respectively for ¼-, ⅜- and ½-in. bolts, and under test has shown an increased strength at the root varying between 11 and 12 per cent. None of these bolts failed by stripping.

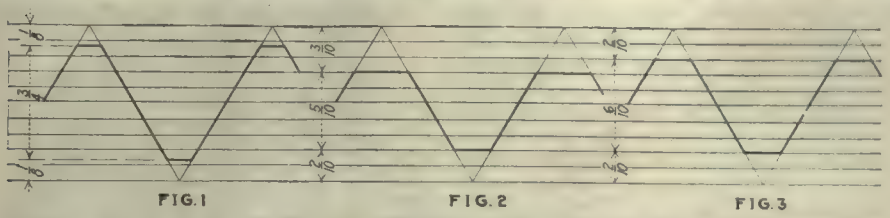


FIG. 1 FIG. 2 FIG. 3

FIGS. 1 TO 3. U. S. STANDARD THREAD AND SUGGESTED MODIFICATIONS

Fig. 1—U. S. Standard thread. Fig. 2—Type of thread suggested by E. Burdsall. Fig. 3—Type of thread suggested by Ernest T. Bysshe and Edwin Ehrman.

The form of screw thread used on the well-known Liberty engine furnishes an excellent example of the possibilities and advantages that are to be gained through a greater truncation than that obtaining in the Sellers thread.

At a meeting of the gage committee of the British Engineering Standards Association in September, 1917, a modified form of thread was proposed having the thread truncated slightly at the crest and slightly deepened at the root, the angle of thread and the effective diameter to remain the same. Arrangements were made with a few manufacturers to make sample screws of this modified form of different metals and to forward a report.

Owing to the fact that the British manufacturers were then in the stress of high production a thorough trial was not possible, and the committee, as a result of the reports received, made the following recommendations:

"It was undesirable to recommend to the designs department the adoption of this flattened form of thread as a compulsory measure, but that tolerance of large amount might be given at crest and root.

"See C. L. 4102, British Engineering Standards Association."

All authorities have agreed that the element governing the fit of a screw is that the engagement must be as much as possible on the side of the thread only and that the crest and root must be clear.

Experience has shown that the sharp V-thread is impossible to produce because the point of the tools wear so rapidly, producing a screw which will only interchange with difficulty.

The U. S., or Sellers, thread is a modification of the sharp V-thread and overcame the low-production manufacturing difficulties of the day now passed.

In this article it has been shown that engineers in widely separated localities have developed independently the same idea and the feasibility of modified threads, has been demonstrated by the Liberty engine. Therefore is it not possible that the proposed modified screw thread contains the fundamental characteristics for modern large-production manufacture and for international agreement?

Great progress in individual standardization of screw threads has been made by the manufacturing countries of the world, but the master mind always considers the future and introduces these questions: Has the best form of screw thread been adopted? When definitely promulgating standards, should other manufacturing countries be considered? After the recent stress of high production, can we complacently look on and consider the science of manufacturing screws thoroughly understood, and further progress impossible? It seems illogical to suppose that the modern engineer will answer affirmatively to the first and third questions. The National Screw Thread Commission is about to publish a tentative report and recommendations on screw-thread form, pitches, classification and gaging. This report considers only the form of thread in use in the United States, but since it is tentative the merits of a modified form of thread may be considered, as the door to International standardization is not closed.

Making Specifications Too Specific

By J. Conklin

We make taps, dies, hobs, and kindred tools for the market, and we have some trouble by reason of customers specifying exact theoretical sizes in respect to outside, pitch, and root diameters when ordering V-threads. We must in each case write back and tell the customer that we cannot work to his figures but will hold to them as closely as practical.

This causes delay and hard feelings on the customer's part for he feels that anybody ought to know that theoretical V-thread depths cannot be made, but experience with these customers has taught us to question this point every time because whenever the pitch diameter is specified and worked to, a micrometer will show the outside diameter to be small and the customers will reject the tools.

Of course figures on drawings must check and be exact but theoretical depths or figures for V-thread forms should be so marked on orders and blueprints. For example: ½-in. 12-pitch V-thread tap, ½-in. OD., 0.4278 P.D., 0.3556 R.D. If the pitch diameter is to be maintained then the outside diameter will be 0.4945 in. instead of ½ in. This order could be changed to read "nominal size ½ in. P.D. 0.4278, theoretical R.D. 0.3556 and the order would not be held up. All theoretical figures for V-threads or grooves should be marked "theoretical" and the work will then be made as nearly as possible to this figure.

This applies not only to the 60-deg. V old-style machine screws but to Harvey grip-thread, dovetails, or any other sharp V-form.

Nuts Castellated While You Wait

By Robert H. Schafer

If you want a castellated nut in an emergency and none is at hand, put two blades together in your hacksaw frame and saw the necessary slots across the back of the nut. This will make a slot wide enough to take a $\frac{1}{64}$-in. cotter pin, and can be done in less than the time necessary to select a milling cutter.



Sparks from the

Great Increase in Number of Motor Trucks

There Are 500,000 Motor Trucks in Use Today and in Ten Years There Will Be Over 22,000,000 It Is Reported

Ten years ago the number of motor trucks in use was but 4000. Today there are between 400,000 and 500,000, according to James P. Nash, office engineer, State Highway Department, Austin, Tex. Mr. Nash points out: "There is no reason why the number of trucks should not increase next year in the same ratio as in the past. If the number of motor trucks increases in the next ten years in the same ratio as in the past ten years, there would be over 22,000,000 motor trucks in use in the United States by 1929.

"The motor truck should be regarded as a public utility, regardless of who operates it. The motor truck came into existence to get food and supplies to people. To add to the cost of motor transportation is to increase the cost of living. The highways of the country are inadequate for present needs. Their capacity must be doubled to meet the requirements of the next year or two."

"Along what line shall we provide this increase?" asks R. E. Fulton, vice-president of the International Motor Co., manufacturers of Mack trucks. "Shall we double the width of the road and increase its first cost and maintenance 100 per cent.? Or shall we provide a road of sufficient strength to carry vehicles of 100 per cent. greater capacity for a given width of road, the first cost of which would be only 10 to 20 per cent. greater per mile than that of present roads? In view of the fact that 50 per cent. increase in hauling capacity gives a reduction of 15 per cent. in transportation costs, the latter seems the wisest thing to do.

"Money spent to build roads according to present standards is money thrown away. We must build for the future and estimate now what the future demands."

* * *

Britain Making Great Strides in Commercial Aviation

The civil aëronautical position in Great Britain is hailed by the British press as being "far more advanced than in any other country," the American Chamber of Commerce in London reports. When General Seely, Under Secretary for Air, presented the air estimates for 1919-20 to the House of Commons recently premier emphasis was laid on the appropriation of £3,000,000 ($15,000,000) for civil aviation research and experiment.

A mail service from Cairo to India is definitely to be inaugurated. The air route has already been surveyed, and the route from Cairo to the Cape is being surveyed. Both in the British Isles and in the possessions, aërodromes are to be established at suitable spots with full equipment of meteorological instruments, sound and light signals, balloons and aërial buoys, wireless telegraphy and telephone equipment.



Already cargo planes are in sight. A huge British seaplane of novel type, equipped with five Rolls-Royce motors, has already had its initial flight, carrying six tons at 100 miles per hour. Another with a carrying capacity of nine tons is being experimented with. The remarkable British military achievements in the air are expected to be completely eclipsed by the development of the airplane as a commercial and economic factor.

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Colonel Baker to Head Steel Company

The American International Steel Corporation has announced that Lieut.-Col. M. G. Baker, former assistant general manager of sales of the Cambria Steel Co., and more recently connected with the United States Ordnance Department, has been appointed president of the corporation. Colonel Baker succeeds Edward M. Hagar, who died more than a year ago. Since then the business of the American International Steel Corporation has been in charge of Morris Metcalf, vice president, who still remains in that position. The company is a subsidiary of the American International Corporation.

Market for Machine Tools in Sweden

Machine tools are made in Sweden in considerable quantities. During the war a number of firms were established for the purpose of manufacturing machine tools and like products to fill the need of the market, which was greater than usual on account of the inability to import from such large tool-making countries as the United States, Great Britain and Germany. Some of these firms will be unable to compete in this market after normal conditions have been reëstablished, because of the higher average cost of production here. There are indications of greater efforts on the part of the machine-tool manufacturers of Sweden to cultivate the export market; but, despite these efforts, the domestic market offers opportunities for American exporters, as the American tool has earned a high reputation. It will be some time, in all probability, before the German machine tools can reënter this market; therefore, unless tariffs or other regulations are imposed, there should be better opportunities for American machine tools in Sweden than heretofore.

* * *

Association of Tin Plate Manufacturers

The recently organized Association of Tin Plate Manufacturers has headquarters in Room 909, Oliver Bldg., Pittsburgh, Penn. The association includes practically all the independent tin-plate mills in the country. The American Sheet and Tin Plate Co. is not a member, because it is against the policy of any subsidiary of the United States Steel Corporation to join an organization of any kind. The officers of the new association are E. T. Weir, Weirton Steel Co., Weirton, W. Va., president; E. R. Crawford, McKeesport Tin Plate Co., McKeesport, Penn., vice president; E. T. Sproull, Trumbull Steel Co., Warren, Ohio, treasurer; and George D. McIlvain, secretary. The board of trustees consists of E. T. Weir, E. R. Crawford, Philip Schaeffer, Jones & Laughlin Steel Co.; John Duncan, Wheeling Steel and Iron Co., and E. T. Sproull.

* * *

Exhibition of Railway Appliances

The Railway Master Mechanics' Association and the Master Carbuilders' Association have combined as the mechanical section of the American Railway Association and will hold a convention and exhibition of machine tools and railway appliances at Atlantic City, June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

World's Industrial Forge

By E. C. Porter, News Editor

Expansion of Japan's Trade During the War

A detailed trade study of Japan for the years 1913 to 1917 just issued by the United States Tariff Commission indicates striking changes in the commerce, industry and the financial position of that country during the war period.

Japan's total trade rose from $680,500,000 in 1913 to $1,319,000,000 in 1917, an increase of 94 per cent. The figures for exports and imports were: Exports in 1913, $316,000,000, and in 1917, $801,500,000; imports in 1913, $364,500,000, and in 1917, $517,500,000. For the four years 1910 to 1913 the imports normally exceeded the exports by an annual average of $32,500,000. In 1914 there was still a slight balance in favor of imports; in the three years 1915-17 the excess of exports over imports averaged $185,500,000. The excess in 1917 was $283,500,000.

* * *

Metallurgic Industry Prosperous in Switzerland

The metallurgic industry in Switzerland, says Consul Phillip Holland, has made satisfactory progress during the war, notwithstanding the difficulties under which it operated. Until 1916 operations went on smoothly—Germany supplying raw materials and coal—and markets were found in all countries. After 1916 Germany limited its exports of raw materials to Switzerland to those needed for the manufacture of war orders for the central powers. After this restriction some raw materials were imported from England and operations continued. The following summary of exports of machinery gives a general idea of the success of this Swiss industry:

Total machinery exports, including machine tools, motors, locomotives, boilers, printing equipment, agricultural implements and machinery for the manufacture of various foods, textiles, building materials, etc., for the first nine months of 1918 were valued at $22,892,309, as compared with $22,022,844 for the corresponding period of 1917. For the whole of 1917 the value of exported machinery was $29,229,850, while in 1913 it totaled only $19,053,925. Exports of machinery reached their maximum during the war in 1916, when they were valued at $29,941,634.

Attention should be called to the fact that in 1917 the export of machine tools to the value of more than 45,000,000 francs ($8,685,000) was for the manufacture of munitions.

There was a heavy demand, both local and foreign, for all kinds of electrical machinery and equipment. The electrification of small railways and the building of hydro-electric plants were taken in hand very actively.

The northern Swiss are expecting the machine industry to retrieve for them the economic losses which are likely to be sustained after the war by the dye and ribbon industries. For the future much will depend upon their being able to obtain raw materials—coal, iron and steel. They will likely turn to France, England and the United States for materials formerly imported from Germany. The home market will probably be a good field for machine products because of the general electrifying of traffic and industries.

Convention of Foundrymen Will Meet in Philadelphia

Invitation Will Be Extended To Foundrymen and Industrial Engineers of England, France, Italy, and Other Countries

Secretary C. E. Hoyt, of the American Foundrymen's Association, 111 West Monroe Street, Chicago, announces that Philadelphia, the birthplace of the association, has been selected as the place of the 1919 convention and exhibit, which will be in the week of Sept. 29. The organization meeting was held in Philadelphia in June, 1896, and in 1907 Philadelphia again entertained the foundrymen of the country in their annual convention, this being the first convention in which any considerable exhibit of foundry equipment was made.

Much of interest to foundrymen has developed in the Philadelphia district in the 12 years since the last meeting there, including the great shipyard at Hog Island, the new foundries at the League Island Navy Yard and the foundries of the Westinghouse company at Essington.

Of special significance in connection with the next convention is the plan of the officers of the association for an international meeting. Invitations will be extended to foundrymen and industrial engineers in England, France, Belgium, Italy and other European countries, as well as in South America and Australia, to come to Philadelphia in September. The fourteenth annual foundry exhibit will be held in the week of the Philadelphia convention in the exhibition hall of the Philadelphia Commercial Museum. This building is located on the Schuylkill River in West

The Careless Machinist's Creed and His Reasons

By N. O. Good, in *Deane News*.

1. I believe in using a monkey wrench in preference to a hammer because a monkey wrench looks better when it is all battered up. And besides, that is what it was made for.

2. I believe in borrowing other men's tools in preference to buying some of my own. This is a good method of cutting down the high cost of living and saves me carting around a heavy tool chest in my travels.

3. I believe in oiling my machine once every six months at least. This is a great saving to the company, as oil costs something these days.

4. I believe in keeping the shop tools in a heap on the floor instead of using the locker provided for this purpose. In this way they can have their cutting edges ruined far more quickly than by using them on the work.

5. I believe in wiping off chips with my fingers in preference to using a stick or brush provided by the company, because the former is a most ancient custom and takes the place of a surgical operation.

6. I believe in keeping tools under the planing machine table and in reaching for them while the table is running. This breaks the monotony of life and gives opportunity for some clever gymnastics.

7. I believe, when running my shaping machine, in having my slide rest projecting far enough to hit the bed on the back stroke. This is great fun and provides employment for the repair gang who might otherwise be out of a job.

8. I believe in wearing loose or torn overalls and a long flowing necktie, when running a high speed lathe or drilling machine. This is also a very ancient custom and a suitable dress for machine-shop work.

9. I believe in mixing brass, babbitt, steel and iron chips in the pans. This mixture always looks well and proves fascinating employment to the man who has to separate them.

10. I believe in using a long-handled wrench in tightening a three-quarter bolt and much prefer a half nut to a nut on the whole depth. This ruins the bolt at once instead of prolonging its life indefinitely.

11. I believe in blaming the night man when anything is lost or goes wrong with my machine. He is not here to contradict me, so I can explain it all to the boss satisfactorily.

12. Finally, I believe in abiding by all the rules and regulations of the company to the best of my ability when the boss is around.

Philadelphia at Thirty-fourth Street below Spruce, only five blocks from the West Philadelphia yards of the Pennsylvania Railroad. The building has a private Pennsylvania Railroad siding for unloading carload shipments. The exhibition hall will be the largest ever occupied by the display of foundry equipment, having 88,000 sq.ft. all in one room on the ground floor. The floor is of cement. The fact that foundrymen and industrial engineers from other countries are expected at Philadelphia gives the meeting an unusual distinction and the expectations are that the exhibits will be more numerous and more representative than at any previous meeting. The program of papers for the session of the American Foundrymen's Association is expected to measure up to the past standards of the association.

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Training and Employment for Soldiers

Every disabled soldier and sailor should know that the Government is resolved to do its best to restore him to health, strength and self-supporting activity.

That until his discharge from hospital care the medical and surgical treatment necessary to restore him to health and strength is under the jurisdiction of the military or naval authorities.

That the vocational training which may be afterward necessary to restore his self-supporting activity is under the jurisdiction of the Federal Board for Vocational Education.

That if he needs an artificial limb or other orthopedic or mechanical appliance the Bureau of War-Risk Insurance supplies it free upon his discharge and renews it when considered necessary.

That if, after his discharge, he again needs medical treatment on account of his disability the Bureau of War-Risk Insurance supplies it free.

That any man whose disability entitles him to compensation under the War-Risk Insurance Act may be provided by the Federal Board with a course of vocational training for a new occupation.

That the Government strongly recommends each man who needs it to undertake vocational training and put himself under the care of the Federal Board, but the decision to do so is optional with each man.

That if his disability does prevent him from returning to employment without training and he elects to follow a course of vocational training provided by the Federal Board, the course will be furnished free of cost, and he will also be paid as long as the training lasts a monthly compensation equal to the sum to which he is entitled under the War-Risk Insurance Act or a sum equal to the pay of his last month of active service, whichever is the greater. But in no case will a single man or a man required by his course of instruction to live apart from his dependents receive less than $65 per month, exclusive of the sum paid dependents; nor will a man living with his dependents receive less than $75 per month, inclusive of sum paid to dependents.

That if his disability does not prevent him from returning to employment without training and he elects to follow a course of vocational training provided by the Federal Board, the course will be furnished free of cost to him, and the compensation provided by the War-Risk Insurance Act will be paid to him, but no allowance will be paid to his family.

That in addition to the above the family or dependents of each disabled man will receive from the Government during his period of training the same monthly allotment and allowance as that paid prior to his discharge from the army or the navy.

That upon the completion of his course of training he will continue to receive the compensation prescribed by the War-Risk Insurance Act so long as his disability continues.

That in nearly every case, by following the advice and suggestions of the Federal Board, he can either get rid of the handicap caused by his disability or acquire new powers to replace any that may have been lost.

That if he is willing to learn and to take advantage of the opportunities to increase his skill offered him he can usually get a better position than he had before entering the service.

That if he fails to take advantage of these opportunities he will find himhelf badly handicapped when he is obliged to compete with the able-bodied men who come back to work after the war.

That the Federal Board, through its vocational experts, will study his particular disability and advise him as to the proper course to pursue and give him free training for the occupation best suited to him.

That on the satisfactory completion of his training the Federal Board, through its employment service, will assist him to secure a position.

That public authorities and other large employers will in many cases, at least, give the disabled soldiers and sailors preference when filling vacant positions, provided they possess the training necessary to fill them.

All disabled soldiers, whether in or out of the hospital, should address their communications either to the Federal Board for Vocational Education, Washington, D. C., or to the district office of the Federal Board of the district in which they are located. The district offices of the board are located at the following points respectively:

District No. 1—Maine, New Hampshire, Vermont, Massachusetts and Rhode Island. Office in the Tremont Building, Boston, Mass., Room 433.

District No. 2 — Connecticut, New York and New Jersey. Office at 280 Broadway, New York, Room 711.

District No. 3 — Pennsylvania and Delaware. Office at 1000 Penn Square Building, Philadelphia, Penn.

District No. 4—District of Columbia, Maryland, Virginia and West Virginia. Office at 606 F St., N. W., Washington, D. C.

District No. 5 — North Carolina, South Carolina, Georgia, Fiorida and Tennessee. Office in the Candler Building, Atlanta, Ga., Room 1404.

District No. 6—Alabama, Mississippi and Louisiana. Office at 822 Maison Blanche Annex, New Orleans, La.

District No. 7 — Ohio, Indiana and Kentucky. Office at 906 Mercantile Library Building, Cincinnati, Ohio.

District No. 8 — Michigan, Illinois and Wisconsin. Office at 110 South Dearborn St., Chicago, Ill.

District No. 9—Iowa, Nebraska, Kansas and Missouri. Office at 517 Chemical Building, St. Louis, Mo.

District No. 10 — Minnesota, North Dakota and South Dakota. Office in the Metropolitan Bank Building, Minneapolis, Minn., Room 742.

District No. 11—Wyoming, Colorado, New Mexico and Utah. Office at 909 Seventeenth St., Denver, Colo.

District No. 12—California, Nevada and Arizona. Office at 997 Monadnock Building, San Francisco, Calif.

District No. 13 — Montana, Idaho, Oregon and Washington. Office in the Central Building, Seattle, Wash., Room 539.

District No. 14—Arkansas, Oklahoma and Texas. Office at 810 Western Indemnity Building, 1000 Main St., Dallas, Texas.

Your Foreign Business Agent

How can we obtain export business? is the question now being asked by many American manufacturers. The desirability of increased foreign trade is keenly appreciated. Its possibilities are being insistently emphasized. There is an eagerness to acquire accurate knowledge concerning it. But some, at least, of our exporters or prospective exporters may not realize that even the least important among them already has representatives working for him in all parts of the world.

From these special representatives reports are received giving complete descriptions of the life and customs of the people in foreign lands, together with the class of commodities they purchase, the prices and the terms. Accounts are given of the home and foreign competition, the character of domestic labor and its cost, the most effective methods of entering the market. Precise and detailed import figures are furnished. Thus the American merchant is enabled to know definitely in advance the conditions that he will have to meet in obtaining foreign trade. The shorter reports of this nature appear in a daily paper, *Commerce Reports*, while the longer, more comprehensive ones are published in special books and pamphlets.

This service is maintained by the Bureau of Foreign and Domestic Commerce, Washington, D. C., which is the agency of the United States Government for promoting trade between this and other countries.

Personals

GEORGE C. RAMER, formerly with the St. Louis office of the Oliver Machinery Co., is now with the sales offices at Chicago, Ill.

W. C. CONYER has resigned his position with the Liberty Steel Products Co., and is now associated with M. A. Palmer Co., of Boston, Mass.

G. C. CONKLIN, who has for many years been connected with the factory of the Oliver Machinery Co., Grand Rapids, Mich., has recently been appointed district manager of the new Chicago office.

D. H. DIEFENDORF, formerly chief engineer and director of the New Process Gear Corporation since 1899, has joined the Weekes-Hoffman Co., of Syracuse, N. Y., as vice president and general manager.

WILLIAM H. RANDALL, formerly superintendent of the maintenance and distribution department of the Toronto water works, has been appointed manager director for the new Canadian office of the Neptune Meter Co. of New York.

HAROLD C. BEMENT has been placed in charge of the electric furnaces at the new plant of the Onondago Steel Co., Inc., at Eastwood, near Syracuse, N. Y. Mr. Bement was formerly melter foreman at the Government Arsenal at Watertown, Mass.

J. D. MOONEY, recently released from service after serving as a captain with the 309th Ammunition Train, 84th Division, is now with the General Motors Corporation, New York City. He was formerly with the Hyatt Roller Bearing Co., Industrial Division, Newark, N. J.

CHAS. EISLER for several years with the Westinghouse Lamp Co., Bloomfield, N. J., as chief designer and engineer, has resigned. He is now with the newly formed Save Electric Corporation, Bush Bldg., Brooklyn, N. Y., as superintendent of the equipment designing and development departments.

DUDLEY H. COHEN, formerly vice-president of the William Brewster Co., and assistant treasurer of the Trojan Tool Corporation, has sold his interest in the William Brewster Co. in order to devote all his time to the Trojan Tool Corporation, in which company he has been elected treasurer and general manager in full charge of production and sales.

SVEN SPELLING, mechanical engineer, is returning to Copenhagen to open offices and manage the Scandinavian branches of the Parker Co. Mr. Spelling has spent the last few years in America, studying machinery and familiarizing himself with the American methods of manufacture. Prior to his connection with the Parker Co., he was associated with A/S Tuxham, Copenhagen and also the R. Hoe & Co., New York and the Bartlett-Hayward Co., Baltimore, Md.

Good Field for Exporters in Central America

According to Gonzalo Boza, a Central American importer now in New York, the American exporter is not taking proper advantage of the opportunities offered by the countries of Central America. During an interview at the offices of the American Manufacturers' Export Association, Mr. Boza explained how necessary it is for merchants in this country to familiarize themselves with the requirements, interests and customs of the Central American countries.

After pointing out the rich natural resources of the five republics of Central America, Guatemala, Salvador, Honduras, Nicaragua and Costa Rica, he discussed the methods which must be adopted by exporters seeking commercial relations with these countries, emphasizing the importance of courtesy and thoughtfulness in corresponding with customers in Central America.

Mr. Boza directed special attention to the importance of sending samples, small pamphlets or catalogs, with a description and illustrations if possible of the merchandise printed in good Spanish, to importers in the Central American countries.

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Sale of Government Equipment Being Made

The following equipment and available hardware is for sale by the Government. Any further information may be had through communication with the nearest District Bureau of Aircraft Production, Attention Material-Disposal Section:

Thirty-nine gross ⅜-in. No. 2 flat-head bright wood screws; three gross ½-in. No. 4 flat-head bright wood screws; 21,379 gross ½-in. No. 4 flat-head bright wood screws; 79,396 gross ¾-in. No. 6 flat-head bright wood screws; 61,545 gross 1-in. No. 2 flat-head bright wood screws; five gross 1-in. No. 3 flat-head bright wood screws; 73 gross 1-in. No. 5 flat-head bright wood screws; 24 gross 1-in. No. 6 flat-head bright wood screws; 119,682½ gross 1-in. No. 8 flat-head bright wood screws; nine gross 1¼-in. No. 7 flat-head bright wood screws; one gross 1¼-in. No. 9 flat-head bright wood screws; 48 gross 3½-in. No. 14 flat-head bright wood screws; 60 gross 2½-in. No. 12 flat-head bright wood screws; 17 gross 2-in. No. 9 flat-head bright wood screws. These are all located at the Grand Rapids Airplane Co., Grand Rapids, Mich., and are in first-class condition.

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Erratum

On page 678 the statement was made that manganese dioxide is used to retard the release of oxygen when heated in a retort with chlorate of potash. This is an error. The manganese dioxide is used because it enables the chlorate of potash to more readily give up its oxygen and at lower temperature than without it.

Business Items

The Allied Machinery Co. of America has removed its main offices in New York to 51 Chambers St., where it has taken the entire eighth floor.

The Hartford Special Machinery Co., Hartford, Conn., is reconstructing its plant to manufacture a patented three-spindle vertical automatic internal grinding machine for production purposes.

Chas. F. Ames & Co. Ltd., 90 West St., New York, has been appointed to act as the New York sales department of the Platt Iron Works, of Dayton, Ohio, manufacturer of pumping and power-plant equipment.

The Holt Manufacturing Co., Peoria, Ill., has returned to the commercial field after having been virtually out of the market for four years, due to the contracts with the Allied nations and with the United States Government. During this period the Holt plant was almost doubled and $1,000,000 was spent on the plant and new equipment.

The Ludlum Steel Co. of Michigan has taken 7500 ft. of floor space in the Siegel Building, Detroit, and has fitted it up with warehouse and offices. This company will carry a stock of high-speed and carbon-tool steel with sawing facilities up to 10 in. in diameter. William A. Edwards is the manager of sales and has charge of the offices and warehouse.

E. I. du Pont de Nemours & Co., Inc., announce the organization of E. I. du Pont de Nemours Export Co., a subsidiary corporation, created for handling its foreign business. The main offices of the new company will be located on the 17th floor of the Equitable Building, 120 Broadway, New York, with branches in San Francisco, Mexico City, London and Rio de Janeiro.

The Sullivan Machinery Co. has recently organized a foreign-trade department with F. W. Copeland, formerly attached to the St. Louis office, as manager, with headquarters at Chicago. The purpose of this department will be to coördinate and assist the work of the foreign branches and agents of the company, and to devote particular attention to correspondence and inquiries from abroad.

Obituary

B. C. KENYON, purchasing agent for the Crocker Wheeler Co., died at his home, East Orange, N. J., on Apr. 5.

FREDERICK BECKERT, master mechanic of the Greist Manufacturing Co., died at his home, New Haven, Conn., after a long illness. He had been with the Greist Manufacturing Co. since 1899, starting as foreman of the toolroom, but in a few years was appointed master mechanic.

New Publications

Punches and Dies.—By Frank A. Stanley. Four hundred and thirty-four 6 x 9-in. pages; 618 illustrations; fifteen tables; bound in dark cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price, $4.

This book contains an enormous amount of material of interest to the toolmaker, diemaker, tooldraftsman or designer. The large number of illustrations show the latest practice in die making as done in some of the largest and best shops of the country. The detailed drawings shown are especially valuable, and these taken with the photographs of the tools given, will prove of great value to those interested. The presswork of the book is unusually good and adds to the ease with which details of the various tools may be deciphered. The chapters are: Press Tools in General; Blanking Dies; Piercing Tools—Blanking and Piercing Dies; Compound Dies for Blanking and Piercing; Cutting-off Dies or Parting Tools; Shaving Dies and Their Applications; Trimming Dies—Trimming and Shaving; Drawing Dies and Their Action Upon Materials; Combination and Compound Dies for Blanking, Drawing, Forming and Piercing; Bending and Forming Tools; Bending, Forming and Other Dies Applied to Specific Lines of Work; Dies for Embossing, Marking, Riveting, Swaging; Indexing and Transfer Dies; The Sub-press and Its Dies; Punch and Die Standards; Finding the Size of Blanks for Shells and other Drawn and Formed Work; Laying Out and Making Templets and Dies; Locating Holes Accurately in Die Work; Making a Set of Shaving Dies; Some Hardening Principles Applied to Dies. Index.

Trade Catalogs

"Star" Ball Retainers. The Bearings Co. of America, Lancaster, Penn., has recently mailed from its Detroit office, 1012 Ford Bldg., a new issue of its load and data sheets on "Star" ball retainers, which are built for thrust bearings, cup and cone and magneto types of bearings. These lists are made to fit in the S. A. E. date sheet folders, and all who are interested may receive copies of these lists by addressing the Bearings Co. of America.

Floating Chucks and Drills for Drilling Square and Hexagon Holes. Watts Bros. Tool Works, Turtle Creek, Penn. Circular, pp. 8, 3½ x 6 in. This explains and describes the method of drilling square and hexagon holes in steel, iron, brass, aluminum, micarta bakelite, wood, marble, etc. List prices of chucks and drills are given.

Standard Reinforced Spiral Pipe. Standard Spiral Pipe Works, Chicago, Ill. Catalog No. 7, giving list prices of the various sized pipes together with descriptions of the testing, coating and special sheet-steel fittings for pipes manufactured by this company.

Thomson Process, Electric Welding. Thomson Electric Welding Co., Lynn, Mass. This is a loose-leaf folder containing seven bulletins descriptive of light- and heavy-duty butt-welding machines, light- and heavy-duty spot welders, tool welding on high-speed and stellite steels, stationary electric riveters and seam welders. All are profusely illustrated and contain general electric-welding information.

Pinite Rigid Couplings for Line Shafts. Smith-Serrell Co., Inc., 90 West St., New York City. Bulletin No. 102, pp. 4, 6 x 9-in. folder giving sizes and list prices of Pinite rigid couplings.

Malleable Iron. A booklet published by the American Malleable Castings Association, Cleveland, Ohio, and treating of the properties and uses of malleable iron. It will be sent free upon application to the association at Cleveland.

Sheet-Metal Stamping. Bay State Stamping Co., Worcester, Mass. Catalog M., pp. 18, 6 x 3½ in. This is a catalog descriptive of self-closing oil-hole covers, oilers, grease cups, emery-wheel dressers, tools and cutters for turning and trying emery wheels, curtain fixtures and screw-driver ferrules. Sizes and illustrations are given.

Catalogs Wanted

S. Coulange, director of the Journal of the Industrial Alliance, an association of engineers and mechanical designers of Belgium, with headquarters at Rue Bonne Nouvelle, 92, Liége, Belgium, would like catalogs and literature of American machine tools.

F. Lamuché, 8 Rue Montesquieu, Bordeaux, France, would like catalogs of American machine tools and equipment. He would also appreciate the names and addresses of French agents for American manufacturers of machine tools.

The Purchasing Agents' Association of Northern California through its secretary, D. B. Gray, 230 California St., San Francisco, invites manufacturers and dealers to send complete sets of their latest catalogs and trade publications. Catalogs covering particularly machinery, mechanical goods, hardware, iron and steel products, etc., are especially requested.

Vincento M. Marti, Calle Maestro Aguilar No. 18-10, Valencia, Spain, desires the agency and catalogs for American lines of machines such as would be suitable for outfitting small machine shops.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A firm in England desires to purchase lathes for turning vegetable ivory buttons, 2-hole, 4-hole, and 1-hole; and drilling and polishing machines for the manufacture of buttons from vegetable ivory. Reference. No. 29046.

A firm in Spain wishes to purchase emery stones for polishing and sharpening, rapid steel drills, ordinary drills for iron, cutlery, steel for making tools, emery powder, and metal saws. Quotations should be given f.o.b. New York. Funds will be placed in New York bank, or shipments may be made against documents. Correspondence should be in Spanish. References. No. 29056.

A firm in Spain desires to purchase industrial machinery, building hardware, heavy hardware, construction material, electrical machinery, emery stones, and automobile truck tires. Quotations should be f.o.b. New York. Payment, cash against documents. Correspondence should be in Spanish. References. No. 29079.

A commercial agent in Belgium wishes to purchase and to secure an agency for the sale of machine tools, twist drills, and small tools in general. Correspondence may be in English. References. No. 29042.

A man in Switzerland desires to secure an agency for the sale of machinery, electrical apparatus, and tools. References. No. 28975.

A man in Greece desires to purchase galvanized-iron sheets and corrugated-iron sheets, size in meters, two by one thickness; 22 to 28 gage; and solder used in connection therewith. Quotations should be f.o.b. New York. Correspondence may be in English. References. No. 29083.

A merchant in France desires to represent manufacturers and exporters for the sale of locomotives, machinery, and materials for railways, steamships, gas and electrical plants, waterworks, mining, construction work, etc. Correspondence may be in English. No. 28959.

A business man in Norway desires to secure an agency for the sale of electrical motors, transformers, storage batteries, dry cells, wires, cables, resistance alloys, apparatus for cooking and heating, insulators, insulating materials, tapes, and other electrical supplies; also varnish, carbon and metal brushes, metals, transformer and dynamo plates, tools, etc. No. 28960.

A firm in Switzerland desires to purchase and to secure an agency for the sale of automatic numbering machines, stamp pads, and automatic adding machines. Quotations should be given f.o.b. American port. Correspondence may be in English. References. No. 29067.

A commercial agent in France desires to secure an agency for the sale of machine tools, industrial supplies, belts, oils, greases, etc. Correspondence should be in Frtnch. Reference. 28932.

A man in Sweden wishes to purchase machines for paper making, especially hydraulic presses, also those for steel pressing. Reference. No. 29064.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago. C. E. Drayer, national secretary, 29 S. La Salle St., Chicago, Ill.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, N. Y.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridge, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, April 28, 29 and 30. National headquarters, Riggs Building, Washington, D. C.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Worm-Wheel Generating Machine

Gould & Eberhardt, Newark, N. J.

"American Machinist," April 3, 1919

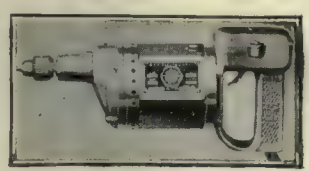


Maximum diameter of worm-wheel cut, 18 in., from 10 to 100 teeth, including even and prime numbers also form 100 to 200 teeth in even numbers, with hobs having from single to quintuple thread inclusive; maximum diameter of hob, 5½ in.; tangential length of hob, 8 in.; tangential travel of cutter slide, 10 in.; maximum distance from center of cutter to center of work spindle, 13½ in.; minimum distance from center of cutter to center of work spindle, 3 in.; fixed distance from top of faceplate to center of cutter arbor, 7 in.; diameter of portable cutter arbor, 1¼ in.; countershaft speed, 800 r.p.m.; driving pulley, 16 x 4½ in.; weight, 8600 lb.

Drills, Portable Electric

Black & Decker Manufacturing Co., 105-115 So. Calvert St., Baltimore, Md.

"American Machinist," April 3, 1919

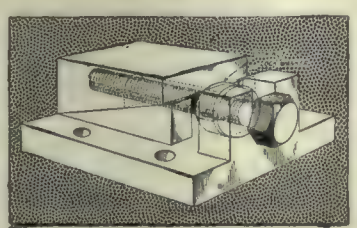


These drills are made in 5/16- and ¼-in. sizes and are equipped with a pistol grip and trigger switch. The current is controlled by pulling the trigger, without the necessity of changing the position of the hand holding the machine. It is also claimed that drill breakage is less because the operator does not have to change the position of his hands to switch off the current. Both models have ⅛-hp. motors with series compensated windings, and operate on any current from direct to 60-cycle alternating. Cooling is accomplished by means of a vane impeller mounted on the armature shaft which causes a forced circulation of air through the housing. Gears run in a grease-tight compartment. The speed of the 5/16-in. drill is 1600 r.p.m. with no load, while that of the ¼-in. drill is 1200 r.p.m. with no load, the energy consumed in both cases being 175 watts.

Leveling Block, Planing-Machine

Cincinnati Planer Co., Cincinnati, Ohio

"American Machinist," April 3, 1919

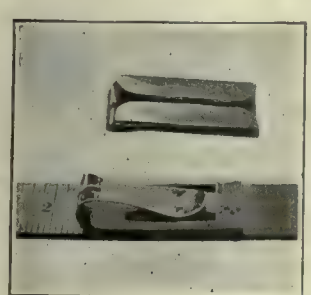


This planing-machine leveling block has a cast base with wide flange and four 1-in. holes and a ground inclined surface. The bearing surface of the leveling block is ground and the block is also ground on the inclined surface. The block is operated by a ⅞-in. drawbolt with a fine thread extending almost its entire length. A locknut and a lockwasher are provided to hold the adjustment against change due to viabration.

Scale and Square Holder "Tamco" Pocket

Automatic Machine & Tool Co., Inc., 87 Frankfort St., New York City

"American Machinist," April 3, 1919



This is a holder for pocket scale or square which can be clipped to pocket, apron or overall, keeping the tool in a convenient place where it cannot be lost. The holder can be reversed to carry the tool inside the pocket when it is no longer needed. It also makes a handy scale reader as it slides easily and has a straight edge. It is made from one piece of nickel-plated spring steel with rounded corners and there are no small parts to be lost or broken or to get out of order.

Milling Machine, No. 20 "Duplex"

Van Norman Machine Tool Co., Springfield, Mass.

"American Machinist," April 3, 1919



Ram, 11½-in. movement over column, 30 in. long held by two lever binders; cutter head can be attached to side of ram at any angle; spindle, 15⅝ in. long, No. 13 B. & S. taper hole; spindle speeds, twelve, 21 to 350 r.p.m.; drive pulley, 10½ in. diameter 4 in. face, running at 385 r.p.m.; feeds, 16 changes from ⅛ to 12 in. per min.; table 42 x 9⅝ in., 28-in. automatic longitudinal feed; saddle, 24½ in. long, 12-in. automatic transverse feed; overhanging arm, 4-in. solid steel with straps and harness; vise jaws, 7 x 1½ in., 4½-in. opening; equipment supplied, draw-in spindle, ⅞ in. split collet, No. 7 B. & S. taper reducing collet, 2⅜ in. end mill, cutter arbor, wrenches countershaft. Semi- or full-universal centers, subhead, and universal slotting attachment supplied separately. Net weight, 3800 lb.

Scraping Machine, Pneumatic

Anderson Bros. Manufacturing Co., Rockford, Ill.

"American Machinist," April 3, 1919

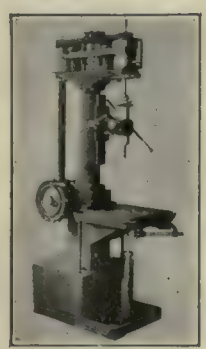


This machine provides a scraping tool operated by a pneumatic ram which is attached by a universal joint to a carriage running on a 4-in. I-beam mounted on a column as shown. A sensitive switch located under the workman's right hand controls the tool, forward movement of the switch producing a similar motion of the tool and the reverse returning it to its original position. The tool holder is carried in ball bearings which permit scraping at any angle. Consumption is 8 cu.ft. of free air per minute at 80- to 90-lb. pressure. A rotating, tilting-top table with T-slots can be supplied for holding small work.

Drilling Machine, High-Speed Ball-Bearing, "Pierle"

Printing Machine Co., Cincinnati, Ohio

"American Machinist," April 3, 1919



This high-speed, sensitive drilling machine runs on ball bearings throughout, which are designed to be dustproof and grease tight. Four spindle changes are obtained through the shifting device which combines plate and face cams in such a way that the belt is shifted off one step before it starts on the other one, thus permitting a tight belt to be used. An idler pulley is held against the belt by a spring except during the operation of shifting. Constructional features include hardened chrome-nickel steel spiral gears running in oil, encased drive shaft, wide-face rack driven by hardened-steel pinion. The machine may be had with single or multiple spindles, two types of motor drive and with and without pump power feed.

Lathe, Duplex-Spindle Plain Turning

Schmidt-Norgren Co., 3121 So. California Ave., Chicago, Ill.

"American Machinist," April 10, 1919



Developed with the object of providing means for turning small-diameter work between centers and operating on two pieces simultaneously. The idea is particularly to provide for the turning of such pieces as cannot be turned on automatic screw machines because they are too long or must be centered for final grinding operations. A number of cutting tools for turning both straight and tapered work can be fitted and back tools can be provided for necking and undercutting operations. Weight, 1300 lb.; length of bed, 56 in.; floor space, length, 62 in., width, 39 in.; height, 52 in.; drive pulley diameter, 6½ in.; face, 3½ in.; speed, 420 r.p.m.; maximum distance between centers, 24 in.; swing over bed, 10 in.; swing over cross-rest, 6 in.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$34.60
Northern Basic	27.55	31.80
Southern Ohio No. 2	28.55	32.80
NEW YORK, Tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	36.15
Southern No. 2 (silicon 2.25 to 2.75)	34.70	39.95
BIRMINGHAM		
No. 2 Foundry	26.75	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	31.90*	36.15*
Virginia No. 2	33.25†	38.10†
Basic	29.65*	33.90*
Grey Forge	29.65*	33.90*
CHICAGO		
No. 2 Foundry Local	26.75	31.00
No. 2 Foundry Southern	33.00	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.25	31.00
Basic	25.75	30.00
Bessemer	29.35	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For $\frac{1}{16}$-in. plates the extra is 30c. per 100 lb.

Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.50	6.22	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	6.12	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	6.07	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	6.02	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	5.37	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	5.27	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	5.17	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.57	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.27	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	7.12	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.

Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
$\frac{3}{8}$, $\frac{11}{32}$, $\frac{5}{16}$, $\frac{1}{4}$, $\frac{7}{32}$, $\frac{3}{16}$ No. 8, $\frac{5}{32}$ and No. 10	25.50 to 33.00	$\frac{1}{16}$ by 12 in. long	14.00
$\frac{1}{8}$		$\frac{1}{8}$ by 19 in. long	12.00
No. 12		$\frac{3}{16}$ by 19 in. long	10.00
$\frac{3}{32}$, No. 14 and $\frac{1}{16}$		$\frac{1}{4}$ by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		$\frac{1}{8}$	33.00
Domestic 20c. for $\frac{1}{16}$, 15c. for $\frac{1}{8}$ to $\frac{5}{16}$.		$\frac{3}{32}$	30.00
		$\frac{1}{16}$	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼, and ⅜	50½%	24%	¾ to 1½	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	¾ to 1½	39½%	24½%
½	51½%	39%			
¾ to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.25	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	4.95	5.10	7.25
Spelter	6.50	6.85	7.50
ST. LOUIS			
Lead	4.75	4.80	7.10
Spelter	6.15	6.50	7.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	23.50	35.00	26.00	35.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	34.00	22.00	34.00
Brass sheets	18.75	23.75–28	30.75	25.00	30.00	21.50	35.00
Brass pipe	28.00	34.00–37	36.50	33.00	41.00	31.00	41.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	43.00	41.50	39.00	48.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	35.00

May 1, 1919 American Machinist Vol. 50, No. 18

The Becker Model D-1 Vertical Milling Machine

The great increase in the rates of feed and speed that have been adopted during the last few years has necessitated the production of machines far heavier and sturdier than those produced a few years ago. The vertical-spindle milling machine here described is the most recent product of the Becker Milling Machine Co., and is believed to be the largest, heaviest and most powerful machine of this type on the market. Its size can be imagined when it is realized that pieces of work weighing up to 10 tons can be carried and machined on the work table.

A VERTICAL-spindle milling machine that is believed to be the largest and heaviest that has yet made its appearance on the market is shown in the illustrations. It is the product of the Becker Milling Machine Co., Hyde Park, Mass and incorporates many of the features used in previous designs of this company as well as a number of new and valuable additions. The machine is primarily intended for the machining of large heavy parts and the construction of the knee, saddle and table has been made very rugged. The knee is of great width and is supported by two telescopic screws instead of a single one as in most designs. This feature provides a support for the table that is well out from the center of the machine and takes care of many of the stresses due to overhang when the table is moved to the extreme positions. The position of these two supporting screws and the great width of the knee, 96 in., can be seen in Fig. 1. The knee is also supported by the column or frame of the machine by the use of the Becker patented knee gibbing. A horizontal cross-section of this gibbing is shown in Fig. 2 and it will be noticed that the forward pull on the gib is not carried by the screws holding the gib in place, but by the lock construction of the gib itself. The knee is cast with heavy ribs running in both directions, the spaces between the ribs on the top of the knee being closed in by covers to prevent dirt and chips accumulating. The telescopic screws are connected by gearing to move simultaneously, a method being incorporated to allow their being adjusted independently in order to make any slight adjustments for alignment. The saddle is also 96 in. long and slides on the knee on tapered gibs at the center and a wide flat way at each end. The table is held to the saddle by tapered gibs and has a bearing the full length of the working surface. The table is provided with power rapid traverse in either direction and also a fine hand adjustment, which is available at

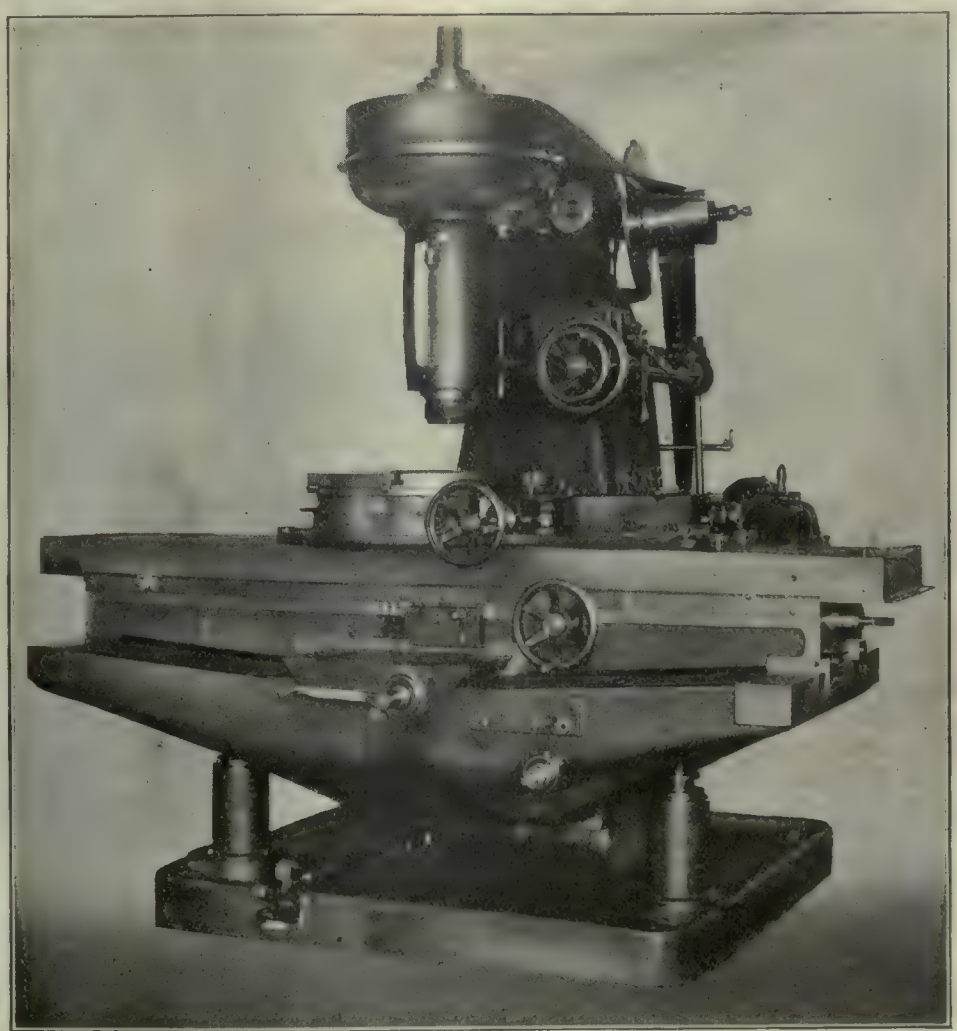


FIG. 1. FRONT VIEW OF THE BECKER MODEL D-1 VERTICAL-SPINDLE MILLING MACHINE

Longitudinal feed of table, 79 in.; cross-feed of table, 20 in.; vertical feed of knee, 20 in.; vertical power feed of spindle, 13 in.; working surface of table, 96 x 20 in.; over-all working surface, 110 x 20 in.; maximum distance between spindle and main table, 22 in.; maximum distance between spindle and rotary table, 13 in.; maximum distance from center of spindle to frame, 25¾ in.; T-slots in table, three, ¾ in. wide; length of saddle, 96 in.; length of knee, 96 in.; width of face of column, 24 in.; feeds, from 0.003 to 0.46 in. per spindle revolution, three changes being obtained by gearing and a wide range through friction pulleys; main spindle bearing, 9⅞ in. long, 4 in. in diameter; end of spindle nose, 4¾ in. in diameter with No. 14 B. & S. taper hole; speeds, fourteen, 7 with open belt, 45 to 260 r.p.m., and 7 with back gears, 9 to 51 r.p.m.

the front of the knee or at either end of the table. The hand adjustment for cross and vertical feeds is at the center of the knee. A particular feature of the machine is the centralized control, which allows the operator standing at his position at the front of the machine to operate all hand and power feeds. In connection with the centralized control it might be mentioned that in the majority of cases the various movements can be operated from both sides of the

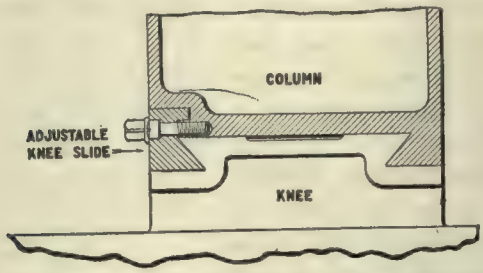


FIG. 2. CROSS-SECTION OF THE KNEE GIBBING

machine in order to save the operator the trouble of walking around it. The table has three ¾-in. T-slots, oil grooves on the sides, and an oil pan at each end for collecting the cutting lubricant from where it is returned to the tank cast in the base of the column.

The head can be raised or lowered from either side and the saddle can be moved on the knee from either the rear or front of the machine. Adjustable stops are provided for all of the various movements.

The spindle is back geared and driven by a 6-in., double, quarter-turn belt. The spindle is of the Becker Barrell type of construction and is provided with an adjustable automatic stop, a micrometer stop gage, a fine hand adjustment, and a quick-return mechanism. The construction is shown in Fig. 3. The spindle is carried in a conical sleeve bushed with bronze bearings, means being provided for adjustment to compensate for wear. The end thrust is carried upon ball-thrust bearings supported by the end of the conical sleeve, this construction preventing possible seizure of the spindle due to unequal expansion of the bronze and iron. A micrometer stop is located directly on the front of the spindle, this being very convenient for setting operations. This stop and the slot in the front of the head in which it runs can be seen on the front of the spindle head in Fig. 1.

The back gears are located in the upper part of the head directly under the spindle-drive pulley, and are operated by the small lever projecting from the bottom of the bowl-shaped casting just beneath the spindle pulley.

The feeds with open belt vary from 0.003 to 0.09 in. per spindle revolution, and with back gears from 0.013 to 0.46 in. per spindle revolution. Three changes of feed are obtained by means of the gearing in the feed box that is located at the rear of the machine, while a wide range of feeds between the limits given are obtained by means of the friction-feed device. The two large disks on the idler pulleys at the upper rear corner of the machine are in reality leather-faced friction disks which drive the small friction wheel and the vertical shaft that may be seen at the rear of the machine in Fig. 4, this shaft continuing down into the gear box.

The machine shown is of the single-pulley-drive type, having a gear box giving seven changes of speed; this construction giving 14 speeds in all, those with open belt ranging from 45 to 260 r.p.m., while those with back gears range from 9 to 51 r.p.m. The spindle is provided with a drawbar and draw-in chuck, and is stopped or started by the foot pedal shown at the left in Fig. 1, while a similar foot pedal at the right, which was not in place at the time the photograph for the illustration was taken, controls the rapid traverse. This is driven through a separate belt and pulley at the rear. The moving member for the clutches for engaging the rapid traverse and the speeds is so made that it is impossible for both to be engaged at the same time.

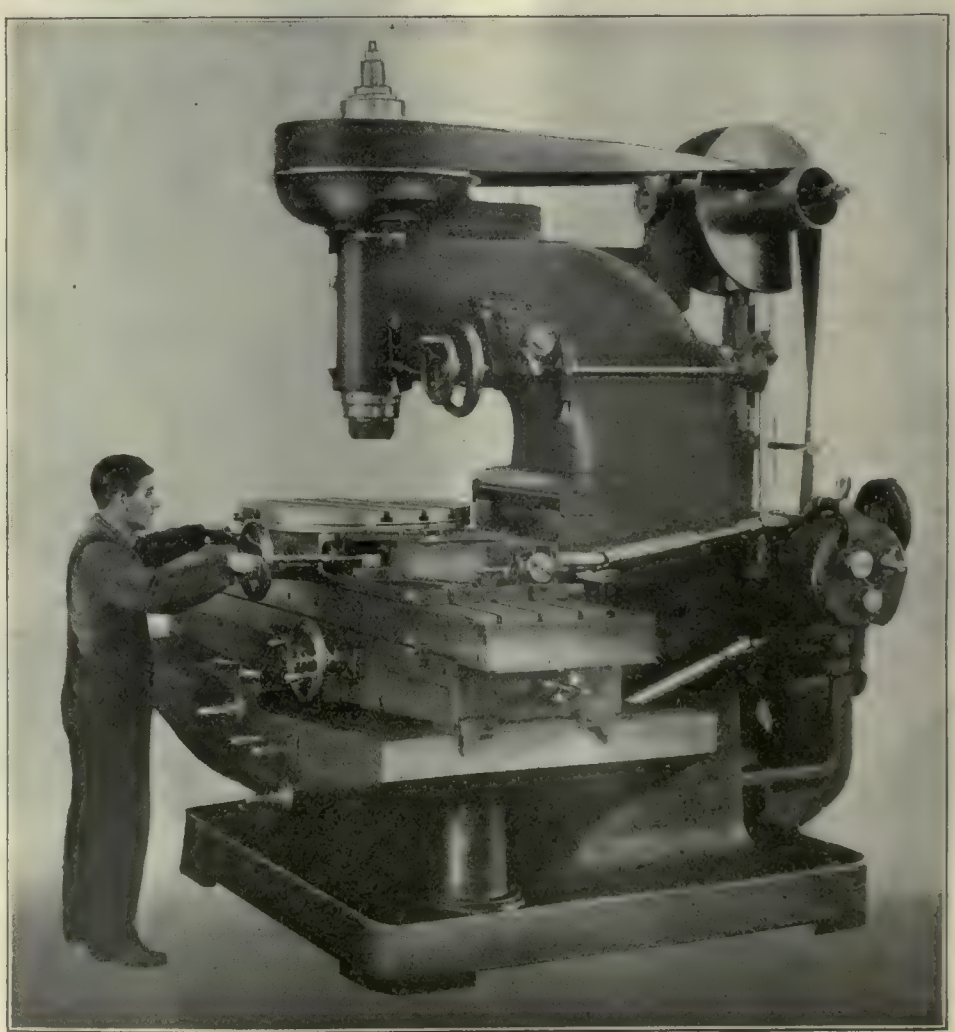


FIG. 4. A SIDE VIEW OF THE MACHINE

Where motor drive is desired, the motor is placed on the extension of the base at the rear right side of the machine. In the case of motor drive, a 10-hp. machine running 850 r.p.m. is recommended, or a motor having a speed range with a ratio of 4 to 1, in which case the speed box is not necessary.

Extras, such as arbor support, oil pump with con-

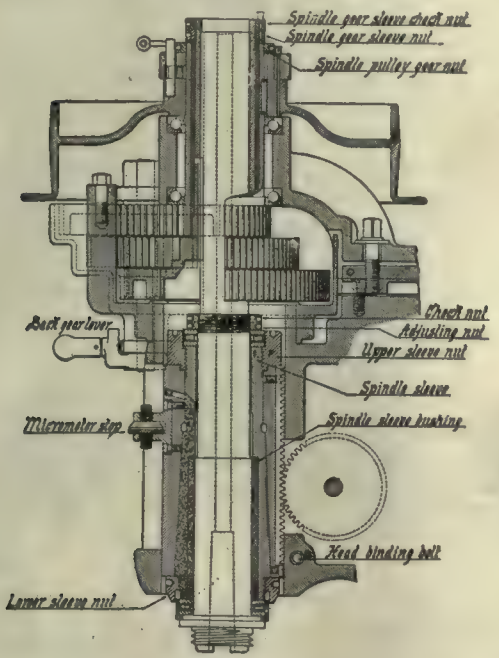


FIG. 3. CONSTRUCTION OF THE SPINDLE AND HEAD

nections, and a rotary table with a circular top graduated to 360 deg. and having a working surface 30 in. in diameter, can be furnished. Both Figs. 1 and 4 show this rotary table in place.

Red Pans to Speed Up Hoodoo Jobs

BY PETER F. O'SHEA

The workmen at the special tap plant of the Greenfield Tap and Die Corporation do not especially admire orders assigned to them which call for only one or two or three duplicate taps. Such orders are to them a nuisance. Even though a very good piece rate is put on such work a man can make more by doing some order calling for 500 to 1000 taps, because the time of setting up his machine more than eats up the extra profit. Therefore each workman had until recently avoided a pan containing only one or two blanks in process. If he had to take the pan he found every possible opportunity to let it lie under his bench or out of sight while he went on with some large order in which there was money.

If only a man here or there postponed a job in this way it would not amount to a great deal. But when at the recent January inventory all the stray small jobs were collected together they made a striking exhibition. There were a total of 300 of them which had been squeezed aside by the pressure of war work. As it was time for New Year's resolutions the manager made one for the whole plant, and like a wise man provided mechanical means for getting action on the resolution.

The work in process in this shop is kept in small pans of uniform size. This is a special plant, something like a job shop, because it confines itself to special taps. These include left-hand and metric threads, odd pitches and unusual diameters, leaving the mass of the regular sizes to another plant of the corporation. One pan therefore may hold either an installment of a fairly large order of 500 or 1000 or it may have only one tap rattling around in it as the complete order. The number of pans in the factory may be judged by the fact that the inventory revealed 300 of the delayed pans containing orders for from one to six taps each.

PANS ARE USED FOR SMALL ORDERS

So the works manager took two hundred of the pans and had them painted with red enamel so brilliant that they could be seen a mile off. These pans are now being used for all small orders unless they are jobs for which there is no hurry. Such a pan cannot remain hidden under a bench for it almost throws a bright light around the corner. And when a man goes to the job bench along the aisle to get his next work the red pans (marked *A* and *B* in the illustration) stand out, so that by no human ingenuity in absent-mindedness can he possibly



THE PANS MARKED A AND B ARE PAINTED RED TO MAKE THEM STAND OUT FROM THE OTHERS

succeed in not noticing them. If he turns away from the bench leaving a red pan behind him he immediately hears about it from the other workmen, who can be depended upon to look after their own interests.

To accompany the red pans the works manager established a regular schedule for putting a small hurry-up order through the shop as follows:

	Hours
One tap $\frac{1}{16}$ in. to 1 in. from blank	20
Two to three taps $\frac{1}{16}$ in. to 1 in. from blank	30
Four to six taps $\frac{1}{16}$ in. to 1 in. from blank	40
One tap $1\frac{1}{16}$ in. to $2\frac{1}{2}$ in. from blank	30
Two to three taps $1\frac{1}{16}$ in. to $2\frac{1}{2}$ in. from blank	40
Four to six taps $1\frac{1}{16}$ in to $2\frac{1}{2}$ in. from blank	50

From steel add 10 hours.
Combination pipe taps and drills, square or Acme thread taps, double time.

DOES NOT INCLUDE SHELL TAPS

The schedule should be interpreted as follows: Making one single tap takes nearly as much time as making six duplicates on account of having to adjust machines. This circumstance is allowed for in the schedule. If the

taps are of special pitch, but can be made from blanks of a regular diameter previously turned and square-ended, manufacture of the order starts in at once from stock blanks. If the blanks in turn have to be specially made from the raw stock of a steel bar 10 hours is added. The number of hours at the right represents the complete elapsed time from the receipt of the order to the shipping-room door. This schedule is posted throughout the shop. The order ticket in the pan bears the date of receipt and the day and hour that it has to be finished so that everybody may know whether he is up to schedule on the job.

This schedule is not an ideal to be aimed at, but a practical working time which is being operated on and which contrasts very much with the former elapsed time of these jobs.

The red pans immediately speeded up the small jobs. Before the week was out all those that had been roaming around the shop for a long time previous to the inventory were cleaned up and out of the way. Now the only small orders that are still in the shop are those received within two or three days.

The Schedule Proved Practical

The schedule proved so practical that it is now maintained as the regular schedule for all small orders that are wanted at once by the customer. Small orders have to be done and they can be done just as quickly at once as later on.

Speed in the carrying through of small orders is especially important. If a man sends in an order for one special tap the likelihood is that he needs that particular tap very much and that his shop cannot go ahead on some job without it. If a man sends in an order for 500 taps he is only providing ahead and certainly does not need the 500 right away. These can therefore be made up on a semi-manufacturing schedule instead of as single pieces. Then too the customer when he is in such a rush wants to know definitely how long it will take him to get the work done and the taps delivered.

Night Life in a Shipyard During the War

By Clarence F. Getzlaffe

I have just finished a year's experience in one of the shipyards and wish to tell the readers of *American Machinist* some of the things that came under my observation during that period. I was on the night shift and all newcomers came under the critical eye of our gang, and they surely got their sizing up just as I did when I first blew in with my trusty tool box.

One night a young fellow came along who knew all the ins and outs about a lathe, so he was given some 3½-in. pipe flanges to bore, thread and face. To his sorrow he soon found that watching some one run a lathe and running one himself really ought to be listed under separate headings. After spending two hours in truing up the first flange, looking at it from every angle even to sighting it over the tailstock, it passed his inspection. However, he evidently thought someone ought to O.K. it, so he asked one of the helpers what he thought of it, but that flippy helper had no sympathy and said, "I don't know, I ain't running the durned thing." A few minutes later the big chief happened along and said, "What are you doing?"

"Just getting started," was the calm reply. This did not suit the boss as far as speed was concerned and he told our friend he would not do. After the *master mechanic* had given the boss's verdict the once over, our friend said:

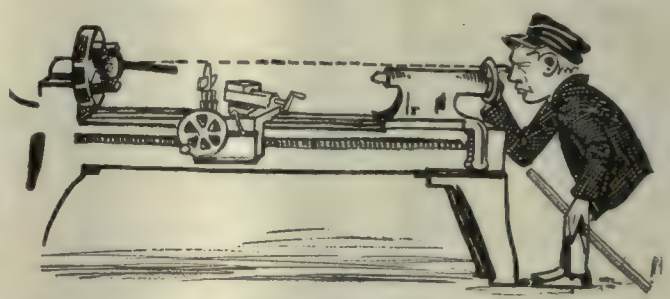
"Have you got a shaper, Boss?"

"Yes," said the boss, "can you run one?"

"Sure," said our friend, "one that goes like this," moving his arm violently backward and forward. This last demonstration made the boss smile but failed to pull down the job.

Then our friend tried to get a job running a hack-saw but the boss told him the helpers ran them, so he packed up his tools and left, thinking we were the meanest bunch on earth.

Next came another lathe hand, inexperienced, but possessing a lot of confidence. He was given the task of making an eye-bolt with a threaded shank about 6 in. long. Whenever I did a job like this in the lathe, I usually ran the threaded end of it on the tail center, but this fellow did not like that way so he gripped it by the eye in an independent chuck. I have seen many threads



and have cut not a few myself, but his was the queerest standard I ever saw—no special name for it. I'd hate like the deuce to make a nut to fit it. I think the angle of thread might be expressed as 60 deg. latitude, longitude unknown. Well, anyhow, this fellow lost his job in two hours.

Regular Guy on a Boring Mill

The next fellow was different from the rest, a type all by himself—regular guy on a boring mill, so he claimed. He hailed from Michigan. The first thing he did was to ask the boys for an "inside hub tool." We usually use a boring tool when boring a hole but this fellow had names of his own. When he saw that he was falling down on the job he said "I don't know much about this *dry cutting*, but if you fellows will help me along a bit I'll get by." Since we were not hired as instructors and he did not hire out as an apprentice, he did not get much comfort from us. As there is a law in this state prohibiting a foreman from discharging a man after midnight, he lasted until morning.

The next fellow was a sad case. He hailed from Washington, had already served in the capacity of master mechanic and took first prize at stammering. The first job turned out to be a bull, but he was not to blame for the toolroom jack gave him the wrong size drill. When he sprung this story on the boss, he was asked if he would use a pipe wrench for a sledge just because the toolroom jack made a mistake. The second night the poor fellow stripped a gear. If the boss jumped an inch when he saw that I'll bet he jumped a yard.

"Say, fella," says he, "I've got a notion to fire ya."

"You can't d-d-do it," was the answer, "I-I-I'm g-g-going t-t-to q-q-quit."

"Well you might as well," says the boss, "for I would have fired you anyway."



MAKING A JOB of TRAINING LABOR

By

Harry H. Tukey

If a carpenter can be made into a lathe hand in a few weeks why not try the system that did it on your apprentices? Aren't the times ripe for the introduction of labor-training methods that will cut down the training period, produce better workmen and boost the credit balance?

I WONDER, Mr. Manufacturer, if we might take a few minutes to recall the old days when you ran your plant so differently from the way you do now?

Do you recall how the forgings came in from the smith shop, were roughed off on the planing machine, then carried up the shop to the lathes, across to the hydraulic press for force fitting, back to the planing machine for a finishing cut and up the shop again to the erecting floor? Don't you remember the confusion that resulted. Nobody in those days ever thought much about locating machines according to sequence of operations, nor about analysis of the job into operations, nor of standards or costs (except roughly) or any of the schemes that developed later. Of course you lost a lot of money in idle time of men and machinery now that you see it that way, but it didn't make much difference then because competition was not so keen and the margin of profit was greater.

Yes, those were the happy days, but they're gone. The advance of the age has changed matters. The production engineer came along and pointed out the error. You laughed at him at first and called him an "efficiency guy." But competition also came along and cut down your margin of profit and you had to sit up and take notice.

Then it became clear that the expense of changing those machines to facilitate handling the work was necessary and would save you money. It became apparent also that it was worth while to hire someone to determine just what operations composed this or that job and to see that they were followed in that order. Your shops took on a semblance of organization. You knew what you were doing with your raw material and could place your finger on the leaks and stop them. You began to know something accurate about your costs and you could meet competition successfully, regardless of the decreased margin. You learned that organized control of machine output was vitally necessary to the economical operation of your shops. You made a job of finding out just what went into the producing of your product to make it salable to someone else at a profit to you that would keep your head above water. You standardized the machine, the shop, the output and to some extent the workman's operations.

I suppose you are about ready to ask what all this has to do with training labor. Just this: While you have been advancing in the above you have neglected the human side of the equation. You have continued to employ the same methods in the development of new or existing labor in your shops that you were employing when competition was not so keen. It is the one leak that you have not yet stopped, and it is a big one.

You have employed your new men as helpers, placed them with mechanics and, figuratively speaking, have let them wander through their work having "operations" performed upon them (experiences) much as the forging used to "wander" through the shop. As the progress of the forging was governed by the machine which happened to be open for it, so the progress of this learner is governed, under the present condition, by the kind of a job the mechanic happens to get.

Further, let me call to your attention the fact that you have placed this helper with a mechanic employed to do a mechanic's job and not a teacher's. You are buying the mechanic's services because he has mechanical ability to be put into your product and not because of his teaching ability. Every minute of his time you utilize for teaching purposes deprives your product of just so much productive time. Every time you make a mechanic responsible incidentally for the training of your labor you commit highway robbery on yourself, both coming and going.

Although it can't be seen, there is a tremendous overhead when eight or ten foremen or mechanics give a portion of their productive or supervisory time to the training of eight or ten green men, and they are probably doing little real teaching at that. In fact we have had to unlearn many mechanics made in this way

within the past few years. We have found that some of their teachers had taught them expensive methods of operation. That again was beyond our control because we had too many teachers with no one responsible for the teaching.

We have taken it for granted that it takes a certain time to make a mechanic, and let it go at that. The peculiar part of it is that very few of us have made mechanics; most of them have made themselves. They have been their own best teachers and have learned by their own initiative and effort rather than by any effort on our part to teach them.

Again in the case of our apprentice systems the same general practice obtains. We indenture an apprentice for four years or more, place him in the shop, forget about him and at the end of the required time release him and call him a mechanic. Sometimes we don't call him that, but he does and gets away with it. The only evidence, however, is four years' time.

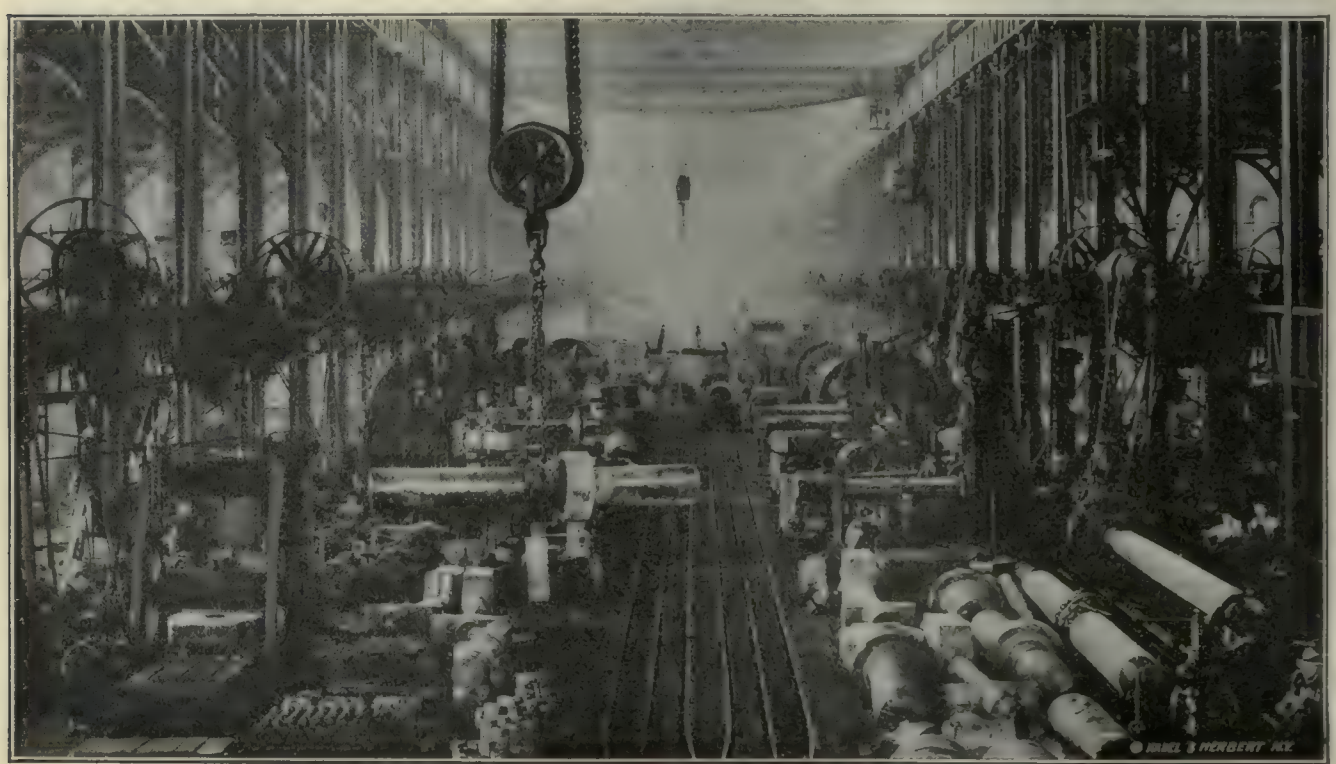
Let's see what happens in that time. First six months—runs errands and sweeps shop. Second six months—odd jobs, some too difficult, requiring a long time to learn or resulting in spoiled work and discouragement; others too easy, leaving time for monkey-shining. Second year—boy improving, able to do a few jobs well enough so that we keep him on those jobs and make a little money on him. All he learned could have been taught in three months and the rest of the time exploited. Third year—same procedure. Fourth year—same thing generally, but not quite so bad. Result—trade half learned.

Unquestionably, all that has been learned could have been taught in two years' time, at the end of which we would have known the product quantitatively and qualitatively. Under the existing method no one person has been responsible for the manipulative knowledge the boy may have obtained. In some plants classroom instruction of a technical nature is given, but nothing more.

Why not determine what a mechanic ought to know to be competent in a given trade, lay it down in black and white in terms of jobs, put the apprentice through them, whether it takes two years or 10, and hold him until he can do them? Cut out the exploitation and get the full mechanical value of your man in the shortest possible time. Give the apprentices real jobs graded to their ability. Train them to use not only their heads but their hands as well. Place them under the supervision of a competent instructor who will be responsible for them, and they will pay the instructor's salary and give you a profit besides.

Many large industries have maintained apprentice schools and other educational endeavors with a view to obtaining greater efficiency. In my opinion most of these schools are only classrooms where apprentices and others may become mathematicians or scientists, and while much of the work has been a valuable aid to the worker a large portion of the instruction did not directly relate to the learner's daily work but was simply of general educational value. It would seem better for the employer to train the employee to use skillfully the kind of technical information that his job demands than spend time and money teaching him algebra when he required only simple arithmetic in his daily calculations. This information can best be given on the job at the time of immediate need when it can be visualized and its practical value shown.

The man you want, Mr. Manufacturer, is the man who can do a good job and whose related trade knowledge is sufficient unto the accomplishment thereof. You want the man who has been trained to think his way through a job, not the one who does simply what someone told him was right without any knowledge of why it was done that way. The only way you



A MODERN MACHINE SHOP

can get such a man is to put someone on the job who can train men to think their way through simpler jobs and turn them over to you as thinking workmen and not automatons or mathematical prodigies. The only reason such men are scarce now is that we have not gone about the job properly. Isn't it high time to begin?

The solution of the problem will unquestionably be found in the installation of an organized training department composed of instructors who are good mechanics and who have been trained to impart their knowledge. These instructors should be placed under a department head who is thoroughly competent both as teacher and mechanic and is an executive as well. By such a plan you will be making a job of training labor just as you have made a job of employing labor, and it should be obvious that the suggested job is just as big and important as any phase of the work of your organization.



THE CLASSROOM METHOD OF LABOR TRAINING

We have tried welfare schemes and countless other philanthropies calculated to create interest on the part of workmen, improve their workmanship and raise their social level, but let me repeat the recent statement of a prominent manufacturer and employer of some 14,000 men: "There is no one industrial activity that will do as much toward increasing and improving the national output and at the same time raise the social level of the working classes as industrial training within the plant."

A proper training plan would first call for an analysis of the line of work or trade for which the learner was to be trained. This analysis would be entirely in terms of learning difficulties and would lead up to the formation of an "operation" sheet, which as applied to the learner is entirely similar in its function to the ordinary operation sheet used in the shop. It provides a schedule of learning experiences in terms of representative shop jobs, through which the learner should pass in order to attain the required ability. As shop jobs are completed experience is gained. When such jobs are laid out in order of difficulty and are given to the learner in this order a close check on progress and ability can be obtained. When the analysis is made and the list of jobs made out no great amount of study is necessary to include with each job the technical information called for by that job. This will facilitate the teaching of the required technical knowledge at the time it will be best understood and appreciated and requires very little if any classroom instruction.

The trained instructor will be able to make the analysis and layouts previously mentioned and adhere to them. He will instruct a number of learners all the time on productive work as against the old plan of one learner (helper) to one instructor (mechanic) with only a portion of the time either instructive or productive. He will develop all there is in the learner and at less cost and will reduce your labor turnover. He will know how to create interest on the part of the learners as a result of his training.

I have had both trained and untrained instructors under my supervision and can testify to the value of the trained instructor in terms of the quality of the mechanic he produces and in terms of decreased training time.

I suppose that by this time the prevailing thought in your mind, Mr. Manufacturer, is the cost of this training of labor. First let me call one or two points to your attention:

It makes no difference whether you follow out the above suggestions or not, if you are hiring labor, skilled or unskilled, and are eventually getting this labor to a state of proficiency that conforms to your standards, you are paying a bill. When this training is carried on in an organized manner you are in a position to know the size of the bill. If you have the mechanic-helper plan you cannot tell what the bill amounts to. Do you prefer to know and control the cost, or do you prefer to play ostrich?

I will point out the general factors involved in the cost of operation of a training department, and from this you may work out your own cost approximately. One instructor can handle from six to twelve men, depending on the trade and conditions. Contrast this

with either of the existing methods, compute the difference and credit it to the cost of organized training.

The production value of the work of these learners should at least offset their wages, and their increased productivity as against their productivity as helpers should credit toward the cost of organized training.

If you still have a charge against organized training subtract therefrom the time lost in story-telling, etc., by the mechanic-instructor and his helper and also the amount it costs you to obtain a skilled worker and you will have your cost. What is it—credit or debit? Account is not taken of the psychological effect of a training department on the rest of the workers nor of the value of a known cost. These values cannot be measured in dollars and cents.

The Advantages Summarized

Summarized the advantages to be gained by making a job of training labor are as follows: (1) Increased efficiency of the trained product; (2) utilization of the entire time of foremen and mechanics in the performance of their proper function; (3) knowledge and control of instruction given; (4) technical instruction functioning with the job; (5) stabilization of labor and reduced turnover; (6) knowledge and control of training costs, and (7) increased productivity of learners.

In the international competition that must necessarily occur in the coming reconstruction period this country must suffer certain disadvantages in high labor and material costs. As this is true even now in many lines it follows that in order to compete successfully we must improve our production both in quantity and quality. This can only be done by training those who produce to become better producers and by improving machinery. Machinery is continually being improved, and therefore it seems that we should now concentrate as strongly in improving the worker to the mutual advantage of all concerned.

What Was the Matter With Jones?

By Harry Senior

"See here boss," said Jones, foreman of the assembling department to his superintendent, "Whatinell am I going to do about this?"

"What's the trouble George?" inquired the superintendent.

"Why, this here lotta pumps that's going through now will be a disgrace to the firm unless something is done. The lathe work is bum. Some of the parts are too short and some are too small in diameter; not very much to be sure; not so much that they can't be assembled, but enough to make a bum job of the whole bunch."

"Does the foreman of the lathe department know of this trouble?" asked the boss.

"Unless he's deaf," retorted Jones. "I've criticized mildly, remonstrated gently, importuned urgently, demanded heatedly, and cussed abominably, but the results of all is nix. He only gets mad or peeved and I've got so I hate to go out there, for it's a sure sign of a row."

"You've got a set of gages, haven't you?"

"Yes."

"Why don't you notify Jim that you wont accept any part that doesn't pass your gages?"

"Because if I did, and acted accordingly, you wouldn't get any pumps," was the instant response.

"Do your gages check up with his?"

"Some do and some don't. When they don't, he says mine are wrong and when they do he says that he can't get every piece perfect and that I should make allowances.

"Its all right once in a while, this allowance thing, for I suppose it cannot always be avoided, but it means that I've got to make the work right myself by changing other parts to fit the stuff he dumps on me, and take the blame when a customer raises the devil because he has paid out good money for a second-hand pump.

"I hate to be making this complaint to you, for I have a notion that if a man can't overcome his troubles himself there's something the matter with the man. I've tried hard and faithfully for over a year and have passed up many things that were against my judgment in the hope that they wouldn't happen again, trying all the while to figure out some way to make things break right.

"Now I've got to admit that I'm up against it. Jim is not responsible to me. On the few occasions that I have so far overcome my scruples as to bring obvious errors to your attention you have immediately called in Jim, heard his excuses, smoothed things over for him, and let him get away with it, leaving me to feel that I am a damphool for making a howl about nothing, and likewise a sucker for running to the boss with complaints about another fellow's work.

"If I had the privilege of taking the lathe work to the little jobbing shop down the street they would do it just as the drawings specified. They wouldn't ask me why I didn't want it done some other way, or explain that they didn't do it quite right because they didn't have time to read the specifications. I don't believe that the proprieter would bring me up a No. 2 spreader with the shoulders ¼ in. too close together and with an 8-thread on one end and a 10 on the other when both should have been 9 and ask me if I couldn't use it up because his best man was out on a drunk, and the boy he gave it to got all mixed up on it, but he worked 10 hours good and faithful and its a shame to waste all that work, etc., and-so-on etcetery."

Jones' goat was sure loose and out on a regular rampage. The more he talked the madder he got (which was most likely the reason why he was only a foreman) so the old man sought to cool him off by telling him that he would have a talk with Jim. Jones had heard this line of chatter before and knew just what it wouldn't amount to, but he didn't know what to do about it so he did just what nearly everybody does under similar circumstances—nothing.

This didn't happen in my shop—if it had I wouldn't have told you about it. The man really to blame was the superintendent and Jones knew it, but the fear of losing his job, or respect for his official superior, or diffidence, or some other darned thing that is forever handicapping a man and lowering his efficiency and consequent value, prevented him from saying what he knew to be the truth.

The point is that it *does* happen, all too frequently, in many shops; perhaps in yours; very likely in mine. Jones' notion that "if a man can't overcome his troubles himself something is the matter with him," is a good one for us all to adopt but each of us must apply it to himself, never to the other fellow.

Is there friction and discord in your shop? Is any one of your foremen either complaining or struggling quietly along under impossible conditions that only you can mitigate? Of course there *isn't*, but let us look again, just to make sure.



X. The Production of Acetylene*

There are two ways of obtaining acetylene for use in the shop. One is to buy it in cylinders and the other is to generate it on the premises. This article gives some details regarding acetylene in cylinders and also describes the positive-pressure type of generator.

ACETYLENE, which is the gas most commonly used with oxygen for gas-torch welding, is produced by the reaction between calcium carbide and water. It is used because of its large carbon content and also because of its endothermic properties, which means that it is heat absorbing and energy stored up in its formation is given off again upon dissociation. Calcium carbide and water produce acetylene and slacked lime, the formula being: $CaC_2 + 2H_2O = C_2H_2 + CaO(H_2O)$. The calcium carbide when in contact with water is divided and the carbon of the carbide joins with the hydrogen of the water to form acetylene gas. The calcium of the carbide unites with the oxygen of the water and forms slaked or hydrate of lime, as just stated.

Since calcium carbide combines with water in all of its forms it must be protected from moisture in handling. For this reason it is shipped in sealed metal drums or cans commonly holding 100 lb. From these drums the carbide is placed in generators for the purpose of liberating the gas.

Like other gases used for welding or cutting purposes, acetylene may be purchased in cylinders, but it cannot be compressed directly into ordinary steel cylinders with safety. When compressed to as much as 30 lb. per sq.in. it becomes very unstable and liable to explode unless handled with extreme care. The heat generated by compression therefore makes this a dangerous process unless means are provided for cooling. The method used in order to compress the gas and make it safe to handle, is to fill the cylinders with some porous substance and then fill them with acetone. Acetone is a liquid that has the property of absorbing acetylene about the way sugar does water, and acetylene in this state is commonly known as dissolved acetylene. As acetone takes up acetylene it increases in bulk. So suppose a cylinder to be filled only with acetone and dissolved acetylene under considerable pressure. If the cylinder gas valve is opened and some of the acetylene drawn off, the acetone will shrink in volume and leave a place in the cylinder filled with undissolved acetylene gas under pressure. This free acetylene under pressure is very explosive, and easily set off from shock or heat. However, it has been found that the gas will not dissociate when finely divided, and advantage is taken of this, and the cylinder or tank is filled with porous material. For this purpose a mixture of asbestos, charcoal, kieselguhr, and a small amount of cement to hold it together, is packed into the cylinder or tank, providing a finely divided porous filling that prevents dissociation of the gas. After a cylinder has been completely filled with this mixture, slightly dampened, it is baked in an oven until the moisture is completely driven off. It is then exhausted of air and acetone is introduced into the cylinder. Acetylene is then forced into this prepared cylinder, by means of a specially cooled, multiple-stage pump, great care being exercised during the process. Each cubic foot of acetone will absorb 24 cu.ft. of acetylene for each atmosphere (15 lb.) of pressure. However, in actual practice, the quantity of acetone in a cylinder is usually so regulated that the cylinder will contain about 10 times its own volume of acetylene for each atmosphere of pressure that is on

*For the author's forthcoming book "Welding and Cutting."
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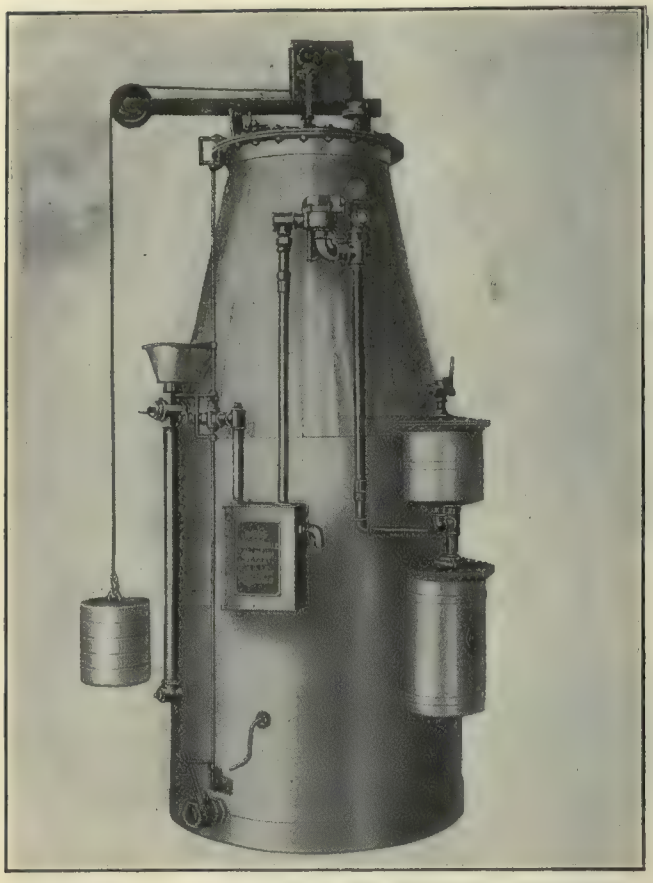


FIG. 95. STATIONARY TYPE OF POSITIVE-PRESSURE ACETYLENE GENERATOR

the gas. Cylinders are, as a rule, charged to 15 atmospheres pressure at 60 deg. F., so they contain 150 times their own volume when charged. Thus a cylinder that would hold 2 cu.ft. of water when empty will hold 300 cu.ft. of acetylene at 225 lb. pressure, 60 deg. F.

The filling material must be so placed in the cylinder as not to settle when handled or shipped, since if it does, a dangerous pocket will be formed filled with free gas. In handling these cylinders, it should always be kept in mind that the pressure increases as the temperature is increased. The best results are obtained by keeping the cylinders of dissolved acetylene at about 60 or 65 deg. F. An average cylinder of about 100 cu.ft. capacity will weigh about 85 lb. and one of 300 cu.ft. capacity, about 220 lb. A Davis-Bournonville cylinder, 12 x 36 in., 225 cu.ft. capacity, will weigh, fully charged, about 180 pounds.

Acetone Injurious to a Weld

Acetone is very injurious to a weld, and in using gas from a cylinder of dissolved acetylene, care must be exercised not to use the gas too fast or acetone will be drawn off with it. The allowable rate of cylinder discharge is at the rate of one-seventh of the capacity per hour. That is, a 225-cu.ft. cylinder will supply $225 \div 7 = 32$ cu.ft. per hour. Under emergency conditions this rate may be considerably exceeded, but the practice is not economical and is liable to injure the weld.

The amount of gas in any cylinder may be found by noting the empty or tare weight stamped on the cylinder, then weighing the cylinder and multiplying the difference in pounds by 14½. In some cases the weight marking may be different, but in any case, each pound by weight of dissolved acetylene, is calculated to produce 14½ cu.ft. of gas. To calculate the amount of acetylene used on any job, weigh the cylinder before and after and multiply the difference in pounds by the number just given. Knowing the cost of a cylinder of gas, the cost of the amount of gas used on any job may be easily found.

Weighing, which has just been outlined, is the only accurate method of computing the amount of acetylene, since gage-pressure readings are affected by changes of temperature. However, gage pressures are a great convenience in *estimating roughly* how much gas remains in a cylinder. In the case of a 100-cu.ft. cylinder, each 15 lb. of pressure represents, approximately, 6½ cu.ft. of gas, and in a 300-cu.ft. cylinder each 15 lb. of pressure represents, approximately, 20 cu.ft. of gas.

There are three types of acetylene generators, the essential differences being the method of bringing the carbide and water into contact. These three methods are: dropping the carbide into the water; allowing the water to rise slowly into the carbide; dropping the

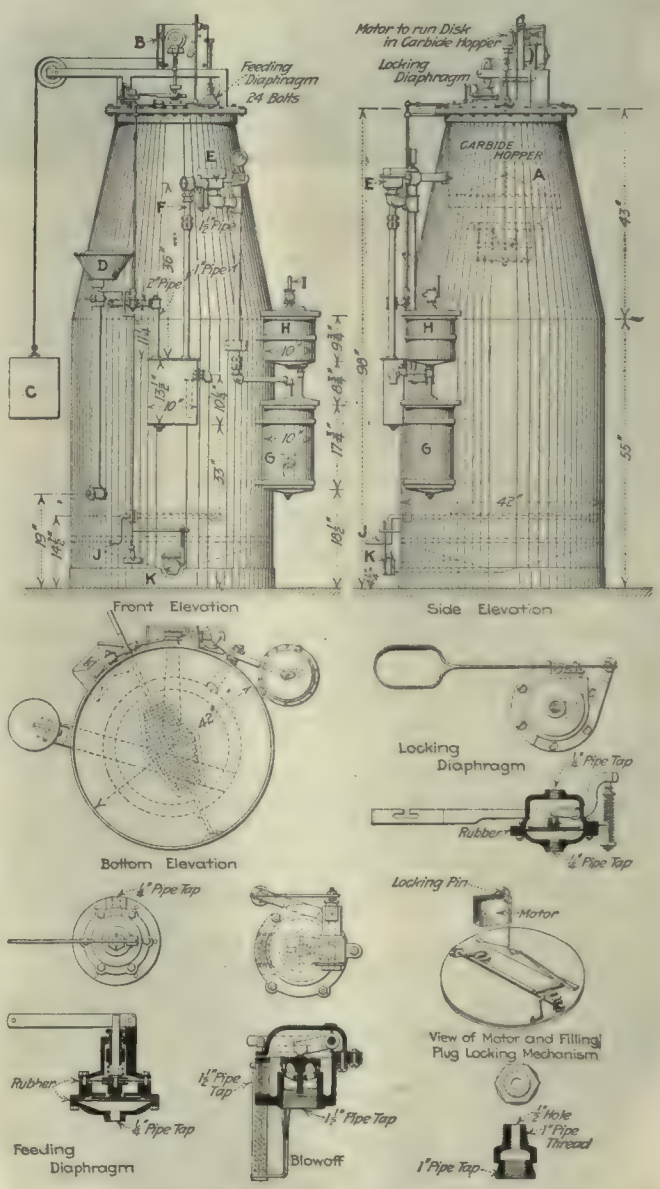


FIG. 96. DETAILS OF 300 LB. CARBIDE CAPACITY ACETYLENE GENERATOR

water onto the carbide. The first is by far the most satisfactory method and the one generally used in the United States, and for this reason will be the only method described.

The carbide-to-water generators are of two types, known as positive- or medium-pressure, generators which deliver the acetylene at a pressure of more than 1 lb. and not to exceed 15 lb., and low-pressure generators which deliver gas at a pressure of less than 1 lb. While there are a number of firms making the different types, only the better known makes will be described in detail, since the general principles are the same. Modern generators of all types are automatic in their action, the feed being regulated by the flow of gas, and they are provided with an ample number of fool-proof devices which render their operation and handling safe.



FIG. 97. NAVY TYPE ACETYLENE GENERATING AND COMPRESSING INSTALLATION IN A BETHLEHEM SHIPBUILDING CORPORATION PLANT

The Positive-Pressure Generator

The first positive-pressure generator built was designed by Mr. Bournonville in 1906. The present type of pressure generator handled by the Davis-Bournonville Co., is made by the Davis Acetylene Co., Elkhart, Ind. These generators are made in several sizes to meet the demands of various sized shops, and they may be had in 25, 50, 100, 200 and 300 lb. carbide capacity. These numbers indicate the weight of the charge of calcium carbide to be used, the number of gallons of water per charge, and also the number of allowable cubic feet of gas generated per hour in accordance with the rules of the National Board of Fire Underwriters.

The generators of 50 lb. and 100 lb. capacity are standard for repair shops and light manufacturing, while the larger sizes provide for more extensive and continuous use in large repair shops and metal-working industries. They are of heavy construction with powerful feeding mechanism. They are frequently installed as units to build up plants for any requirements of the oxy-acetylene process. They all have automatic feed with independent power and the quantity of carbide remaining in the hopper is constantly indicated. The acetylene gas is piped directly from the generator under the required pressure through service pipe lines to the welding stations and is regulated by means of reducing valves fitted with pressure gages to govern the proper working pressure.

The size of carbide used in the Davis stationary generators, is designated as $1\frac{1}{4}$ x $\frac{3}{8}$ in., and it is estimated to produce approximately $4\frac{1}{2}$ cu.ft. of acetylene gas to a pound of carbide. The size of carbide just quoted has reference to the size of screen mesh it will go through or not, that is: $1\frac{1}{4}$ by $\frac{3}{8}$ in. means that the lumps will all go through a $1\frac{1}{4}$-in. mesh screen, but none through a $\frac{3}{8}$-in. mesh; carbide quoted as $\frac{1}{4}$ by $\frac{1}{16}$ in. size, will go through a $\frac{1}{4}$-in. mesh screen, but not through a $\frac{1}{16}$-in. mesh, and so on. This smaller size is estimated to yield about 4 cu.ft. of gas per pound of carbide.

The carbide-to-water generators are designed to hold a gallon of water for each pound of carbide capacity. In practice the carbide is fed into the water only in sufficient quantity to maintain the gas supply at the required pressure. The extreme limit of safety pressure for free acetylene is 30 lb. and in the positive-pressure types of generators the pressure limit is placed at 15 lb. When this pressure is reached, the various safety devices begin to act to prevent further generation and consequent increase in pressure. As the carbide is fed from the containing hopper it drops down into the tank of water beneath, and sinks to the bottom. In this way most of the gas is generated close to the bottom of the water tank, and has to rise through a considerable body of water to reach the top. This not only serves to

cool the gas but also washes out a large part of the impurities. The carbide used in these generators may be obtained from distributing points in nearly all of the large cities in the country, in sealed drums containing 100 pounds.

The acetylene generator shown in Fig. 95 is the Davis standard stationary 300 lb. carbide capacity apparatus. It is 115 in. high, 42 in. in diameter, and weighs about 1000 lb. Details of this apparatus are shown in Fig. 96. In this cut, *A* is the hopper into which the carbide is introduced from the top. A feeding mechanism at the bottom of this hopper is run by the clock motor *B*, which is operated by means of the weight *C*. The feeding device consists principally of a rotating disk with inclined vanes which sweep the lumps of carbide off into the water below. There are two safety-pressure diaphragms for stopping the motor should the gas pressure become too high. The first diaphragm acts when the pressure reaches 15 lb. If this should fail to act properly, the second diaphragm will be actuated a little above 15 lb. pressure. This last diaphragm operates a positive lock which effectually stops the motor and consequently the carbide feed. In addition to this, there is a safety valve at *E* which is connected to a pipe leading to the outside of the building, so that the gas can escape in safety. At *D* is a funnel by which water is run into the tank. As the gas is generated it is carried through the pipe *F* to the bottom of the flash-back chamber *G*. This chamber is full of water and serves the double purpose of giving the gas a second washing, and acting as a water seal between the service pipe and the gas in the generator. From this chamber the gas passes up through the filter chamber *H*, which is filled with asbestos that removes suspended impurities. From this filter the gas passes out through valve *I* into the service pipe and thence to the torches. The handle *J* operates the agitator and the tank settlings are removed through the gate valve *K*.

In addition to the regular stationary type, the Davis-Bournonville Co. makes what is called a "Navy Type." These comprise a complete equipment for use in shipbuilding yards, railway systems, and large industries. The installations provide acetylene generation with two-pressure, air-excluding generators of large capacity, supplying acetylene under direct pressure to welding and cutting stations and an additional low-pressure supply for compression into portable safety cylinders, with purification system, and three-stage specially designed acetylene compressor. Three sizes of the navy type, two-pressure, air-excluding acetylene generators are manufactured, having a capacity of 100 lb., 200 lb., and 300 lb. of carbide each, and with normal output of 100, 200 and 300 cu.ft. of acetylene per hour respectively. When greater capacity than 300 cu.ft of acetylene per hour is desired, two or more generators may be connected serially with a special purifying and compressing plant.

A navy type installation is shown in Fig. 97 and a suggested plant layout in Fig. 98. One of the special features of the navy installation, is the low-pressure supply from which the gas is drawn for charging portable cylinders. This is done because in many places around a shipyard or other large plants, it would be practically impossible to pipe the gas or to use a portable generator. The cylinders used are, of course, previously prepared as already outlined. After charging they may be transported to the work in various ways, but for convenience they may be mounted on a small hand truck, like the one shown in Fig. 99. This truck holds an acetylene cylinder and an oxygen cylinder, together with the necessary accessories.

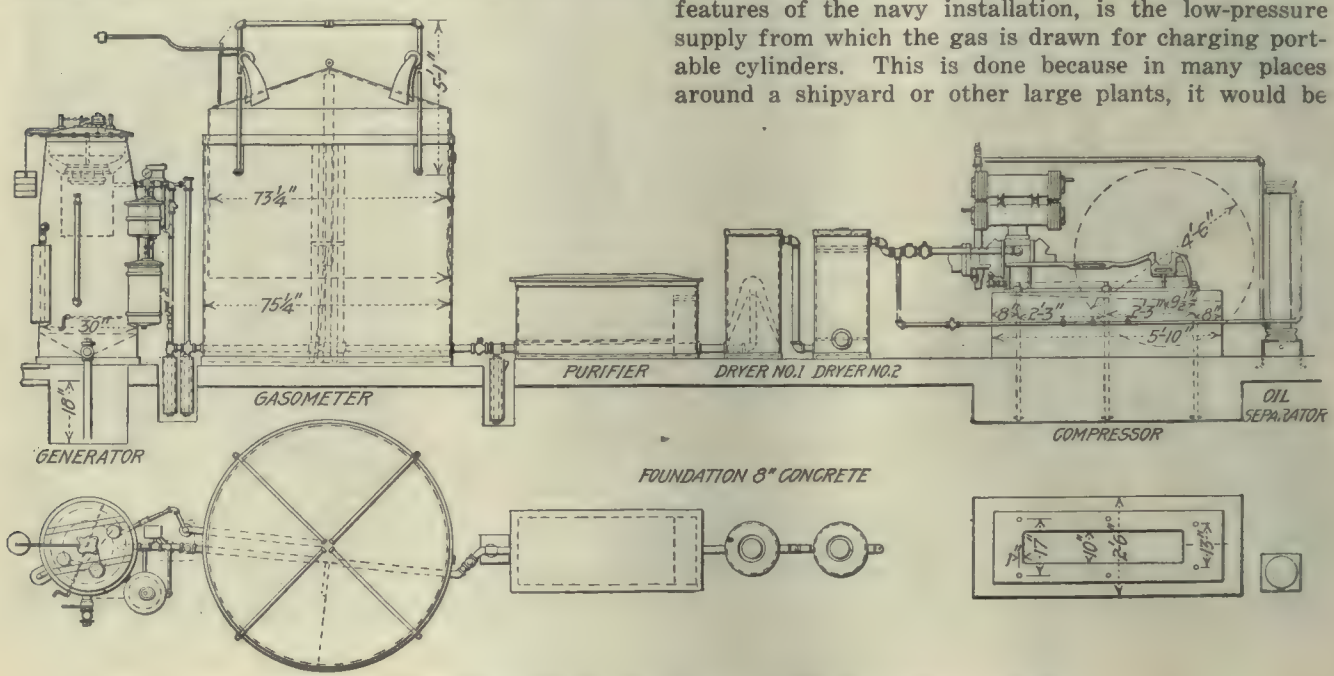


FIG. 98. NAVY TYPE ACETYLENE PLANT LAYOUT LENGTH OVER-ALL 36 FT. 6 IN.

The approximate dimensions and weights of the various types of generators made by the Davis-Bournonville Co. are given in Table VII.

The Buckeye Carbide-Feeding Mechanism

The phantom view given in Fig. 100 illustrates the feeding mechanism used by the Macleod Co., Cincinnati, Ohio, on their pressure generators. These are made on the same principle as those just described, but this illustration gives a clearer idea of the arrangement of the feeding device. The operating motor is driven by a weight which is wound up by means of the handle on top. The way the vanes are set so as to sweep the carbide lumps into the hole in the center of the bottom of the hopper, is clearly shown.

Since commercial demands frequently make a portable type of acetylene pressure-generating apparatus desirable, such apparatus particularly suited to the requirements of large shops, ship or railroad yards and the like, is made by several firms. The Davis Acetylene Co., makes them in two sizes, of 25- and 50-lb. capacity. These generators are provided with a locking mechanism which prevents the operation of the feeding mechanism when the generator is being moved.

The Portable Pressure Type

The portable pressure type of generator made by the Oxweld Acetylene Co., Newark, N. J., and Chicago, Ill., is shown in Fig. 101. These generators are made with 50- and 100-lb. carbide capacity and respective productions of 50 and 100 cu.ft. of acetylene, capable of supplying 3 and 6 torches. The 50-lb. generator is 3 ft. 1 in.

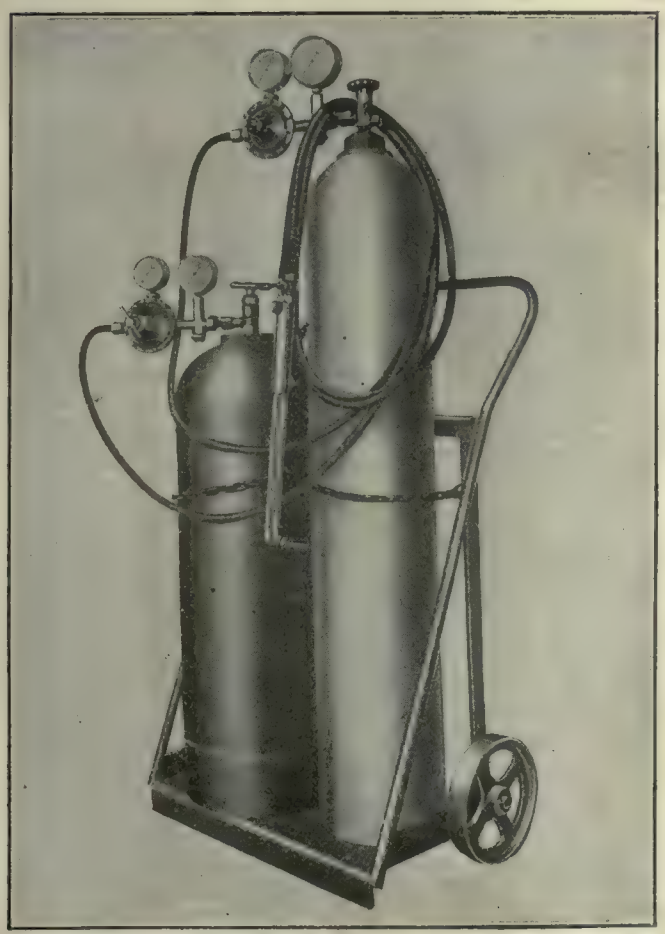


FIG. 99. ALL-STEEL HAND TRUCK FOR HOLDING GAS CYLINDERS AND WELDING OUTFIT

wide, 3 ft. 3 in. long and 5 ft. 8½ in. high. It is mounted on a 4-wheeled truck 4 ft. 5 in. wide and 7 ft. 8 in. long, with an over-all height of 6 ft. 11½ in., and a weight of 1750 lb. The 100-lb. size is mounted on a truck 9 ft. 5 in. long, 4 ft. 10 in. wide, has an over-all height of 8 ft. 6 in., and weighs 2300 lb. This type of generator consists of a single shell which contains both the carbide hopper and the generating tank. There is no gasometer, the carbide-feeding mechanism being controlled by the pressure of the generated gas against a flexible diaphragm.

The feeding mechanism is positive in action and is provided with an automatic auxiliary no-pressure stop mechanism which closes the feed opening in case the

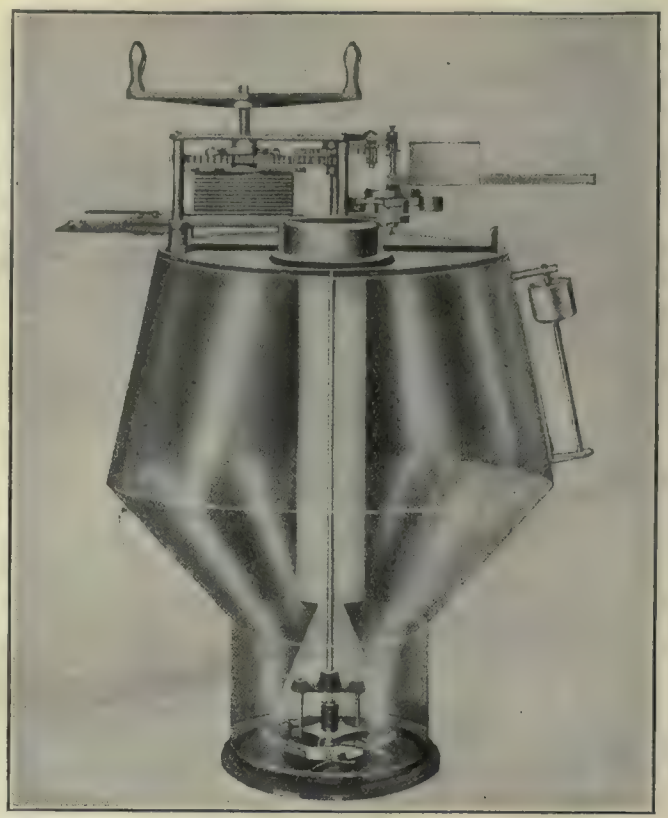


FIG. 100. THE BUCKEYE CARBIDE-FEEDING MECHANISM

pressure in the generator should be reduced to zero through a leak in the line or connections or by reason of any derangement in the controlling device. A locking handwheel positively locks the feed mechanism in its closed position when the generator is out of service or when it is desired to move it from place to place. This effectually prevents any carbide from falling into the water or the water from splashing onto the carbide while the generator is being moved. A complete system

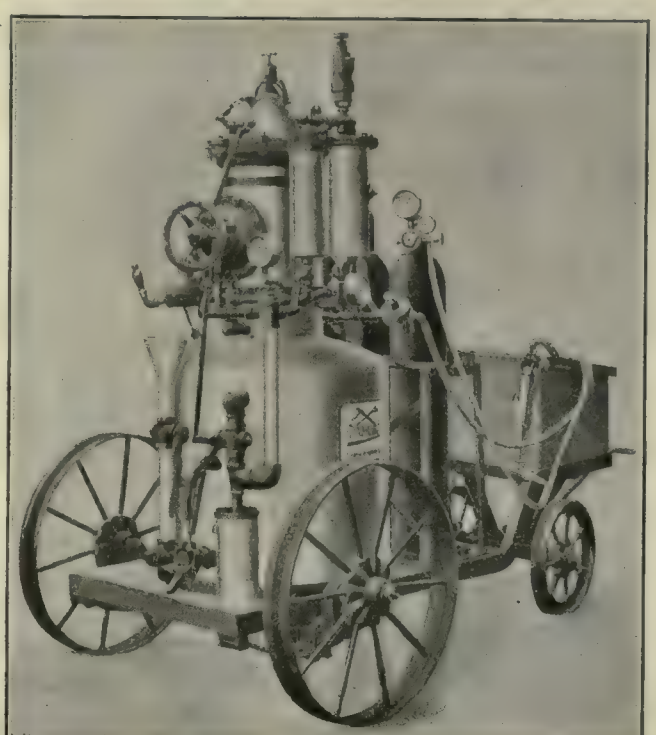


FIG. 101. OXWELD PORTABLE PRESSURE GENERATOR

of interference devices connecting the filling cap, feed mechanism and residuum gate, provides against mistakes in operation. The hydraulic back-pressure valve is of heavy construction and is provided with a pop valve of ample size to carry off any excess pressure. The generator is also provided with a diaphragm relief valve of special design. The filter has a cover which is interlocked with the shut-off cock to prevent the escape of gas when the lid has been removed for cleaning purposes.

The construction of the generator throughout is of a heavy and substantial character. It may be mounted on a 4-wheel truck, as shown in the engraving, or it may be located in a stationary position. Space is provided on the truck for three oxygen cylinders and a tool chest, making the entire equipment self-contained.

This same concern also makes other pressure generators in 200-, 300- and 500-lb. capacities.

Acetylene Generators	Height, Inches	Diameter, Inches	Weight, Lb.
100 lb. carbide capacity	78	30	800
200 lb. carbide capacity	104	36	1000
300 lb. carbide capacity	115	42	1200
Gasometer, 100 cu.ft. capacity	120	76	1500
	Height, Inches	Diameter, Inches	Weight, Lb.
Driers, each	40	16	80
Oil separator	52	6	200
Purifier, 24 x 36 x 74 inches	...	....	800
Compressor, 31 x 36 x 74 inches	...	....	2500

TABLE VII. APPROXIMATE DIMENSIONS AND WEIGHTS OF ACETYLENE GENERATOR SETS

Pressure Generator Capacity	Diameter	Height Over All	Approximate Floor Space	Net Weight	Gross Weight Crated	Dimensions Crated	Motor Weights and Fittings Crated
25 lbs.	18″	54″	4′ x 4′	200 lbs.	300 lbs.	27″x29″x 55″	10 x 10 x 14—150 lbs.
50 lbs.	24″	62″	4′ x 5′	450 lbs.	550 lbs.	34″x36″x 67″	10 x 10 x 14—150 lbs.
100 lbs.	30″	76″	5′ x 6′	550 lbs.	680 lbs.	36″x38″x 80″	10 x 10 x 14—150 lbs.
200 lbs.	37″	104″	6′ x 6′	850 lbs.	1000 lbs.	43″x48″x110″	14 x 14 x 43—400 lbs.
300 lbs.	42″	115″	6′ x 7′	1000 lbs.	1200 lbs.	53″x55″x110″	14 x 14 x 43—400 lbs.
One Torch Unit					60 lbs.	11″x12″x 23″	
Two Torch Units					90 lbs.	14″x15″x 32″	
Three Torch Units					120 lbs.	15″x21″x 32″	
NAVY TYPE PLANTS							
100 lbs.	30″	78″	5′ x 5′	550 lbs.	680 lbs.	34″x38″x 96″	14 x 14 x 43—400 lbs.
200 lbs.	36″	104″	6′ x 6′	850 lbs.	1000 lbs.	46″x48″x110″	14 x 14 x 43—400 lbs.
300 lbs.	42″	115″	6′ x 7′	1000 lbs.	1200 lbs.	53″x55″x110″	14 x 14 x 43—400 lbs.
Gasometer	75″	120″	7′ x 7′	1500 lbs.	1900 lbs.	79″x83″x 94″	(100 c. f. capacity)
Purifier		26″	26″ x 80″	500 lbs.	600 lbs.	30″x30″x 72″	
Dryers	16″	40″	16″ x 24″	80 lbs.	110 lbs.	20″x20″x 24″	(two required)
Separator	6″	52″	12″ x 12 ″	200 lbs.	250 lbs.	14″x14″x 72″	
Compressor		64″	30″ x 112″	2500 lbs.	2900 lbs.	36″x48″x 84″	

An Aid to the Chief Draftsman

By John S. Carpenter

The most of us have heard so much about efficiency that it has become a bore, and one finds that the subject is often the signal to begin yawning when brought up at meetings and conferences. It does not follow, however, that because we have had enough of efficiency that we have exhausted its possibilities. In this article I propose to take to task an old offender who should have "done time" long ago.

It is a fact, regrettable though it is, that the chief is the most inefficient man in the drawing room. He will try hard to get his men to the proper state of efficiency by driving them or by seeking to awaken their interest; but as a rule he does not consider his own working efficiency. Thus it happens that the boss may come in and wonder why it is that the Smith job is not as yet in the shop while the Jones job, which wasn't in any hurry at all, should be already on the cars. Next comes the old story in which the boss tells the chief that he was plainly told to get that Smith job in the shop at once, to which charge the chief enters a general denial.

One of the most efficient and well-liked chief draftsman I ever saw in the course of 14 years in the business made what he called "a work organizer," which helped to explain the secret of his efficiency. I liked it so well that I made one for myself and feel that no drawing room should be without one. It is made as follows and used drawing paper can just as well be utilized as not.

Cut out a top sheet 15 x 12 in. and then cut nine more, all 15 in. wide, but with lengths of 13, 14, 15, 16, 17, 18, 19, 20 and 21 in. respectively. Fold back rather sharply a piece of ½ in. wide on the 15-in. edge of all of the sheets; then fasten the sheets together on the edge opposite the folded tabs so that the tabs project 1 in. over each other. Eyelets are preferable for fastening. Now decide what titles you want lettered on the tabs, the latter being a ready means with which to pick up the sheets. My efficient friend's titles were as follows: "Rush Orders," "Routine Orders," "Repair Jobs," "Propositions," "Revisions to be made," "Under Consideration," "New Designs," and "Supplies to Order."

When the boss gives the chief draftsman an order, he will mention whether it is in a hurry or not, and the papers should then be put in the folder between the proper leaves.

The same applies to all memoranda that usually lie around and cannot be found when wanted. The folder should be gone over thoroughly at least once a day so that its contents are well in mind. In large drawing rooms it will be found profitable to furnish such a work organizer to squad bosses as well, the titles being appropriate to their needs. In this way there should be no excuse for overlooking important items when the whole situation is at one's finger ends.

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Manufacturing the 9.2-In. Howitzer Shell

By S. A. HAND.

(*Continued from Page 801, April 24 issue*)

THE construction of the finishing reamer is shown in Fig. 8, and Fig. 9 shows the gages for the diameter of the straight part of the bore.

Before removing the shell from the boring lathe a single-bladed, flat offset-cutter is put in the place of the finishing reamer and fed up bodily against the shell base. This is done so that the bore shall be the proper depth when gaged from the base.

The gage for this is shown at *A*, Fig. 10, and the two limit marks for length may be seen at *B*. After boring has been completed, the heat and serial numbers must be transferred from the body to the now finished base of the shell, otherwise they would be obliterated and so lost to record in turning the outside.

Having the base finished and the proper depth of hole assured, there is often much surplus stock as to length. This must be removed by facing-off the nose. This is an operation that is not on the list, but was made advisable by a change in the type of machines used for rough-turning and time is saved thereby.

To remove the surplus stock from the nose end the shell is mounted on an expanding mandrel in a heavy lathe and a counterfacing cutter fed bodily against it until brought to the proper length.

Previous operations may not have left the hole in the nose and the bore in the shell concentric with each other. To correct this and to make the hole smooth and within close limits as to size the nose must be rebored. This is done in a Foote-Burt upright drilling machine with much the same equipment as used

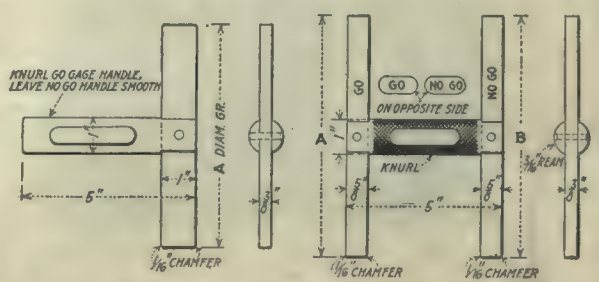


FIG. 9. GAGES FOR DIAMETER

in drilling the nose, as will be seen in Fig. 11. An assembly drawing of this fixture is shown in Fig. 12, which needs no explanation. In place of the jig on the machine column used in drilling the nose, bushings are fitted in the upper ends of the expanding mandrels as

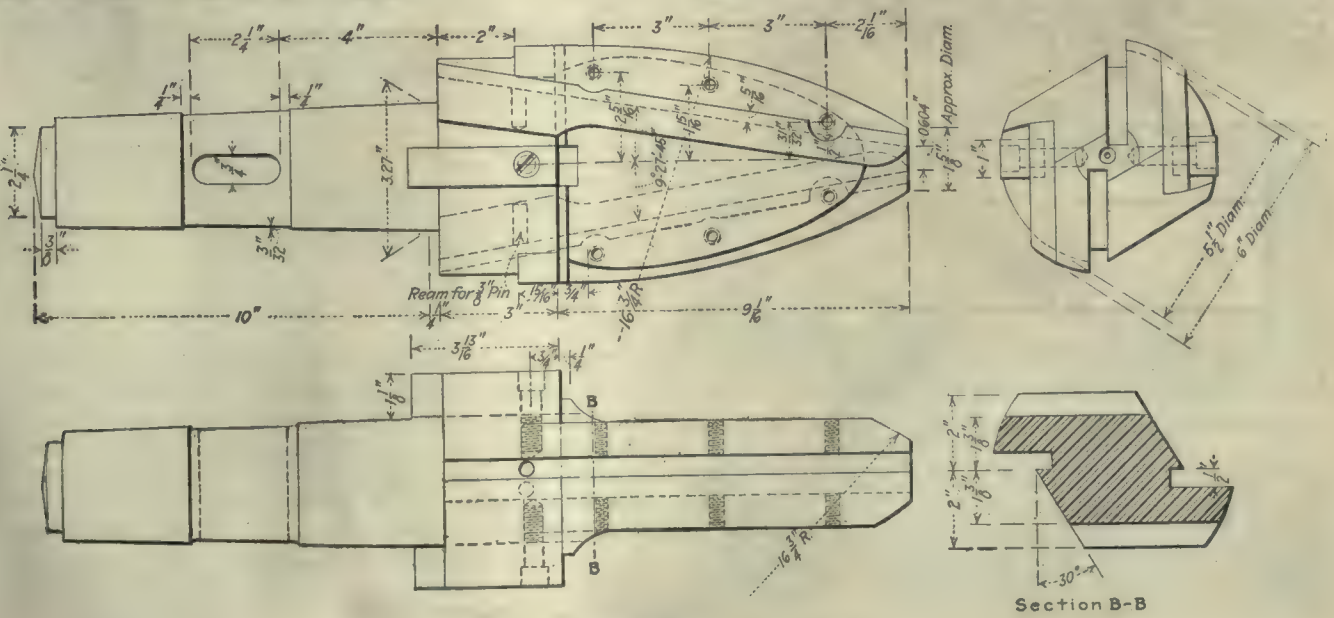


FIG. 8. THE FINISHING REAMER

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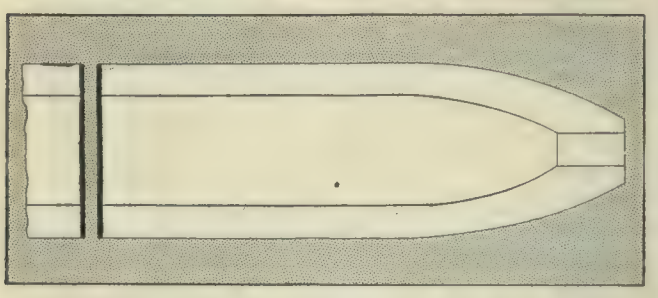
a guide for the boring bar, which is provided with a single-ended high-speed-steel cutter.

Rough-turning, Fig. 13, is done on a No. 21 Amalgamated lathe, and the shell is mounted on a short pawl mandrel having three heavy, wide blades that bite into the interior of the finished bore. The nose end is supported by and revolves on a hardened-steel plug which fits the hole in the nose and is carried by the tail spindle. Heavy graphite grease is used as a lubricant, and there is no appreciable enlargement of the hole in spite of the heavy cut taken in rough-turning.



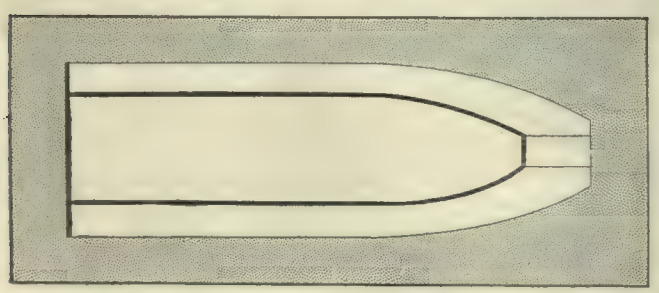
TRANSFORMATION FOR OPERATION 501—DRILL NOSE

Machine—Colburn drilling machine. Number of operators—One. Work-holding device—Lever-operated expanding mandrel. Cutting tool—One $\frac{3}{4}$-in. high-speed twist drill. Number of cuts—One. Cut Data—Speed, 76 ft. per minute; feed, 0.010 in. per revolution. Coolant—Soluble oil. Special Fixtures—Turret with two expanding mandrels on base of machine. Jig for grinding drill on column of machine. Gages—Plug go, 1.656 in.; no-go, 1.676 in. Production—115 per machine in eight hours.



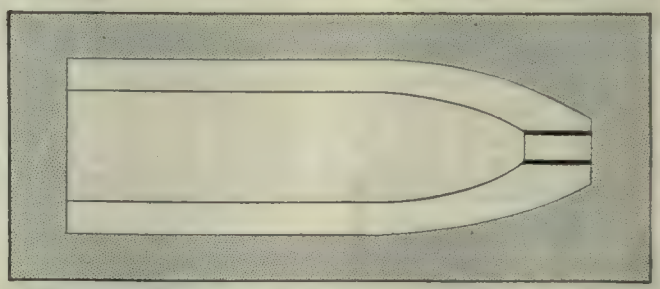
TRANSFORMATION FOR OPERATION 502—CUT OFF TO 24$\frac{3}{8}$ IN. INSIDE

Machine—Williams cutting-off machine. Number of operators—One. Work-holding device—Pot chuck. Cutting tools—Two high-speed cutting-off tools, one at front and one at back. No. of cuts—One. Cut data—Speed, 57 ft. per minute; feed, 0.025 in. per revolution. Coolant—Soluble oil. Special Fixtures—Plug center at rear of chuck to center shell by hole in nose. Gages—Tool-setting and depth. Production—95 per machine in eight hours.



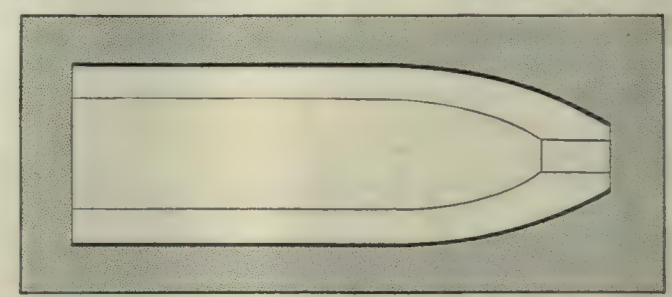
TRANSFORMATION FOR OPERATION 503—ROUGH-AND FINISH-BORE AND FACE BASE

Machine—Amalgamated lathe No. 23. Number of operators—One. Work-holding device—Pot chuck and steadyrest. Cutting tools—Hog-nose drill and finishing reamer both with two high-speed steel blades, one facing tool. Number of cuts—One with each tool. Cut data—Speed, 35 ft. per minute; feed, 0.153 in. per revolution. Coolant—Soluble oil. Special fixtures—Plug center at back of chuck to center nose by hole; plug center in tail spindle to center open end. Gages—Depth with limit lines scribed. Diameter, go, 6.490 in.; no-go, 6.510 in. Production—25 per machine in eight hours.



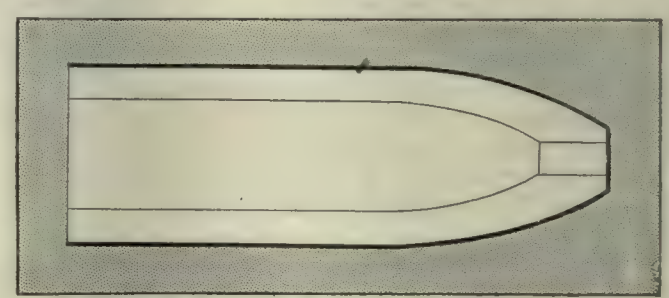
TRANSFORMATION FOR OPERATION 504—REBORE NOSE

Machine—Foote-Burt drilling machine. Number of operators—One. Work-holding device—Lever-operated expanding mandrel. Cutting tool—Single-point high-speed steel, cutter in boring bar. Number of cuts—One. Cut data—Speed, 68 ft. per minute; feed, 0.017 in. per revolution. Coolant—Soluble oil. Special fixtures—Turret with two expanding mandrels on base of machine. Top of mandrels center shell by interior profile and have bushings to guide pilot on boring bar. Gage—Plug, go, 1.775 in.; no-go, 1.785 in. Production—175 per machine in eight hours.



TRANSFORMATION FOR OPERATION 505—ROUGH-TURN

Machine—Amalgamated lathe No. 21. Number of operators—One Work-holding device—Pawl mandrel with three blades that bite into interior; hardened plug center. Cutting tools—Two high-speed steel. Number of cuts—Two. Cut data—Speed, 45 ft. per minute; feed 0.100 in. per revolution. Coolant—Soluble oil. Special fixtures—Tool slide for profile turning nose, swings on pivot; rear pivoted to radius block. Gages—Profile templet; snap, go, 9.260 in.; no-go, 9.220 in. Production—42 per machine in eight hours.



TRANSFORMATION FOR OPERATION 506—FINISH-TURN. AND TRIM NOSE

Machine—16-in. Fairbanks-Morse lathe. Number of operators—One. Work-holding device—Wrench-operated expanding mandrel with three blades; hardened plug center. Cutting tool—$\frac{1}{2}$-in. square Stellite in holder. Number of cuts—One. Cut data—Speed, 142 ft. per minute; feed, 0.032 in. per revolution. Coolant—Soluble oil. Special fixtures—Profile guide at rear of machine. Gage—Snap, go, 9.155; no-go, 9.150. Production—24 per machine in eight hours.

The lathe is equipped with a duplex carriage on which two tool slides are mounted. The slide *A* carries the tool for turning the straight part of the shell, and being of the usual construction needs no further description. The slide *B* carries the tool for turning the nose profile. It is pivoted underneath to a free traveling slide and at the rear to a stationary block fastened to the back of the lathe. As the carriage travels longitudinally the tool slide swings upon these pivots and describes an arc.

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The distance from the central pivot to the point of the turning tool is obtained by adjustment of the tool slide, but the distance from the central pivot to the pivot at the rear is predetermined and established by

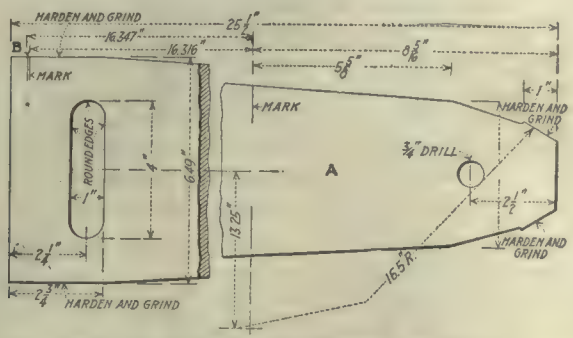


FIG. 10. GAGE FOR DEPTH OF HOLE

direct proportion of the length of the straight part of the shell to the axial length of the nose. It is clearly evident that the radius turning tool, traveling but about one-third of the whole axial length of the shell in the same time the body tool travels the remaining two-thirds, has its feed reduced to about one-half that of the body-turning tool. This is particularly desirable in shell turning, as the feed limit is governed by the excess amount of stock and the greatest eccentricity which is generally found at the nose end. With this arrangement the operator gages his feed by the limits of the tool for the straight cut and the automatically reduced feed of the radius tool will then be well below its maximum limit.

The straight cut on the body of the shell is finished before that on the radius, and an automatic knockout stops the feed at the completion of the latter cut.

Fig. 14 is a detail drawing of the pawl mandrel. The blades *A* are free to move in an angular slot. When their center lines are radial, the tightest grip is obtained. When they are moved 30 deg. ahead of the radial position they release the work. It will be readily seen that a shell placed on this mandrel will be gripped automatically by resistance of the cut against rotation.

The gaging is done while the work is revolving and the wear on the gage points is very great, particularly with green operators, who try the gages oftener than

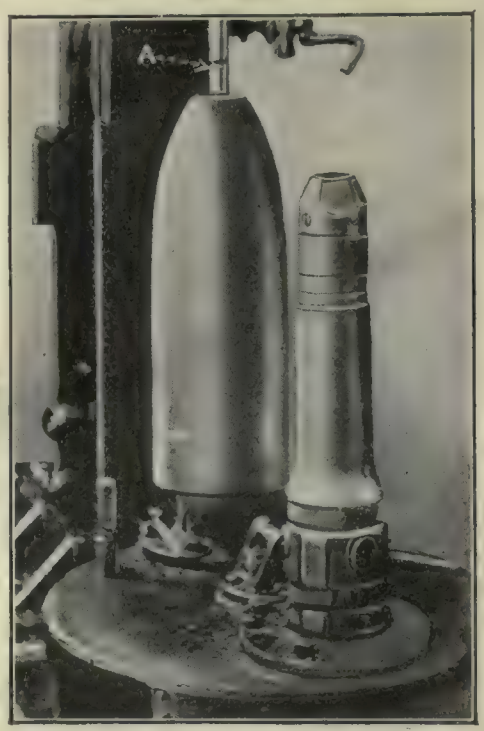


FIG. 11. REBORING THE NOSE

the experienced ones. Green operators often get the gages caught on the revolving shell, with the result that they are either bent or broken. To overcome this difficulty some gages have been made with the contact pins solid on one jaw only. On the other jaw they

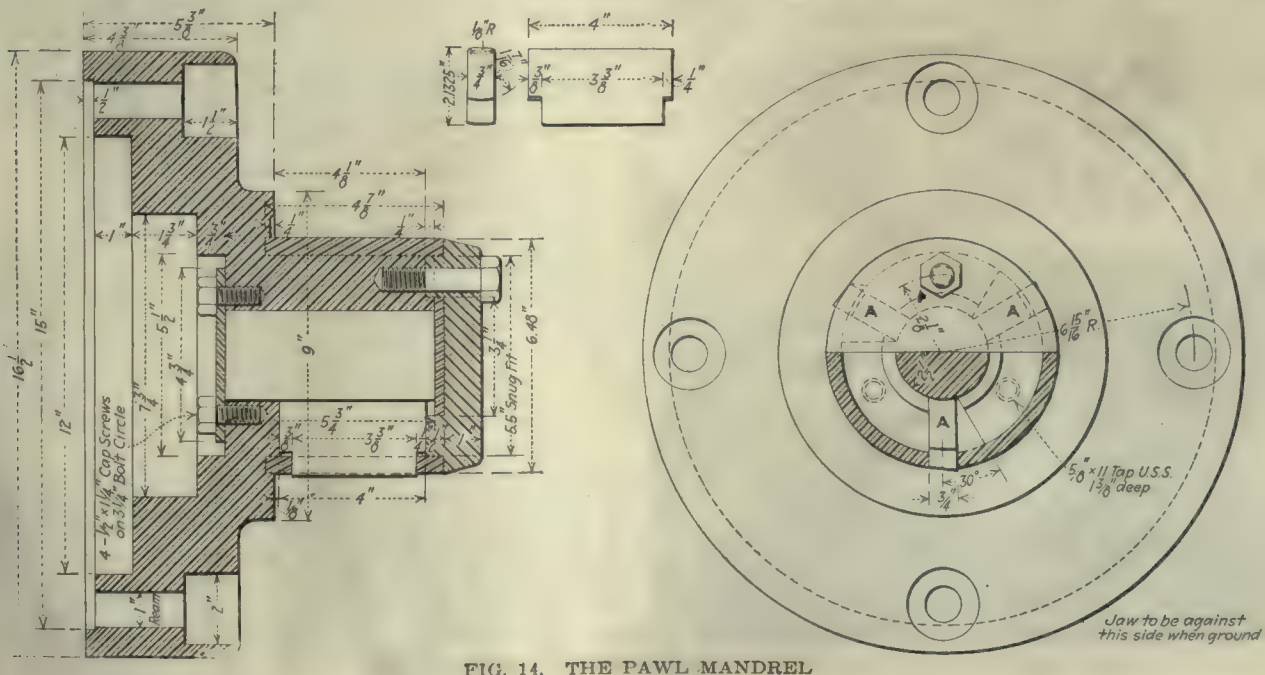


FIG. 14. THE PAWL MANDREL

ARMY ORDNANCE NEWS

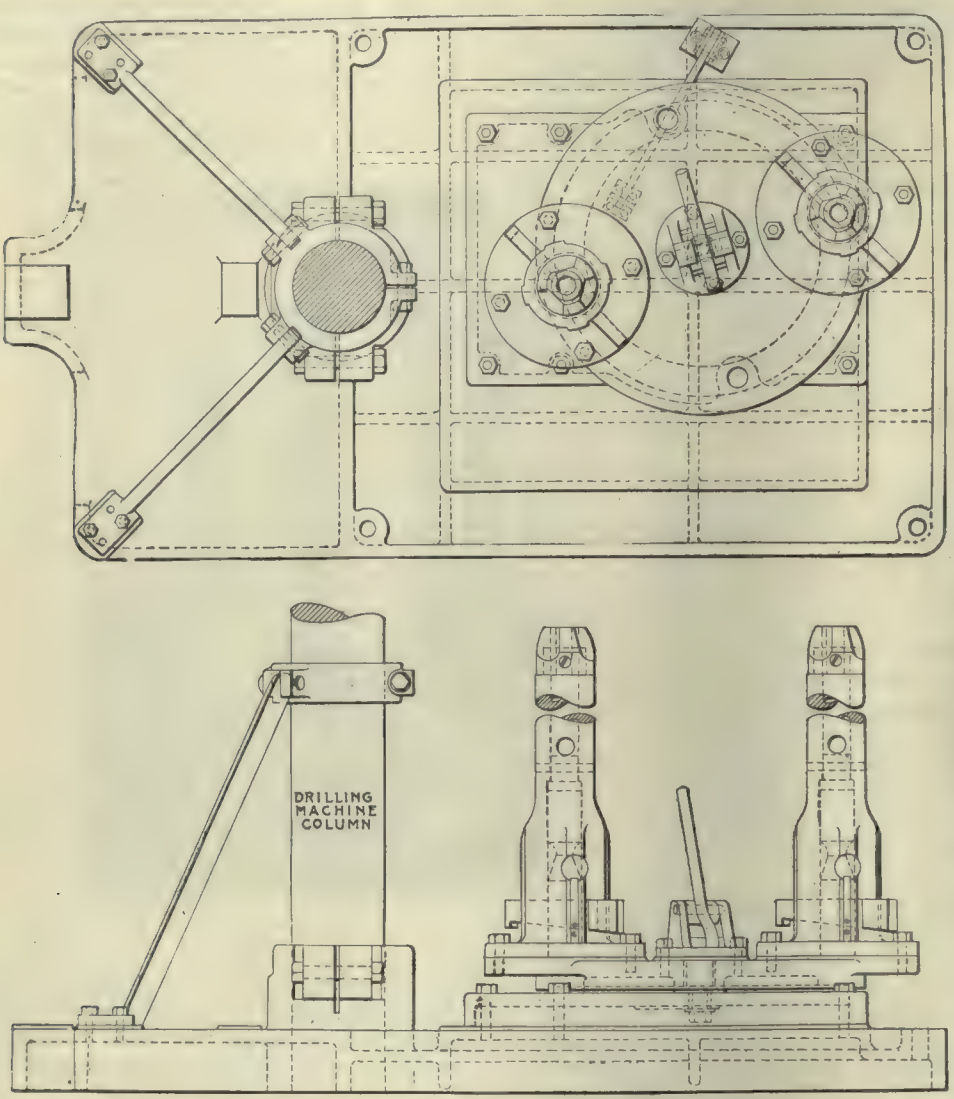


FIG. 12. TURRET FIXTURE FOR REBORING THE NOSE

are pushed out against stops by spiral springs. While gages so constructed are much safer from injury than are solid gages, the experienced operators prefer the solid gages. After rough-turning, the burrs raised on the interior by the bite of the mandrel blades are ground off by the use of a portable electric grinding machine having a flexible shaft. This is done while the shell is on the bench and is necessary for two very important reasons. First, that the expanding blades on the mandrel used for finish-turning will not by any chance rest on the top of any such burrs and so throw the shell out of true, and, second, to prevent premature discharge of the explosive charge.

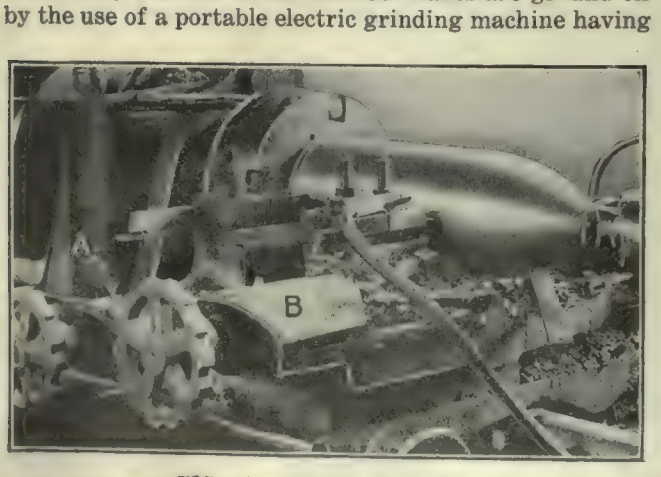


FIG. 13. ROUGH-TURNING

Pouring the Explosive

The explosive charge is poured into the shell when in a molten state and when it cools it shrinks so that it is loose in the bore. In firing the gun the twist of the rifling starts to revolve the shell both rapidly and suddenly. As it is some appreciable time before the inertia of the explosive charge is overcome the shell is revolving around the stationary charge during the interval and any burrs might scrape or cut the charge and generate enough heat to cause its premature explosion.

Finish-Turning

Finish-turning is done in a Fairbanks-Morse 16-in. lathe, and the shell is held on a short expanding mandrel provided with four wide blades expanded by a wrench. These blades do not bite into the interior surface of the shell as do those in the rough-turning operation. As the cut is comparatively light the friction of the blades when tightly expanded against the interior of the shell is sufficient to resist the pressure of the cut. A single tool is used and the lathe is equipped with a profile guide at the rear. A roller attached to the free slide underneath the regular tool slide and engaging in the slot of the profile guide governs the shape turned. The diameter gages are similar to those used in rough-turning. The combined profile and length gage is shown in Fig. 15.

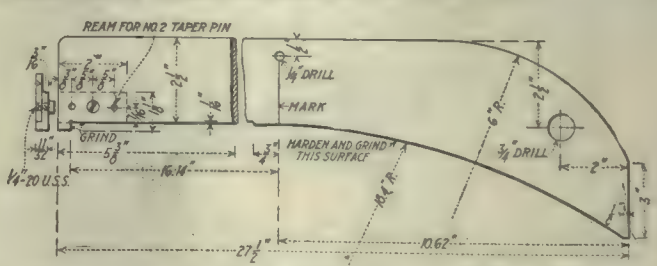


FIG. 15. COMBINED PROFILE AND LENGTH GAGE

Getting a Share of General Machine Shop Work

By L. W. ALWYN-SCHMIDT

Peace-time reconstruction problems are no less engrossing to the machine shop than to the rest of the country. On the contrary they are probably more vital to many a shop which has been working entirely or in part on war work. If your old market has suffered from the war, new work must be obtained in the near future if your organization is to be held together. Your share is waiting if you know how to get it.

THE war has brought to the machine shops of this country a considerable increase in general machine-shop work, with the result that a good deal of new equipment required for this kind of work has been added to the general machine equipment of the nation. Now, when the war has come to an end, there is some heartburning that this additional equipment should go begging for a job or that it may land in the scrap heap. Fortunately there is every chance that sufficient work can be found for all the existing production facilities, provided our machine-shop men are willing to accept it at commercial rates.

So far there is very little evidence of a slackening down in the machine-shop industry. Glancing over the advertising pages of the technical and general press there is no noticeable increase in the advertisements of machine shops looking for work, and manufacturers who can place work of this character do not find machine shops ready to accept new business on short notice. This need not cause any surprise, considering the general situation in the country. It is proposed to complete the original shipping program, and the Secretary of the Navy has only recently announced an additional building program. There is a good demand for industrial machinery from all parts of the country, and the resumption of building activity which is expected in the near future must bring many orders to the machine shops. All this follows historic precedent, most big wars having been succeeded by a period of great industrial activity.

Industrial conditions like those expected to prevail during the next two years always bring much business to the general machine shops. As the influx of orders in the specialized industries becomes too large to be handled by the special shops overflow work goes to the general-construction shops, so that the outlook for this branch of the industry seems to be very favorable. What can the individual machine shop do to attract that part of the general machine-shop business which it is able to carry?

General Machine Shop Sells Service

Campaigning for contract work is always a difficult matter for a general machine shop. A machine shop of this character is very much in the position of an ordinary wage earner. It hires its services out to others who want to pay for it, but the quantity of these services is limited by the size and equipment of the shop. Dependent upon the capacity of the equipment is also the earning power of the establishment. Here again the comparison with an ordinary workingman holds good. Having only one pair of hands he can not multiply their productive capacity, but he can improve upon their efficiency by using his brain. As the increase in brain efficiency enlarges the income of a man, so quality of output may add to the earning capacity of the machine shop. It is well worth while to keep this in mind because the lessons to be learned from it must form the basis of all business-promotion work of the average machine shop.

The limitations put on the output and turnover of the establishment by its size and equipment also limit the exertions that can be made for the purpose of obtaining new business. Take, for instance, an establishment able to turn out $100,000 worth of labor, which means approximately $16,000 profit, the profit in such shops of course varying a good deal with the character of the work. Such a shop can hardly spend more than $4000 on the acquisition of new work, and it cannot make use of more work than it is able to handle. The effort therefore must correspond to the results that are desired. It should neither be too small and court failure nor should it exceed reasonable limits in cost. How to attain the proper balance is a problem which so far does not seem to have found a satisfactory solution.

Two Principal Talking Points

The man in charge of the trade-promotion end of a general machine shop has two principal talking points. One is the efficiency of the equipment of the shop, the other the quality of the expert knowledge of its engineering staff. These two he must play for all they are worth. If he does his work well he knows that he is bound to get his share of the general trade coming into the market. He certainly will get business during a time when much engineering work is in demand. He may, however, be less successful in times when work is scarce. Then he will have to show his mettle and ordinary business methods will not succeed. During busy times engineering contractors will be glad to get any sort of shop to do their work, but only the most efficient and well-conducted enterprises can count on keeping going fully when business slows down. It is, however, during such times that machine shops are putting forward their best effort to get new work.

The head of a small but perfectly organized general machine shop doing practically only job work once explained his business-promotion policy to me as follows: "During normal times or when business is active and there is a great demand for engineering we follow the general run of the market and take everything that comes along at a paying rate. We simply advertise that we are ready for taking work. During slack times we specialize. We tell the people that we are doing something better than others, and we pick our orders from a small but well-paying field." This is business wisdom for the engineering shop in a nutshell. It explains why general advertising pays during busy times but brings little return when business is slack all round.

Business at the present moment is still brisk, and

trade-promotion work in the machine shops therefore may proceed on general lines. The advertisements appearing in the press announcing the willingness of engineering shops to accept new or additional work for this reason seem to be the correct way of procedure. They must bring some results and they probably will bring enough work to keep the shops busy and allow the continued employment of the additional equipment.

The wise machine-shop manager, however, looks ahead for the time when business will not be as brisk as it is today and when active promotion work will have to be done to get new work for the machines and men in his charge. To slacken down with production work is a dangerous thing. Not only is it a loss to the establishment to have its machine equipment idle, but the value of a machine shop as a job worker often depends on the training and quality of its labor force. To keep the latter together necessitates continuous employment. A man who knows that his job has the chance of permanency is a better worker than the one who fears being laid off, and the men find out quickly enough how they are placed in this respect. It is a well-known fact that a permanent job commands a better type of men than an occasional one.

The Machine Shop With a Policy

The first step to be taken is that of deciding on a policy to be followed in the general trade-promotion work of the shop. Most shops go along without a special policy. They manage with one or two outside men whose business it is to keep things going and who are asked to do some more hustling when things get slow. The reputation of such shops is rarely their own. If they are left suddenly by their outside men they find only too often that the good-will of the concern belongs entirely to the salesman and leaves with him. It was the personality of the salesman which carried the trade, and the fact that he was well backed up by the shop had very little weight with the customer. A machine shop therefore should have a policy of its own. It should be, in the imagination of the customer, not a thing far removed from personal contact but a live entity with a will of its own. It should have a personality independent of the personal force it exerts by way of its salesmen. To give a machine shop such a policy often requires a genius, but it can be done. Buying engineers often have an instinct of discovering the shop with a policy by merely handling a part made in such a shop, and the shop which has gained this distinction has rarely to go begging for work. It is soon known all over the market.

A distinctive policy can never be carried through by a machine shop unless it has at its disposal first-class engineers, men and equipment. All must be in sympathy with the aims to be attained. It may be the policy of the shop to take only high-class work or cheaper work, or both. It does not matter much which policy is adopted; the principal condition is that the policy once established must be carried out.

If it does not matter what policy is selected why trouble at all about selecting one? Why not go along in a happy-go-lucky fashion and pick up what comes along in the way of a job? The answer to the question is decidedly to "do as you please" as long as you stick to your purpose; but not to hold yourself out today as taking only first-class work and run tomorrow after a cheap job of some sort. There is a psychological influence at work in the mind of the customer which acts in favor of the shop with a declared policy. The customer having some cheap work to be done will call on Walter & Co. because he knows they are handling that kind of work, or he will go to Smith Bros. because he knows they take anything as long as it pays. But he will not call on Miller & Co. who said they would handle everything and then told him they would take only first-class work.

Powerful Factor in Distribution

This disposition of the buyer is a powerful factor in the distribution of general engineering work all over the world. It has succeeded for years in bringing a good deal of first-class work into the machine shops of England, and it has turned much cheap work in the direction of Germany. If a machine shop declares itself for a policy it is bound to get a regular share of all the general contract work that is available.

Like labor general contract work seems to be a commodity for which there is always only a certain limited demand. This demand depends on conditions over which neither labor nor the general contractor has any particular influence. If the demand is filled neither low prices nor any other inducement will help to expand it. But whether the demand is large or small it is always graded in standards. There is a demand both for first-class and cheap work. Both have a tendency to flow to him who holds himself out as being particularly fit in one or the other direction. The undecided gets only what is left over after the shops with a declared policy have got their fill. To possess a production policy is a real and valuable asset in the good-will of a machine shop.

Driving Home Your Point With the Customer

Having once decided upon a policy the next step to be taken is to make known this fact and to connect with firms likely to have use for a shop of this particular customer. The policy of the shop therefore should not only be made a talking point with the outside men, but it should also find expression in the advertising and general publicity of that shop. Most up-to-date engineering and general machine shops are doing today a certain amount of technical-press advertising.

Considering the large amounts of money which are spent annually for this purpose it is often astonishing to see how little many firms are making out of the space they hire. Advertisements containing a mere general wording such as

Miller & Co.
Engineering and General Machine-Shop Work
X St., X City.

are frequently seen. Such an advertisement conveys little to the reader. It does not give an impression of the size of the shop, its capacity and special character; in fact it leaves no impression at all. It is forgotten as soon as read and will rarely be referred to if the reader should some day require the service of a machine shop. There is much reason to believe that advertising of this character does not pay.

To make general machine-shop advertising an effective medium in the general sales campaign of the shop

the advertisement must carry a certain distinction, as for instance:

Miller & Co.
General Engineering Works
X Street, X City.
We are open to undertake special work of a high-class character beginning from Jan. 15, 1919.

There is a suggestion in this advertisement of dignity and prosperity. The new work can be accepted only after a certain date, which implies that the shop is busy at present. For permanent advertising wording similar in character should be selected. So, for instance, runs the advertisement of a well-known British-Colonial engineering shop:

Quality in Machine-Shop Work.
Our force of 200 men supported by the most modern equipment of European and American machine tools working under the supervision of well-trained construction engineers is at your service.
Write for our booklet, "Shop Service."

This booklet, "Shop Service," is sent free of charge to all who ask for it. It is a 24-page affair in a stiff cover and well illustrated. Its contents impress the reader that the work done by the firm is accomplished by a first-class organization of engineers supported by a first-class shop. To convey this impression photographs are reproduced showing the offices and the workshops of the establishment. There is a list of all the principal machine tools found in the various shops, some of which are shown in illustrations, and one section of the booklet is reserved for a description of the general welfare work of the firm among its employees. The whole publication leaves with the reader the feeling that he deals with a well-conducted establishment and that he places his interests in able hands when he transfers his custom to it. Service being the principal commodity sold by the machine shop to its customer the quality of service is the mainstay in the advertising campaign of this firm.

The offer of service, however, is only acceptable to the customer if services are just then required and if the character of the service is of that kind which is needed by the customer. The advertisements in the technical press reach a great number of readers only a few of whom can be interested in the special offer of that shop. And among these few there are only a still smaller number which may have a use for the special character of the service provided. It is this small number of likely customers which the advertisement must attract. Therefore it cannot be too personal. It must convey in the small space that is available the whole character of the advertiser and tell the reader that this is the shop he must connect with if he wants to have his work well done. This impression of personality and character must further be strengthened by the personal appeal of the outside men. They must drive home the policy emanating from the advertisement so that it is finally settled in the mind of the prospective customer.

What applies to the talk of the salesmen, to the advertisements and to the advertising literature applies with equal force to all other forms of active propaganda: to letter heads, to the paper selected for these, to the style of the letters, even to the conversations over the telephone. All tend to create a certain atmosphere, the existence and strength of which must decide what the share of the establishment in the general contract work in that particular market will be.

All this work naturally is done with one aim in view—that of attracting the right sort of work to the shop, meaning that sort of work for which it is particularly equipped and which therefore it will do best. To connect the demand with that source of supply which is best fitted to satisfy it is the big problem of all commercial activity. Everything that can be done to facilitate this meeting will aid the general efficiency of the nation.

The clever business-promotion engineer will know the abilities of his plant. To be entirely successful he must also know his market. He must know which of the many possible customers for the services of his organization are likely to be most interested in the particular quality of the services that can be rendered. As already explained there is as a rule little trouble in finding the right work during generally busy times. This then is the proper time for collecting all the information that will be required in the future. When business slows down and when specialization in production may become advisable it is of advantage to know beforehand which field is likely to bring the best orders and holds the best prospect for permanency of employment.

To facilitate this selection a trade index is of considerable value. The preparation of such an index by itself is not a difficult matter. First a list is made of all likely customers in the district or the special market of the machine shop. Some discrimination will have to be used during this part of the work in order to include in this list only those names which give a fair promise for later success. If every advertising manager would go to the trouble of studying all his prospects he would be astonished how small their number really is and how large an amount of money is wasted every year by mailing advertising matter to firms which hold a very remote prospect of becoming customers. The original list of prospects therefore has to be cut down a good deal until a working list of a few thousand names is established, which, by the way, represents a fairly good-sized market.

Creating Additional Trade Outlets

The special wants and conditions of each of these firms must be made the subject of an intimate study. The outside men of the shop must be instructed to collect all possible information on each, as, for instance the character of the work done by the prospect, its commercial connections, its machine equipment if it is a manufacturing firm, the standard of the engineering staff and similar points likely to be of interest in the future approach of the prospect. All this information is carefully indexed and preserved for reference. It takes some time before such an index can be provided, and the work on it naturally never ceases. New prospects will have to be added constantly and others withdrawn.

The firms indexed in this way are the trade outlets of the shop; they form the immediate medium by which it hitches itself to the general prosperity of the country. The rule of averages tells us that if we work persistently on a certain number of firms which in their

character are such as to hold a promise of later business, a part of their business must finally accrue to us. This effort must consist in having each of these prospects visited at certain intervals, in order to offer the rule of averages a chance to work in favor of the shop, and in a judicious use of the mails. Let the mail campaign be uniform with all your other campaigning methods; let it be a permanent expression of the shop's policies. Only a few days ago I received from a Western concern a New Year's greeting which, out of a pile of similar greetings, will not be forgotten for quite a while.

SELECTING PROSPECTS

It was a short greeting, a welcome to peace worded by a gifted writer, with a direct human appeal in it, printed in a distinctive type on a high-class bond paper. It wound up with, "We have done our duty to the nation. We are now released by the Government and we are ready to accept other work again. Our equipment, largely extended during the last years, is as perfect as can be. It is at your service."

High-class printing entails considerable expense. Hence the necessity in the interest of economical advertising of not wasting it. Therefore pick your prospects well and concentrate your efforts. There are only a limited number of firms which have use for your special service, but there are also only few machine shops which can render the identical service provided by your organization, so the interest of establishing a connection is mutual.

The man in need of your service will be only too grateful if you bring it to his notice. This is especially true if the customer has some special work to be performed. It is a good plan therefore to keep a watch on all public work coming in the market. Much of this work is contracted for by public contractors, and later part of it is subcontracted to firms especially fitted to do the particular end of it. To approach a firm of this character just at the moment when the issue of the subcontracts is contemplated means entering the field at the psychological moment, when there is most chance to obtain the order. To know those among one's prospective customers who have taken on public work or any other large work likely to require outside assistance is of great help in getting business of this sort and must be made part of the general trade-promotion work of a general machine shop.

In all these cases it is always best to approach the likely customer with a ready-made offer stating exactly what particular service can be rendered by the shop and why the shop is especially suitable for that purpose. It is in just such a case where having an established shop policy comes in most handy. No long explanations are required. The customer is inclined to take the view of the shop's representatives because subconsciously he is convinced of the ability of the shop to do the work. The policy of the shop impressed upon the prospect by the earlier campaign scores.

Getting a share of the general contract work means nothing but giving an engineering shop that place in the general industrial activity of the nation to which it is entitled by its equipment and the character of its service. Keep moving and go with the market. Get a reputation for the kind of work done in your particular line and orders soon will take care of themselves. It is by way of the live wires that the nation's business is conducted.

Incorrect Lead of a Die

BY J. B. GRAY

On page 634 of the *American Machinist*, O. F. Kuhlman tells of a threading job on some $\frac{7}{8}$-in. studs, wherein the die cut a lead less than itself. Mr. Kuhlman, however, merely states the matter as a sort of mechanical curiosity, and as he offers no explanation he may be somewhat mystified by the action of the die. If so, the following is the "reason why": The lead of the die itself was no doubt quite correct and the trouble was due altogether to the stock being threaded.

It is one of the peculiarities of dies of all kinds that if the stock being threaded is a trifle large as to diameter, the die will crowd, so to speak, and while it will pass over the work, a nut of corresponding pitch will not. As Mr. Kuhlman speaks of having obtained all kinds of fits, it is probable that his lathe hand turned down the pieces and roughed out the threads rather carelessly, and the difference in the fits obtained from the die vary in accordance with the variation in the studs from the lathe.

The $\frac{7}{8}$-in. studs should have been turned down to about 0.865 in. or even a few thousandths under, and that would have compensated for the tendency of the die to force the stock up between the cutting points, thus increasing the diameter of the work. If a number of studs have been carelessly roughed out the amount of stock crowding the die will not be the same and the tendency to retard the die will vary, causing the die to finish threads more or less incorrect as to lead.

I have had this same difficulty not only with hand dies but also with die-heads on screw machines, and I have always found that oversize stock will result in a false lead, while stock that is slightly undersize will thread nicely.

Mr. Kuhlman is really lucky; I have seen screw-machine dies lose one thread in a 2-in. run, due solely to the stock being six or eight thousandths over size.

Should the Loose Pulley Be Smaller in Diameter Than Its Mate?

BY H. D. BLOCK

I have noticed that nearly all countershafts furnished with new machine tools are equipped with the tight and loose pulleys of different diameters. This custom, I believe, is bad practice by reason of injury caused to the belts when they are shifted. While it is true that the bearings are relieved when the belt is on the loose pulley, this does not offset the loss caused by injury to the belt in climbing over the step, or loss in output of machine through slippage caused by loss of contact on the pulley when the edge of the belt is stretched.

In most all cases the countershaft with tight and loose pulleys of the same size will give better results and prove to be the most economical. A belt does not have to be very tight to pull properly if it is kept clean and pliable and proper attention is given to the lubrication. If machine manufacturers would experiment with both kinds of countershafts, they would soon conclude that making the tight and loose pulleys of a different size is good for the belt manufacturers only.



Combination Tools

By W. P. Lotz

Combination tools of various sorts are in common enough use to make comment on their advantages unnecessary. Three examples of this type of tool which have been satisfactory are shown in the figures.

The combination drill and counterbore of Fig. 1 was designed to save time by eliminating spindle changes and is applicable to lathe or screw machine. The drill shank runs through the counterbore and is held in by

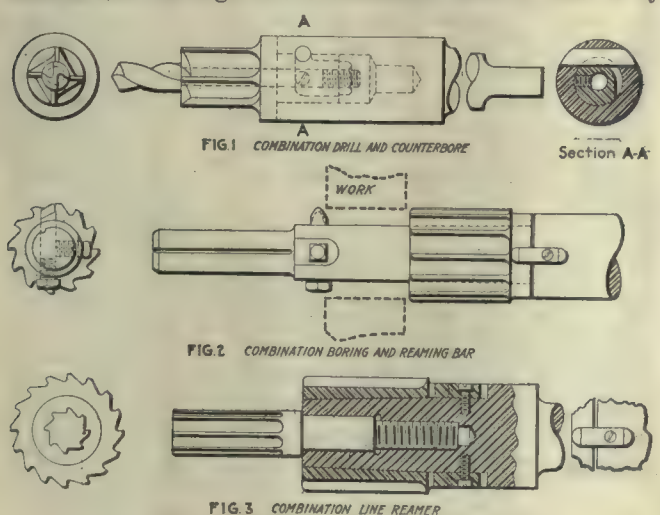


FIG. 1 COMBINATION DRILL AND COUNTERBORE

FIG. 2 COMBINATION BORING AND REAMING BAR

FIG. 3 COMBINATION LINE REAMER

FIGS. 1 TO 3. SOME COMBINATION TOOLS

Fig. 1—Combination drill and counterbore. Fig. 2—Combination boring and reaming bar. Fig. 3—Combination line reamer

a nut on the threaded end which should have the threads carried down far enough to allow the drill shank to enter the counterbore as material is removed from the latter in sharpening. The drill is kept from slipping by the small setscrew which bears on the flat, and the counterbore is held in the shank by a device which acts in the same manner as a bayonet lock and must be given a quarter turn to the left before it can be removed.

Fig. 2 shows a combination boring and reaming bar which was used in a turret lathe but which could be adapted to use in a drilling machine or boring mill by the addition of a fixture and end support. The pilot on the end of the tool reaches in to a supporting bushing in the spindle. The boring tool is a single-point tool backed up by an adjusting screw and held by a setscrew as shown, and the ordinary type of shell reamer with a taper hole is locked in position by driving keys. To prevent chatter marks the boring tool must be far enough ahead of the reamer so that it has cleared the work before the reamer starts.

On jobs which call for different sizes of holes in line a properly designed combination line reamer saves time and increases accuracy. Fig. 3 shows such a tool with a shell reamer mounted on a taper and held by locking keys as in Fig. 2. The smaller reamer has a straight shank which fits a ground hole in the tool body and a threaded extension which screws into the tapped hole shown. The difficulty in true lining up of the two reamers usually encountered in making tools of this sort is not met with in this design, and the replacement feature makes it much more valuable than the solid combination tool which must be discarded when one reamer is worn out.

A Micrometer of Early Vintage

By Ellsworth Sheldon

While the micrometer shown in the accompanying picture is not exactly a pioneer it was made in the days when such tools were rare. Micrometers were first made commercially in this country in 1867 by the Brown & Sharpe Co., so that the maker of this one probably had one of them as his model, but the fact that a really



AN EARLY MICROMETER

serviceable tool of this nature was made as early as 1874 in a shop whose principal business was the building of steam engines and mill machinery is worthy of note.

The frame of the micrometer, together with the barrel, is sawed from a block of tool steel, the piece being then swung up to turn the barrel, and bore and tap for the measuring screw. The frame is split at the threaded part and fitted with a transverse screw for adjustment. The thread of the measuring screw is exposed as in the commercial tool of that period, the desirability of protecting it not being then so apparent as it became later.

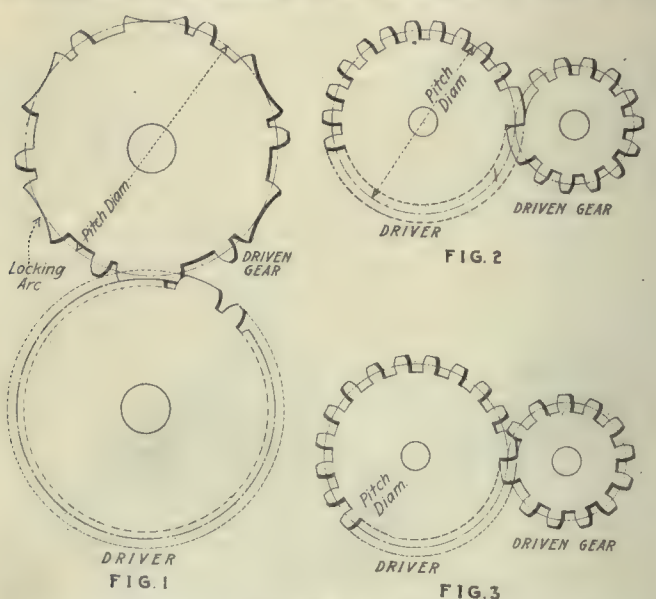
This micrometer was made in 1874 by Mr. F. W. Horstman, Sr., who at that time was employed as a foreman by the Hewes and Phillips Iron Works, Newark, N. J., with only the regular tools and appliances then in use in such a shop. While it has seen long and honorable service, it is now retired, and reposes in a cozy corner in the safe of the F. W. Horstman Co., Newark, N. J., who will be glad to show it to anyone who may be interested in its history.

Strengthening Intermittent Gears

By S. H. Yorks

In the operation of intermittent gears the teeth that first come into mesh at the end of a period of rest of the driven gear are subject to a severe shock, and in the application of this type of gearing to certain machines this sudden contact between moving and stationary teeth causes such abnormal wear that it is important that this condition be taken into account in the design of the gears. A successful method of taking care of the difficulty is to make the teeth that receive the shock two or three times the thickness or size of the regular teeth. This can be accomplished in either one of two ways, as illustrated in Figs. 2 and 3 of the illustrations.

With the type of gearing in which the driven gear is provided with locking arcs, as shown in Fig. 1, a



FIGS. 1 TO 3. SHOCK TEETH FOR INTERMITTENT GEARS
Fig. 1—Large tooth applied to gears using locking circle. Fig. 2—Large tooth on both driving and driven gear. Fig. 3—Tooth with extra large pitch milled on each gear.

large tooth on the driver may be made by cutting the first space, then indexing for the next space without cutting, and then indexing and cutting the next two spaces. This provides the driver with a tooth having a thickness on the pitch circle three times that of the ordinary tooth. The shock on the driven gear is taken by the part of the gear forming the locking arc, which becomes in reality a large tooth. A large space is cut into the driven gear to accommodate the unusually thick tooth on the driver.

This method may also be applied to gearing of the type where the driven gear contains a full number of teeth and no locking arcs, as shown in Fig. 2. In this case a large tooth must be provided on each gear and a large space must also be provided on the driven gear to accommodate the large tooth on the driver. This space can be formed by cutting the teeth in the regular manner and afterward milling out the large tooth. The large teeth will roll on each other exactly as the ordinary teeth do.

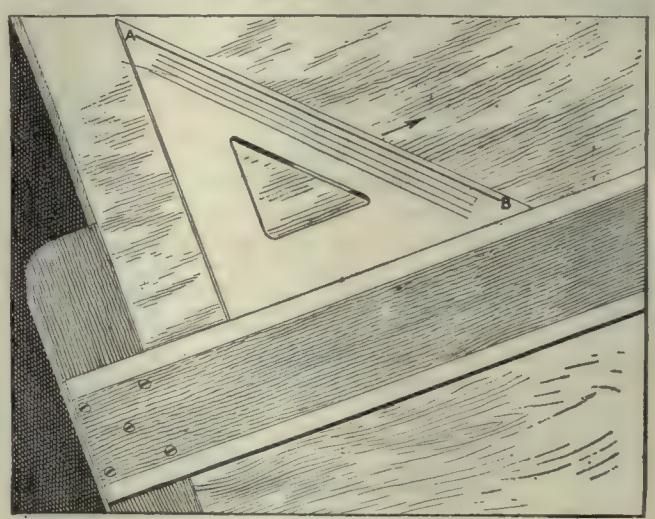
The second method of taking care of the unusual stress on gears of this type is to cut on each gear a large tooth of two or three times the pitch of the ordinary tooth and consequently of greater strength, as shown in Fig. 3. These teeth are cut on the same pitch circle as the ordinary teeth and a large space is provided on the driven gear. This type of gearing cannot be used, however, where a locking arc is employed as in Fig. 1, but is used where some other device is made to prevent the driven gear from moving during its period of rest.

Section Lining Kink

By A. E. Kipps

I have used the kink described below for a number of years and have found it very handy.

I scratched a line along the edge of my 45-deg. triangle, as shown at *AB* in the sketch, at a distance



EVENLY SPACED SECTION LINES

from the edge equal to the space required between the section lines.

When the first line has been drawn the triangle is moved in the direction indicated by the arrow, until the line on the triangle coincides with the first line. The second line may now be drawn, and so on.

This method insures even spacing and is also quicker than the old way.

Removal of Safety Device

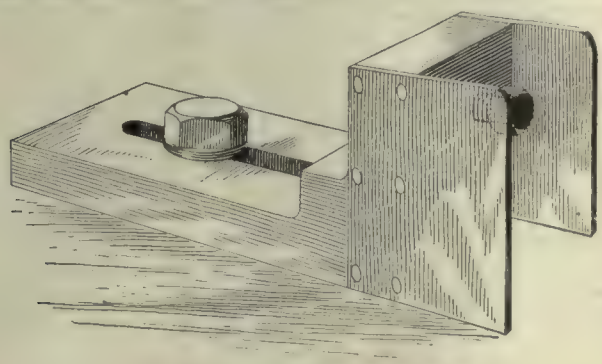
By H. J. Gustav Kopsch

On page 396 of the *American Machinist* is a letter entitled "Operator Removes Safety Device," by James Forrest, in which the author shows some exasperation at what he terms the "cussedness" of the operator.

It is of course extremely annoying to men who are to be held responsible for accidents occurring under their supervision, especially if they feel a moral responsibility as well for the safety of the workers. However, there are two sides to a problem and a safety device that involves extra work on the part of the operator, especially

if he is paid by the piece, is of doubtful value and is usually removed as soon as the supervisor's back is turned. I have found by experience that, next to safety, convenience is the main feature of protective devices and this consideration should be always in the mind of the safety engineer.

In the case of the chuck jaw shown by Mr. Forrest, why not have a jaw designed as shown in the sketch?



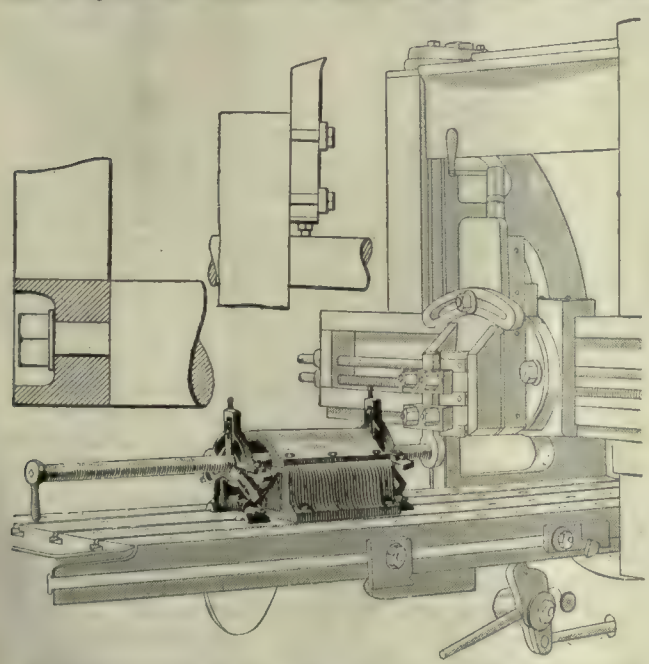
SAFEGUARDING THE CHUCK

The ribs would perform the double duty of strengthening the part and partly enclosing the screw which was the source of danger. If it is not desirable to make new jaws, why not screw pieces to each side of each jaw to project beyond the screw head? The connecting piece with the hole in it as shown by Mr. Forrest is superfluous in that it does not materially reduce the hazard and it does make the operation inconvenient.

Large Work with Improvised Tools in a Small Shop

By Miles C. Smith

The other day I was going through a small jobbing shop when a peculiar-looking device attached to one of the planing machines attracted my attention and I stopped to see what it was. Upon asking the manager-foreman who was with me what it was he answered that they were boring a large bearing that had been sent to him from one of the large shops in the city for the reason that the city shop had no lathe large enough to swing the job and it was considered too accurate work for an ordinary vertical boring mill. The cut will serve to show the equipment used and make clear the way in which the job was set up.



BORING A LARGE BEARING ON A PLANING MACHINE

The work was bolted to the table of the planing machine and a long bar was so attached to a holder held in the toolpost that the bar could be turned by means of a wrench, applied to the squared outer end. At either side of the work the bar was held from springing by a steadyrest and a casting fastened to it by two pins answered for a tool block. The entire equipment had been picked up here and there about the shop and had been fitted up for this job very easily, the only uncommon part being the device which permitted the bar to turn.

I waited until the job was ready for a cut and watched the procedure. It was very simple; in fact all there was to it was a series of light roughing cuts fed around by the operator with the wrench in hand. Then when the bore was within one-sixteenth of size the roughing tool was replaced by a radius tool ground to a radius just enough smaller than the radius of the bore to keep the corners of the tool from dragging, and I have never seen a smoother or more accurate job than was left after this tool had taken its second cut.

While this may seem a long way around to do a job, if you consider that no boring mill of any sort was available and no lathe large enough to swing the work, you may realize that the man who had taken the job and made a success of it deserved a little more credit than the fellow who sent it to him from a modernly equipped plant.

Adapter for Inside Micrometer

By Fred W. Stalker

The adapter shown in the sketch when used in connection with an inside micrometer saves a lot of



EXTENSION FOR INSIDE MICROMETER

chasing after the shop vernier, and with three pins and three sleeves permits several men to use their own "mikes" for work that ordinarily would call for the vernier.

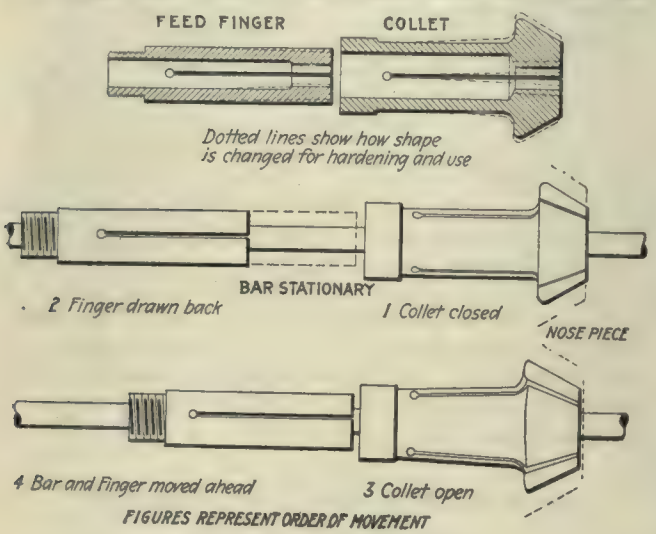
The Bar Feed on Automatics

By Donald A. Hampson

A question frequently asked by men being instructed in automatic screw machine operation is, "How does that bar feed work?" Out of sight, this movement cannot be traced while running as can others whose parts are exposed. It is therefore not surprising that the apparent self-movement of the bar excites interest.

An excellent simile of the feeding principle is presented by grasping a bar of steel in both hands and going through a few simple movements. Let the only movement of the left hand and arm be the opening and closing of the fingers. When they are open, shove the bar forward with the right hand and arm. Close the left hand on the bar with a tighter grip

than the other hand so the bar will stay in place, then draw the right hand back along the bar to the original position. That is the entire cycle of movements. In the screw machine, the left hand is represented by the collet. Its duty is to drive the bar during the working period just as it would be driven by a universal chuck. When the collet is released, it opens sufficiently to allow the bar to be moved through it without hindrance. The collet is released only long enough for the feeding to take place. The feed finger or shell corresponds to the right hand. It grips the bar hard enough to move it against the resistance imposed by weight and friction but not hard enough to move it when the collet closes. Thus the feed finger may be drawn back over the bar at any time during the cutting operations, setting itself in readiness for the next stock feed when the collet opens. The feed finger must remain stationary until the collet has



DETAILS OF FEED MOVEMENT

closed or the bar would be drawn back into the spindle and the feed be short. Advantage is taken of the finger slipping to always insure a full length of blank. The speed of the machine, chips or a crook in the bar may cause the feed finger to slip a little on the forward stroke, resulting in a short piece if the feed were set exactly the length of the piece, but by setting the machine to overfeed and letting the finger slip when the bar strikes the stop, a full length is insured.

Tubes, passing through the spindle to the visible cams and forks at the end of the machine, control the movements of the collet and feed shell to any desired camming. The collet is practically stationary in a longitudinal direction, a sixteenth of movement or less being ample for its release; its own "spring" and the taper of the nose end cause it to open. Return of the feed finger is always through a cam movement while the forward, or stock feeding, may be either by cam or the action of a coil spring.

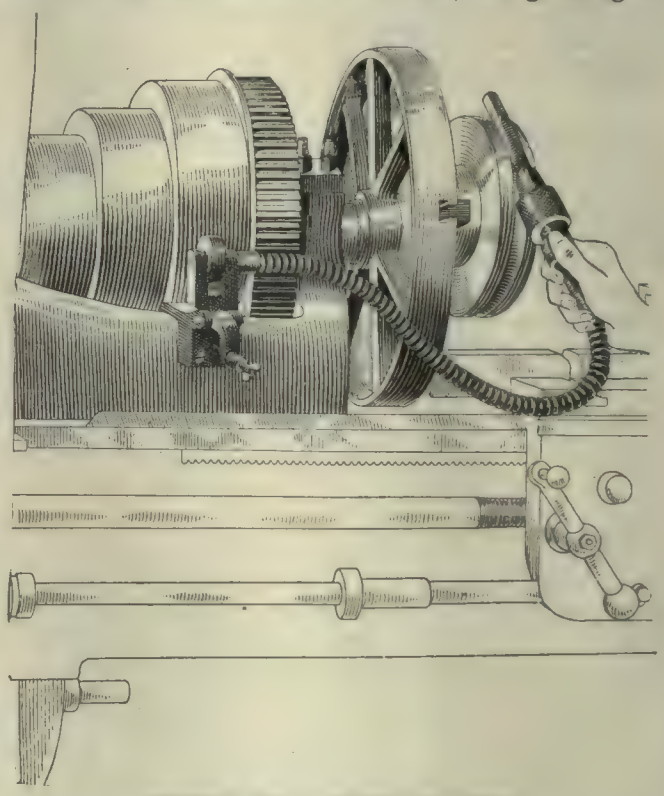
Hand screw machines feed in much the same way. The chief difference is in the movement of the bar which is often moved by hand, the operator reaching toward the end of the machine and grasping it after the collet is opened and drawing it forward against the stop. The collet action on the hand machine is identical in results with that of the automatic but a conveniently located hand lever takes the place of the cam-operated parts.

The collet and feed finger for any size of bar are made up with straight holes of the same size as the bar. These are then split and the collet is spread open while the feed finger is closed. In this condition they are hardened, producing a collet that in its natural shape allows the bar to pass through very freely and a feed finger that is a tight push fit on the bar. Upon the accuracy with which these parts are made and the nicety of hardening depends the smooth working of the machine; lack of concentricity is responsible for short feeding; anything but glass hard-working surfaces cause sticking of the collet and early wear in both collet and feed finger; too soft a spring temper in either piece means erratic feeding, the only cure for which is rehardening. Except for variations of about a sixty-fourth, separate collets and feed fingers are required for each size and shape of stock. Master collets and shells are used on larger machines with bushings or pads for the different-sized bars. The drawing shows the parts in various positions.

Lapping Grooved Rolls

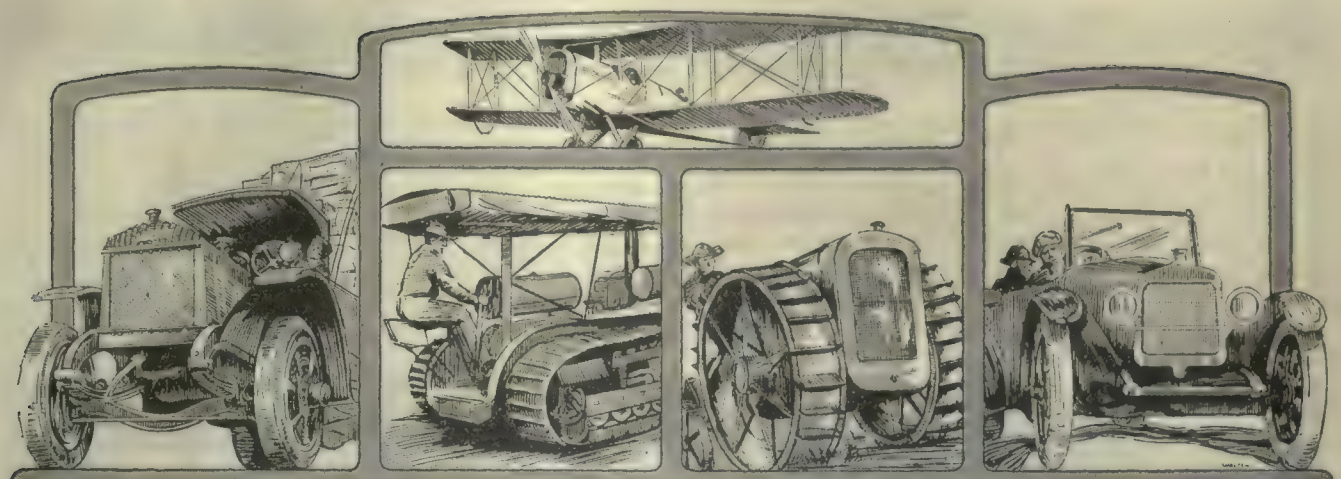
By S. B. Royal

Hardened-steel rolls with round grooves are used for many purposes particularly in wire feeding and straightening devices. The grooves soon wear out of shape, becoming too deep or too wide, and grinding or



METHOD OF LAPPING GROOVES

lapping with a stationary lap not only presents difficulties but does not always give satisfactory results. If instead, they are lapped by means of a lapping rod of the required diameter on the end of the flexible shaft as shown in the cut, perfect results will be attained. The method of operation is obvious. The roll, mounted on an arbor, is run at a high speed and a soft copper or brass rod is used with emery or diamond dust and oil. Besides securing a better job, the saving in time will be considerable.



AUTOMOTIVE CONSTRUCTION

Machining a Six-Cylinder Motor—I

By J. V. HUNTER
Western Editor *American Machinist*

Automobiles equipped with six-cylinder motors are constantly increasing in popularity, and the machining operations necessary in the production of such motors represent the latest refinements in efficient shop practice in maintaining a high quality of output which is being secured at a minimum cost of production.

AMONG the well-known manufacturers of the six-cylinder automobile motor the Falls Motor Corporation of Sheboygan Falls, Wis., has specialized in six-cylinder motors of one size. In the motor under consideration the cylinder block is cast in one piece with the upper half of the crank case. The first of the major operations on this part is performed on the milling machine shown in Figs. 1 and 2, and at this setup the top and bottom and one side are milled complete. The details of the fixture used for this operation are more clearly shown in Fig. 2. The fixture is substantially made and has machined stops *A*, on which the cylinder block rests. The block is clamped into position by means of a holding-down bar *B*, and adjustable stops *C* insure a full pressure on all parts of the casting. Large milling cutters with inserted high-speed cutters are used.

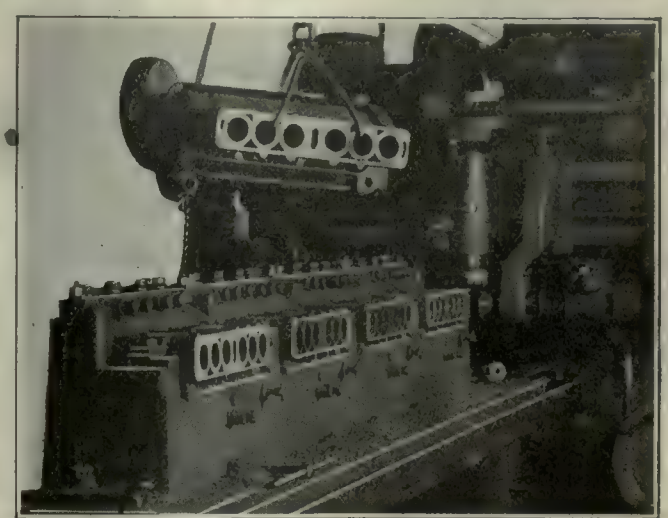


FIG. 1. MILLING ENDS AND ONE SIDE OF MOTOR BODY

Four holding fixtures are carried on the machine table, permitting the operator to remove and insert fresh castings in some of the fixtures while the machine is taking a cut on the others. In Fig. 1 one of the cylinder blocks is shown suspended over the table, indicating the method by which they are handled to and from the milling fixture. At the rear of the machine the operator removes the finished blocks from the first fixture while the machine is making its cut on the last block of the series.

The blocks are then placed on a second milling machine, Fig. 3, where the two ends are milled, using a fixture somewhat similar to those employed in the first milling operation, with the exception that it has permanent stops which contact with the surfaces already machined. This machine carries six fixtures on its table, and the machined blocks at one end are being removed while the cut is working on the remainder. It is the practice of this shop to use a milling-machine cutting speed on cast iron of about 120 ft. per minute with a feed of 12 in. per minute. When it is necessary to vary the cutting speed of the machine the feed is varied in direct proportion, that a ratio of 10 ft. of cutitng speed to 1 in. of feed is maintained. A similar practice is followed in operations on aluminum castings, with a ratio of ½ in. of feed to 10 ft. of cutting speed. On aluminum it is not permitted to use a cutting speed of less than 325 ft. per minute, and from this it is occasionally increased to a maximum of 900 ft. per minute. The maximum cutting speeds are used when a highly finished surface is desired.

For boring the cylinders the block is mounted on a special vertical cylinder-boring machine, built by the Foote-Burt Co., arranged to bore all six cylinders simultaneously. In this operation 0.015 in. is left for the finish-grinding operation.

AUTOMOTIVE CONSTRUCTION

The fixture consists of a heavy frame *A*, Fig. 4, which has a top guide plate *B* with bushings *C* for steadying the boring bars. The cylinder block is placed on the plate *D*, which slides on the ways *E*, which are a part of the baseplate of the fixture. This table is drawn forward on the ways to permit placing the block in position, and the block is guided into place by stops which fit against the surfaces previously milled. When the loaded table is pushed back into position for boring, stop pins *F* pass through the lugs in the table into the baseplate and hold it securely. Additional security during the boring operation is provided by means of the clamps *G*, on top of the cylinder block.

Grinding of the bore of the cylinders is done dry on a battery of Heald internal grinding machines in which two roughing cuts and one finishing cut are taken.

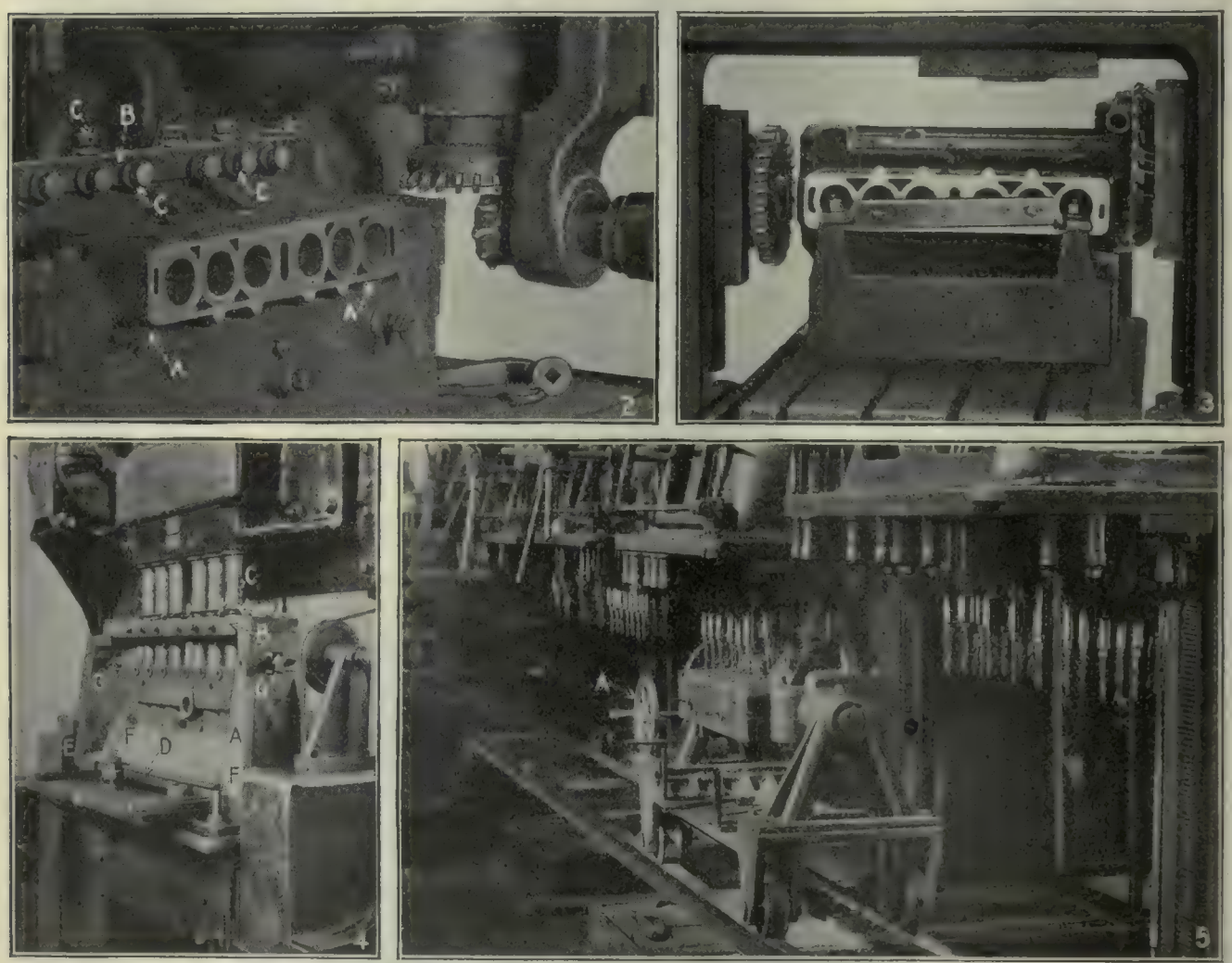
Multiple Drilling

For drilling, five 72-spindle Natco drilling machines, Fig. 5, are arranged so as to permit drilling approximately 290 holes in the cylinder block at one setting of the work. The drilling machines are placed in a line, and a track laid across their beds, one of the rails being a T-rail and the other a piece of 2-in. cold-rolled shafting.

The first four drilling machines are handled by a single operator, and their output is 15 cylinder blocks per hour. The fifth machine of the series, which has a different set of operations to perform, is handled by another workman. The cylinder block is mounted in the revolving and indexing jig which runs on the rails referred to, and is pushed into position under the first machine of the series. Here it is indexed by a suitable stop, and this machine drills all the holes in one side.

From the first machine it is successively pushed along to the other three machines of the series, and between each machine it is indexed 90 deg. to present a different side to the drills, and when its trip is completed all four sides have been drilled. At the far end of the line the block is removed from the fixture and is ready for end drilling under the fifth machine of the series.

Another view of the fixture, Fig. 6, shows how the base *A* is ribbed both above and below to give it additional stiffness. The revolving body *B*, supported by



FIGS. 2 TO 5. MILLING AND DRILLING OPERATIONS

Fig. 2—Fixture and clamping methods for milling motor. Fig. 3—Milling both ends of motor. Fig. 4—Fixture and machine for boring six cylinders. Fig. 5—Drilling all sides of motor body in sequence of operations.

AUTOMOTIVE CONSTRUCTION

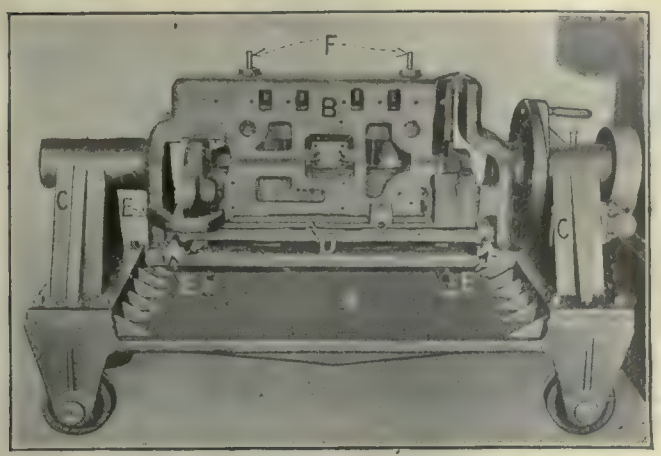


FIG. 6. REAR SIDE OF SPECIAL DRILLING FIXTURE

means of the uprights *C* is provided with a sliding bottom plate *D* which can be pulled in and out on the Vs *E* in a manner similar to the baseplate used in the fixture of the cylinder-boring machine.

When the block has been set on the baseplate *D* and slid into place it is securely clamped into position by means of the screws *F*. The secure manner of clamping by these screws permits the jig to be revolved without any danger of movement which would tend to get the holes on any one side out of place. The fixture is revolved by worm gearing turned by the handwheel *A*,

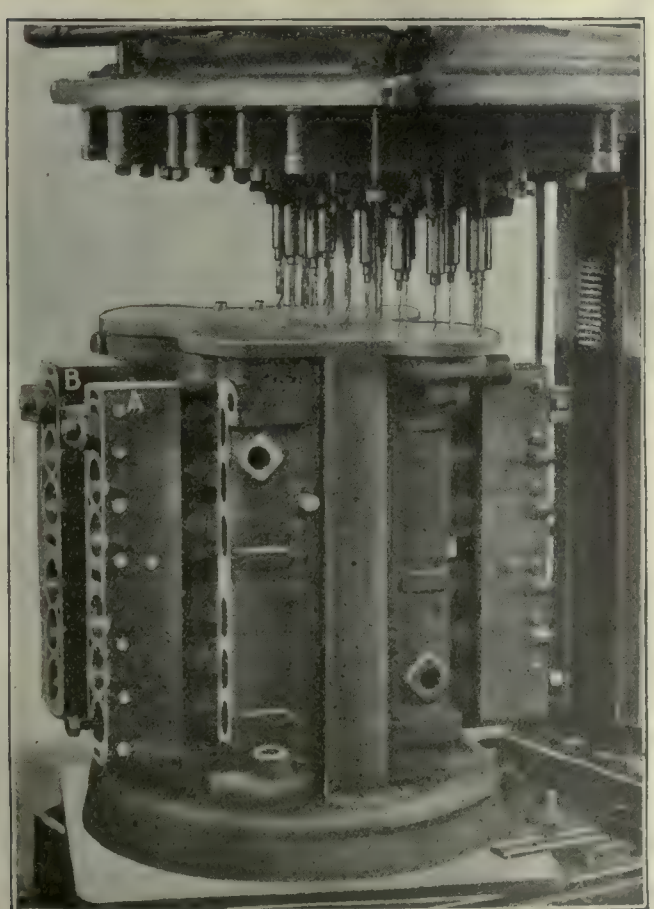


FIG. 7. INDEXING JIG FOR DRILLING MOTORS IN PAIRS

Fig. 5, until the indexing pin comes into place in each position.

For drilling the end holes the cylinder blocks are mounted in the drilling fixture, Fig. 7, which holds four cylinder blocks at one time, two of these being drilled while the other two are being dismounted and others mounted ready for drilling. This fixture is so made that the cylinders are drilled in pairs, and at each operation one cylinder block is drilled on its gear-case end and the other on the flywheel end. These are shown mounted at *A* and *B*, and when they have passed beneath

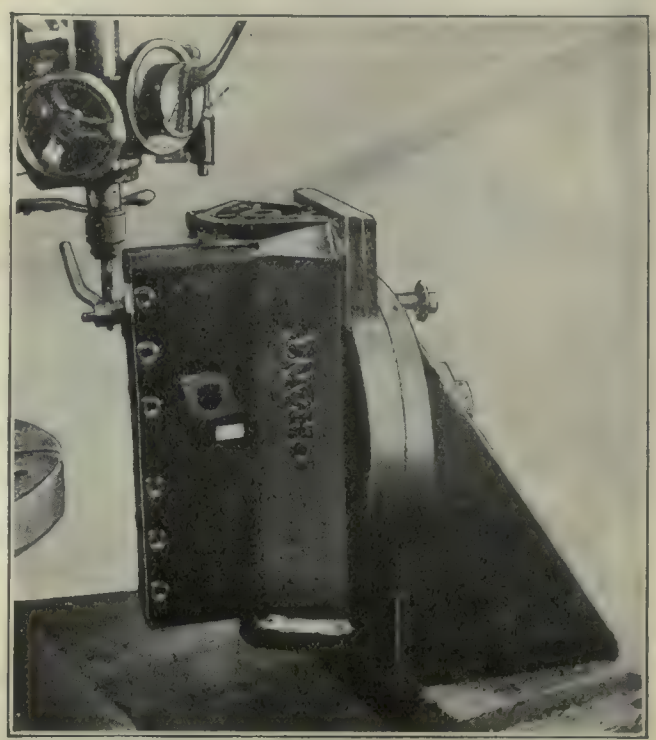


FIG. 8. FIXTURE FOR TAPPING HOLES IN BODY

the drills they are removed and turned upside down and reversed in position in the fixture so that the other ends will be drilled. The fixture has an indexing device providing for a complete half turn at each operation.

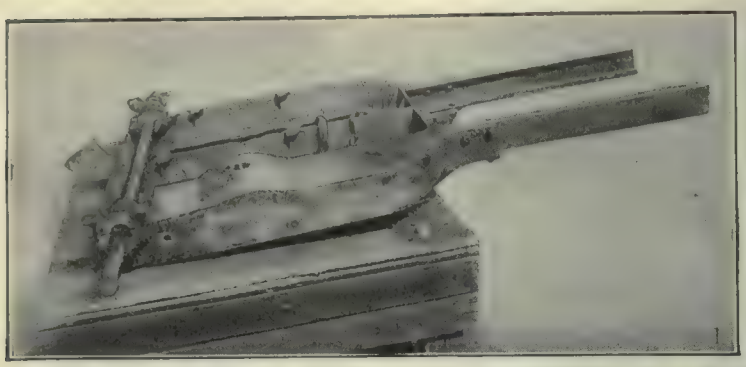
After drilling the cylinder block, a number of holes are tapped under a reversible radial drilling machine, Fig. 8, which is equipped with a special revolving fixture for swinging the cylinder block into the required positions. This fixture will be understood from the illustration, which shows that it is provided with a large and massive circular plate and center bearing and may be indexed to the correct positions so that the tap will always enter the holes in correct alignment.

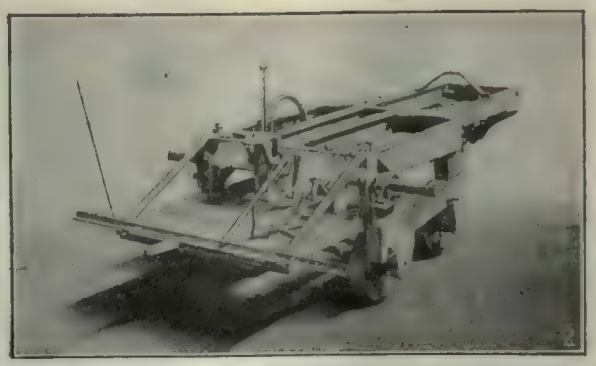
Building a 30-Hp. Tractor

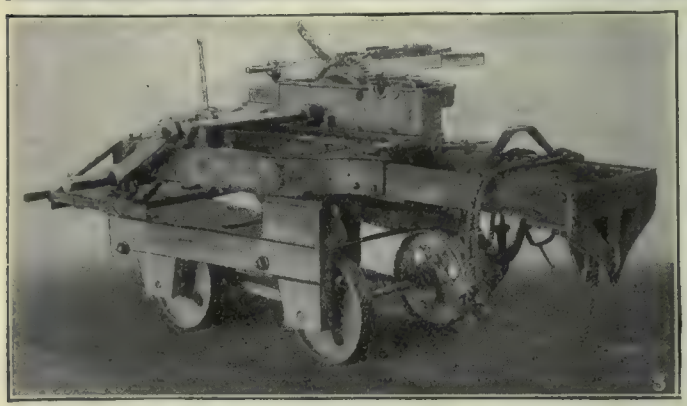
By B. Caldwell

The illustrations give a picture story of the progressive assembly of the Hart-Parr 30-hp. tractor, in their shop at Charles City, Iowa, showing its progress from the beginning of the frame assembly in Fig. 1 to the completed machine. As will be seen the frame consists of a steel casting to which are bolted two channel irons which form the front end. The main

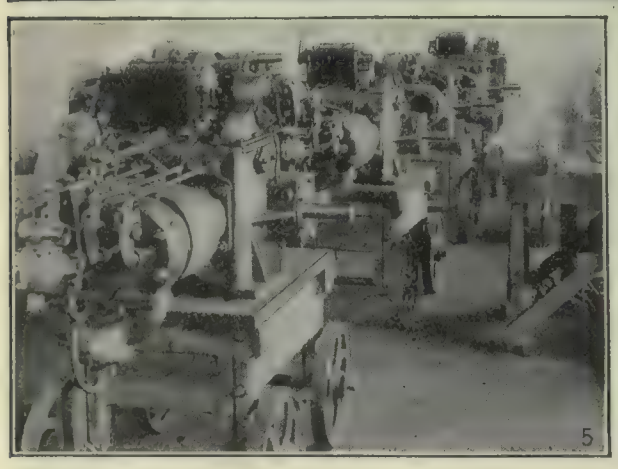
AUTOMOTIVE CONSTRUCTION











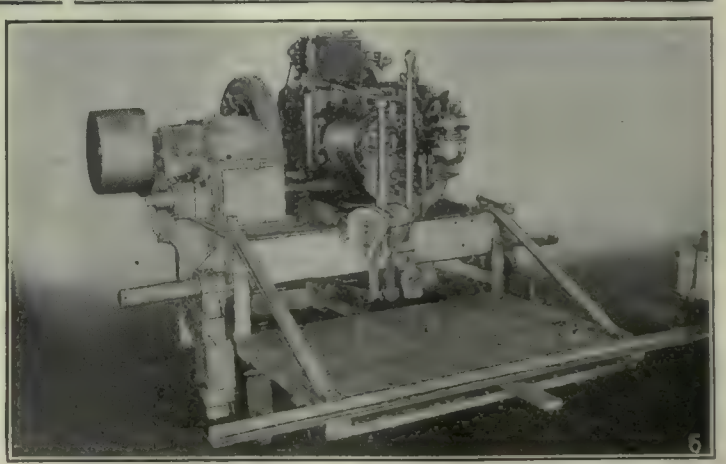
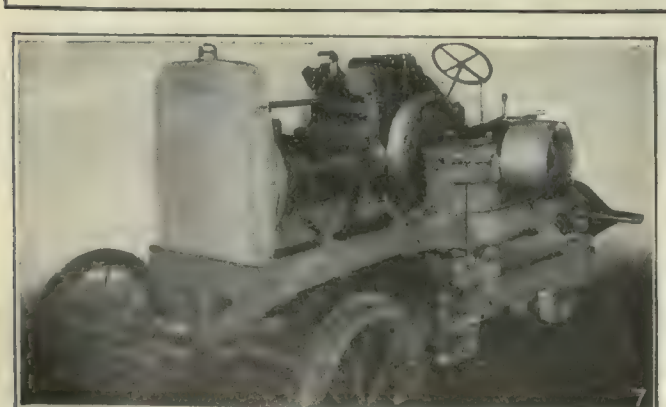
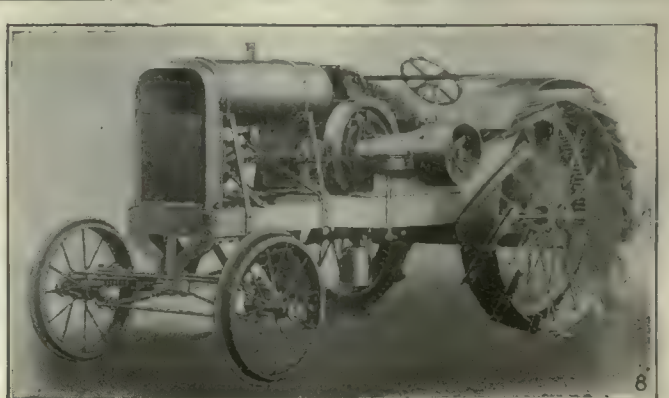


FIG. 1. THE CAST STEEL FRAME
FIG. 2. REAR PLATFORM IN PLACE
FIG. 3. ASSEMBLING TRUCK USED
FIG. 4. CYLINDER-HEAD ASSEMBLY
FIG. 5. MOTORS READY TO MOUNT
FIG. 2. MOTORS IN PLACE
FIG. 7. FRONT AXLE IN PLACE
FIG. 8. THE COMPLETE TRACTOR





axle bearings are babbitted on the mandrel shown, which is 2¼ in. in diameter.

The next stage, Fig. 2, shows the rear platform bolted in place, the axle in position and the front end ready to receive the steering wheels. This assembly takes place on the small four-wheel truck which carries the body until it is ready to go on its own wheels.

FINISHING THE ASSEMBLY

The driving gears and jackshaft are shown in place in Fig. 3, which also gives a better view of the supported truck. The motor is a two-cylinder, four-cycle, with a removable head carrying the valves. Some of these heads are shown in unit assembly in Fig. 4. The cylinder is 6½-in. bore by 7-in. stroke and runs with 70-lb. compression. The normal speed is 750 r.p.m., the speed being controlled by a centrifugal governor. The assembled engines are shown in Fig. 5, also mounted on trucks and ready to be put in position on the tractor frame, as shown in Fig. 6, which begins to assume the appearance of a completed tractor.

The last stages of the assembly is putting the wheels in place, Fig. 7 showing the front pair in position with the rear end supported on the truck. The completed tractor is shown in Fig. 8 with its driving wheels in position, the kerosene tank in place and the machine ready to run.

Multi-Bladed Airplane Propellers

Experiments in airplane-propeller design are being made to show the advantages of the different types. Airplane designers however are apparently overlooking the important question of the relation between airplane efficiency and the number of propeller blades. There is unfortunately no conclusive data at hand, regarding the relative merits of the three- and four-bladed propellers. For training work and all ordinary work two blades are usually preferred. For expert flying, and for high-powered machines in which there is a restricted diameter of propeller in proportion to power applied, three and four blades are giving better performances. There are numerous instances where the three-bladed screw, even though it has less diameter, shows marked superiority over the two-bladed propeller. The three-bladed propeller is also noted for its peculiar jointing and fitting together of the ends of the laminations where they form the hub.

This hub is trebly laminated over its entire area with the material so disposed as to direction of grain, etc., that it makes without doubt the strongest hub that can be built in any propellers.

Lawrence Airplane Motor

The Lawrence 3-cylinder air-cooled airplane motor designed for use on the sport-type machines develops 52.5 hp. at 1600 r.p.m., has a bore of 4.25 in. and a stroke of 5.25 in. The cylinders, placed 120 deg. apart, are aluminum castings with air-cooling fins machined on them and are fitted with $\frac{1}{16}$-in. case-hardened steel liners. The valve seats are made from bronze having the advantage of requiring infrequent grinding, while the aluminum and bronze have nearly the same expansion coefficient. An interesting feature of the engine is the valve spring, this being made of a flat ribbon of steel. The steel ribbon is tapered and rolled into a spiral so that the wide part of the ribbon forms the outer coils. This gives the valve springs a very low over-all length and all coils are stressed equally. The weight of the motor with magneto and carburetor is 132 lb.

Aërial Transportation Corporation Recommended

Alan R. Hawley, president of the Aëro Club of America, recently addressed the National Rivers and Harbors Congress held in Washington, D. C., to solve the problems regarding the disposal of the Army and Navy equipment approximating $1,000,000,000,000, and the employment of the 28,000 pilots and 300,000 men discharged by the Army and Navy Air Service. He recommended the organization of an Aërial Transportation Corporation, owned by the Government and capitalized at $50,000,000. This organization is to take over this $1,000,000,000,000 worth of airplanes, motors and aëronautic equipment which the Army and Navy cannot use and are trying to dispose of. The officials of this corporation are to devise ways and means for salvaging this equipment, utilizing whatever can be used to establish aërial transportation lines in the United States and supplying the South and Central American countries which are anxious to have aërial transportation lines. The abandoned Army aviation stations and depots shall be operated by the corporation as public aërodromes where civilian aviators may use the hangars and facilities by paying rent. This corporation shall establish and operate aërial transportation lines between industrial centers. All air traffic should be classed with interstate and international traffic and the interstate traffic regulations should be extended to include air traffic.

Japanese Motor-Vehicle Subsidy

A military motor-vehicle subsidy law has been passed recently by the Japanese Diet, which provides subsidies for manufacturers and owners of motor vehicles suitable for military use, capable of carrying one ton. The vehicle may be requisitioned at any time for reasonable compensation. The law provides that the manufacturers and owners must be Japanese subjects and vehicles must be of Japanese origin. Pending greater production of Japanese vehicles, however, owners of cars of foreign manufacture are allowed within the subsidy scheme.

New Waterproof Propeller Coating

The Forest Products Laboratory at Madison, Wis., has developed a waterproof coating for air propellers. By the application of this new coating, the propeller surfaces are practically covered with a plating of a thin aluminum leaf in the finish, to protect the airscrew from the absorption of water. Propellers finished with the coating have been found very satisfactory in the Government tests, particularly in the storage stage.

Prices, Yesterday, Today and Tomorrow*

By O. P. AUSTIN

THE purpose of this address, as implied by its title, "Prices, Yesterday, Today and Tomorrow," is an attempt to look into the future and determine, if possible, the probability as to the course of prices. That there have been great and continuous advances during the war period we are painfully conscious, and in the five months since the cessation of hositilities we have failed to experience the reduction which some had fondly hoped would come with the close of the war. In a few instances there have been slight reductions, but in others there are still advances, and the index figures on foodstuffs in New York today are actually higher than those on Nov. 5, when the whole world so joyously welcomed the apparent termination of the great conflict which had raged for fifty-one months.

To attempt to determine what is likely to happen in the future we must try to find the cause of the things which have happened in the past, and also to see whether this cause is or is not likely to continue in the near future. When prices began to advance in the opening of the war, we could readily see that the upward movement was due to the urgent demand for the food and raw material required by the enormous armies which had been put into the field, and this cause has been designated the "scarcity demand," but when we found the advance extending to many articles in which there was no scarcity and which were not used by the armies or utilized in the manufacture of their requirements, we began to realize that a part of the advance must be due to some cause other than mere war or scarcity demands.

Since 1918, paper money with a face value of $36,000,000,000 has been issued by the countries engaged in the late war. This amount is greater than the value of all the gold and all the silver mined in the world since the discovery of America. In the four years of the war the national debts of the world have increased from $40,000,000,000 to $220,000,000,000 and the annual interest charge, from $1,750,000,000 to $10,500,000,000 or more than fivefold. In the meantime most of the gold formerly in circulation has been locked up in governmental vaults. These conditions constitute an inflation of currency greater than ever known and it would seem impossible that commodity prices should be much reduced until some progress is made in deflation.

Edgar Crammond, the distinguished British statistician and economist, in an address before the London Institute of Bankers on Mar. 26, 1919, stated that the three facts which would tend to make the fall in prices a very gradual one are: (1) The vast increase in the amount of paper money; (2) the huge increase in the amounts of public debts of the belligerents; (3) the determination of labor to maintain wages and improve the standard of living.

Price Advances Were World-Wide

Raw silk, for example, for which the war made no special demand and which was produced on the side of the globe opposite that in which the hostilities were occurring advanced from $3 per pound in the country of production in 1913 to $4.50 per pound in 1917, and over $6 per pound in the closing months of the war. Manila hemp, also produced on the opposite side of the globe and not a war requirement, advanced in the country of production from $180 per ton in 1915 to $437 per ton in 1918. Mechanically ground wood pulp, not a war requirements, advanced, as our publishers are aware, from $14 per ton in the opening months of the war to $35 per ton in the opening months of 1916, and the grade known as "chemical bleached" advanced from $50 per ton at the beginning of the war to $100 per ton in January, 1919. Goat skins, from China, India, Mexico and South America advanced from 25c. per pound in 1914 to over 50c. per pound in 1918 and yet goat skins were in no sense a special requirement of the war. Pig tin produced by Chinese labor in the Malayan Peninsula and the Dutch East Indies and not to a very great extent a war requirement sold in the country of production in 1914 at 30c. per pound and in the same markets at 75c. per pound in the closing weeks of the war. Sisal grass, produced in Yucatan, advanced from $100 per ton in 1914 at the place of production to nearly $400 per ton in 1918, and Egyptian cotton, a high-priced product and thus not used for war purposes, jumped from 14c. per pound in Egypt in 1914 to 35c. per pound in 1918. Even the product of the diamond mines of South Africa advanced from 60 to 100 per cent. in price per karat when compared with prices existing in the opening months of the war.

The prices which I have quoted to you are in all cases those *in the markets of the country in which the articles were produced* and in most cases at points on the globe far distant from that in which the war was being waged. They are the product of countries having a plentiful supply of cheap labor and upon which there has been no demand for men for service in the war. The advance in the prices quoted is in no sense due to the high cost of ocean transportation since they are those demanded and obtained in the markets of the country of production.

All Classes of Producers Affected

Why is it that the product of the labor of women and children who care for silk worms in China and Japan, of the Filipino laborer who produces the Manila hemp, the Egyptian fellah who grows the high-grade cotton, the native workman in the diamond mines of South Africa, the Mexican peon in the sisal field of Yucatan, the Chinese coolie in the tin mines of Malaya, or the goat-herd on the plains of China, India, Mexico or South America has doubled in price during the war period? The articles enumerated were in no case for use in the war and the prices are those in the country of production and thus not due to the increase in ocean freights or dangers of oversea transportation. The advance has been general, world-wide. In a few articles in which an overproduction was occurring in which the demand fell below normal the advance was not so strongly marked, but there is scarcely an article in the long list of those entering world markets in which there has not been an advance, no matter how distant its place of production from that in which the war was occurring, or how little the war's demands for it, or for the labor by which it was produced.

Great Underlying Causes of World Advances

Surely there must have been some general underlying causes for this world advance, this simultaneous demand by people of all classes and in all parts of the globe for higher prices for their products irrespective of their relation to war requirements. While we may be willing to accept the immediate demands of the war as a part explanation of the advance in the prices of foodstuffs and certain manufacturing material and manufactures we must look farther for the cause of the similar advance in articles upon which the demands of the war could have no direct bearing. It is true that a marked advance in the price of one important class of product does cause an advance in

*From an address before the Editorial Conference of the New York Business Publishers' Association, in New York City, April 11, 1919.

the prices demanded for other articles which must be exchanged for those in which the advance has already occurred, but it does not seem probable that the advance due to scarcity of a comparatively few of the world products required for war could have been the chief cause of the doubling of prices in practically every article produced in every part of the world, many of which had not the most remote relation to war requirements.

Principal Causes of Advance in Prices

Apparently the principal causes of the advance in prices during the war were, stated in their chronological order, first, "scarcity demand"; second, the advance in wages presumably due to the increased cost of living and demand for labor, and, third, the large increase in world circulating media; or to put it in a single world "inflation." Prof. A. C. Miller, member of the Federal Reserve Board, an authority whose views are entitled to high consideration, in a recent address before the American Academy of Political and Social Science named as the two chief causes of the advance in prices, "scarcity demand" and "inflation," adding that "there is so much evidence of an artificial abundance of money in comparison with the things that are purchasable by it that the abundance of money must be credited *with at least* an equal influence in explaining the high prices which have prevailed."

The "Scarcity Demand"

What were the articles for which the war created a "scarcity demand?" Food, clothing, transportation facilities, and material for the battlefield. How much did it add to the world's demand for these articles? Of course, the percentage of increase in demand for strictly war materials was very large, but was there really as great an increase in demand for other materials, food, clothing, and transportation facilities as we are accustomed to imagine? Let us assume that the number of people participating in the war was forty million, which is probably more than those in the field at any one time. Do we realize how small a share those forty million were of the world's consuming population? Less than two and one-half per cent. We think of forty million as a large number of people to feed, and so it is, but it must be remembered that the number of people in the world who must be fed and clothed and supplied with transportation facilities every day of the year is 1,800,000,000 or forty-five times as many as the highest number in the military service at any time during the war. Of course the soldiers were better fed than are many of the people in certain sections of the world, but even if their per capita consumption was four times as much as the average it would still represent but a small percentage of the world's daily food consumption. And it must be further remembered that all these forty million people in the armies had been consumers of food before the beginning of the war, not to quite as great an extent perhaps as after entering the activities of the military service, but it cannot be assumed that the war added forty millions to the world's consumers of food and clothing. Nor can it be properly assumed that the withdrawal of these millions from the industries actually reduced to that extent the world's producing power, for four millions of these were already in the military service and the places of the other thirty-six million were to a considerable degree filled by others who had not been up to that time actively engaged as producers.

Supplies "Switched" from Usual Lines of Industry

Much of the material used in preparing the supplies for the battlefield was "switched" from the usual lines of industry, for there was an immediate cessation of railway construction, building operation, and a thousand industries which formerly required manufacturing material, and as a result of this cessation of activities the material formerly used by them became available for war purposes.

It thus appears on close analysis that the "scarcity demand" created by the war was not as great in food, clothing, or manufacturing materials as has been pictured, while the fact that fifteen millions are still under arms minimizes the reduction in military demands which had been expected.

One factor often mentioned in the attempt to determine the causes of high prices is the advance in wages of labor, but the fact that the increase in compensation of labor was in most cases given because of the fact that the cost of living had already advanced at least somewhat minimizes the relative importance of this factor in attempting to discover the real causes of the general world-wide advance in prices. And it must also be remembered that several million persons who had not been engaged in the industrial and business world came to the assistance of those engaged in these duties during the war.

Increase In World Currency—"Inflation"

Where then shall we turn in the search for the principal cause of the general advance in prices of articles produced the world over and their relation to the demands of the war? What other cause can we find after giving due consideration to the "scarcity demand," the destruction by war and the increased cost of labor? The most prominent among the possible or probable causes is the theory advanced or accepted by the historians, economists, statisticians and financiers of the world that inflation in currency is usually accompanied or closely followed by an advance in prices; and, as already indicated, so high an authority as a member of the present Federal Reserve Board, Prof. A. C. Miller, has recently declared that "the abundance of money must be credited with at least an equal influence in explaining the high prices which have prevailed."

I wonder if we do fully realize the quantity of paper money which the responsible governments of the world have put afloat since the beginning of the war—thirty-six billion dollars. The paper money in existence in the fifteen principal countries of the world at the beginning of the war was less than eight billion dollars and at the end of the war was over forty-four billions, an increase of thirty-six billions in fifty-one months, and this does not include any of the eighty billion dollars worth of paper currency issued by the Bolsheviki in the eighteen months of their control in Russia. Thitry-six billion dollars of new paper money added to the circulation of the world by fifteen responsible governments in a little over four years of time!

Thirty-Six Billion Dollars Worth of Paper Promises

We had been inclined to charge up the advance in prices occurring prior to the war to the fact that eight billion dollars worth of gold was turned out by the mines of the world in the twenty years following our famous gold and silver campaign of 1896. But here are thirty-six billion dollars worth of paper promises to pay turned out as legal tender money by fifteen responsible governments in a short four-year period.

Do we realize how vast a sum is this thirty-six billion dollars worth of paper currency which has thus been put into circulation in such a brief time? It is more, *in its face value*, than all the gold and all the silver turned out by all the mines of all the world in the 427 years since the discovery of America.

True, much of this paper money is now more or less depreciated in its value as compared with gold, the world's accepted standard, but the fact that it has behind it not only a certain amount of the yellow meal but also the pledge of the governments by whose authority it was issued renders it as least an accepted medium of exchange in the countries of its origin, while the fact that nearly every neutral country of the world has meantime increased its paper currency and national indebtedness, permitting its gold to pass from circulation into the vaults of its banks as a security for the paper circulation, tends to widen the field affected by this inflated currency.

Increase in Other Governmental Obligations

In addition to these vast sums of legal tender currency turned out by fifteen responsible governments of the world, these same governments have at the same time made an even more spectacular advance in their issue of another series of promises to pay, which, while not legal tende

in the ordinary sense of the term, do form a more slowly moving mass of currency. By this I mean the one hundred and eighty billion dollars worth of bonds or other forms of national obligations issued by the governments of the world in the past four years, for national debts of the world have advanced from forty billion dollars at the beginning of the war to two hundred and twenty billions at its close. And while these bonds or other governmental promises to pay money at some future date are not legal tender currency in the ordinary sense of the term they do pass current in the financial world and prove a basis upon which money may be readily obtained by their holders, and to this extent are an addition to the world's circulating medium.

Bank Deposits Greatly Increased

Still another increase in circulating media is found in the enormous growth in bank deposits, which of itself increases circulation through the increased use of checks, especially in countries such as the United States where the check forms so large a share of the daily business transactions of the country. Bank deposits in fifteen principal countries of the world have grown from twenty-seven billion dollars in 1913 to approximately seventy-five billions at the present time, the ratio of increase being about the same as that of currency.

These increases in circulation, indebtedness and bank deposits, while occurring chiefly in the countries participating in the war have also extended to many other countries, especially in Europe, where the six principal neutrals have during the war period increased their national debts one billion dollars, their note circulation over a billion dollars and their bank deposits by about one billion.

Thus in a short four and one-half year period world paper money has increased thirty-six billion dollars, world evidences of national indebtedness one hundred and eighty billion dollars and world bank deposits nearly fifty billion dollars. Most of this enormous increase has occurred in "uncovered" paper. The gold mines of the world have turned out less than two billion dollars worth of the precious metal during the war period and most of the world's gold, which formed fifty-five per cent. of world circulation at the beginning of the war, has passed into the vaults of the governments of their great banks as a basis for their paper currency, and now bears a relation of but about twenty per cent. to the flood of paper money in circulation, and this proportion of gold to paper varies widely when the respective countries are compared.

Inflation and High Prices

If the world's historians and financiers and economists and statisticians are right in their general belief that an advance in prices usually accompanies or closely follows inflation in currency, and especially in paper currency, can we be surprised at the world-wide advance in prices which we have witnessed during the past four years in which world currency and bank deposits trebled and national debts quintupled?

Prices of Tomorrow

We come now to the third and final question, that of prices of tomorrow. May we expect a material reduction in general prices in the near future? And in trying to determine this we must see whether the causes which brought about the advance during the period are likely to be removed.

The chief causes of the advance seem to have been the "scarcity demand," the higher cost of labor, and the increase in circulating media.

Will the "Scarcity Demand" Terminate?

The "scarcity demand" came on the very first day of the war, for most of the countries entering the struggle found that the demand upon them would be far in excess of their supplies either of foodstuffs or military requirements and as the weeks and months and years progressed this fact was more strongly impressed upon them.

During the closing year of the war the ammunition factories of the various participating countries were able to meet to a great extent the requirements of their own armies but in the matter of foodstuffs the "scarcity demand" still continues with little prospect of abatement at least in the near future. The number of mouths to feed in Europe has not decreased and that continent, which has not for many years been able to produce its own requirements of foodstuffs, now finds itself with neglected soils, a disordered population and unable to return to normal production in the immediate future. In manufacturing materials, for which Europe has also been dependent upon other parts of the world, she will require abnormally large quantites at least in proportion to her attempts to manufacture, for her stocks of this class of merchandise are absolutely exhausted. In all parts of the world which have relied upon Europe and the United States for manufactures the shelves are empty and must be filled and most of the manufacturing sections of Europe will evidently be slow in resuming the production of manufactures for exportation, and will have limited facilities for transporting or marketing them even if produced. So it seems that, although the demand for war material has terminated, the other features of the "scarcity demand" will continue at least in a somewhat modified form in the immediate future, especially as relates to world requirements of food, manufacturing material and manufactures, while developments thus far do not point to an early reduction in labor costs.

Will the Over-Supply of Currency Be Reduced?

If we are right in assuming that a considerable proportion of the world advance in prices is due to the enormous increase in world currency can we expect a marked reduction in prices until the cause, "inflation," is removed? Or, to put it in another form, that part of the advance caused by inflation can only be cured by deflation, by a reduction in the enormous stocks of currency which, as I have shown you have trebled during the war, while that other form of slowly moving currency, governmental obligations, has quintupled.

Is it probable that these two forms of currency can be or at least will be reduced in the near future? The governments of the world, which were paying less than two billion dollars a year of interest on national debts at the beginning of the war are now paying and must continue to pay a total of over ten billion dollars a year in interest, and at the same time all other expenses of governments have advanced. Official estimates of the "budgets" or expense accounts of several of the principal countries for the coming fiscal year have already been announced and indicate that their necessary expenses in the first full year of after-war peace will be about four times as great as in the year preceding the war. The British budget for next fiscal year is estimated at about six times as much as in 1913 and those of France, United States and Canada about four times as much as before the war. Present indications are that the governments of the world will be compelled to collect in taxes from their people about fifty billion dollars a year as against about twelve and one-half billions in 1913, or say a billion dollars a week as against a billion dollars a month before the war, *and* this does not include anything for "sinking funds" or other provision for reduction of outstanding debts. If this be true is it probable that the governments in those countries which have greatly increased their circulation and must now demand such enormous increases in annual payment of taxes will find it advisable or possible to materially reduce the amounts of currency available for such payments?

Are We Justified in Expecting a Reduction in Prices?

If the governments which have been the chief participants in the world increase of currency should fail to materially reduce that excessive supply, and if the world's demand for food, manufacturing material and manufactures is to continue at the present rate, are we justified in expecting a general reduction in prices in the near future? The question I think answers itself. There will, of course, be instances in which there will be material reductions, but in general terms the outlook for marked or rapid decline, at least in the near future, does not seem encouraging.

Liberty 48-Inch Open-Side Planing Machine

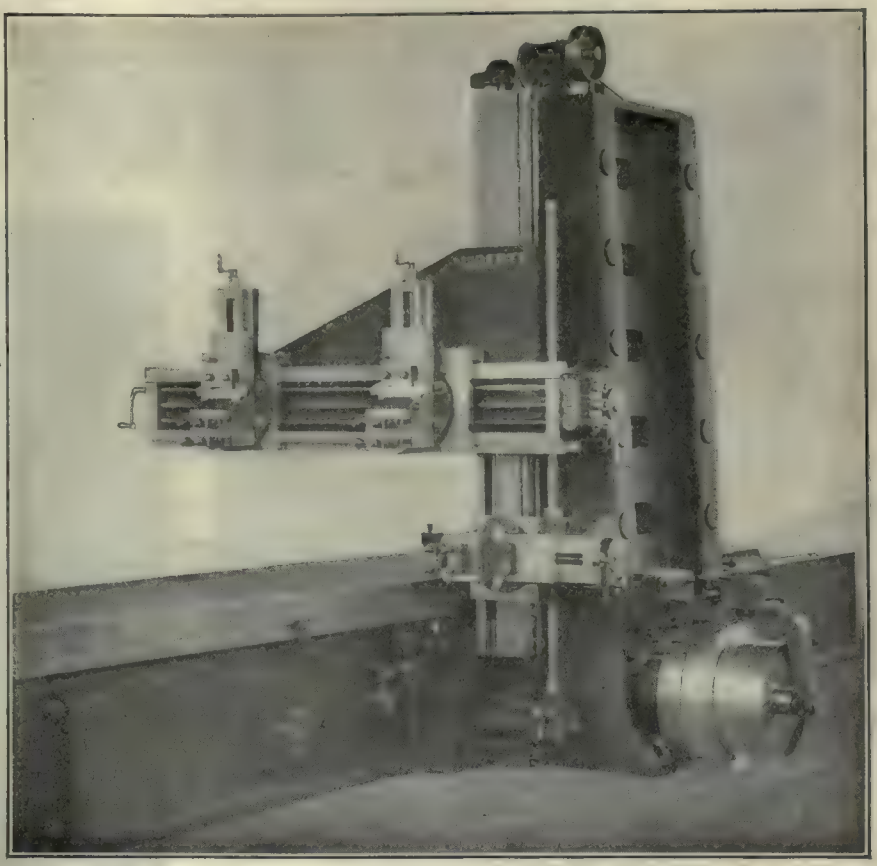


FIG. 1. FRONT VIEW OF LIBERTY 48-INCH OPEN-SIDE PLANING MACHINE

THE illustrations show a new 48-in. open-side planing machine that has just been placed on the market by the Liberty Machine Tool Co., Hamilton, Ohio. The crossrail is triangular in shape with a long narrow guide extending upward on the front of the column, and is bolted and doweled to the triangular brace or knee, which extends to the rear of the column with a tongue in the rear T-slot. This brace is clamped to the side of the column by three T-bolts in addition to the rail clamp on the front of the column, this construction keeping the rail square with the table when the bolts are loosened for raising or lowering. The column is of two-post, box-type construction, extending to the floor, and is bolted and doweled to the side of the bed. The bed extends to the floor to afford a solid foundation and the top is closed in between the ways, except through the gearing section, which is reinforced with heavy girths. The ways are V-shaped and are fitted with automatic oil rollers to insure proper lubrication. A place is also provided on the bed for the operator's tools.

Table Construction

The table is ribbed, and T-slots and reamed holes throughout the entire length afford facilities for clamping work. The driving gear is placed inside of the bed and is accessible from the top. Gears are pressed onto the hubs of the pinions to relieve the shafts of torsional strains, and wick-oiled bronze bearings are used for the shafts. The pulley or driving shaft has an additional support outside of the pulleys, which are made of aluminum with cast-iron centers to reduce the inertia and trouble caused by it at reversal. The loose pulleys have wick-oiled bronze bushings and a solid web instead of arms. The entire belt-shifting mechanism is inclosed to avoid the accumulation of dirt on cams and other moving parts. The belt arms are adjustable to keep the belts in the proper position at all times and have an additional support on the pulley bracket to relieve the fulcrum stud of bending stresses. The machine may be started or stopped from either side of the machine and a safety lock secures the shifting mechanism to prevent accidental starting.

The feed is said to be a decided improvement over the old-style arrangement and has the following advantages: (1) The operator can control or change the feed on the cross-heads at any time without stopping the machine or disturbing the feeds on either right- or left-side heads or vice versa. (2) All parts are well protected, yet accessible. (3) All operating handles and knobs are conveniently located. (4) The amount of feed is indicated by a dial enabling the operator to set the feed to the proper amount to suit various requirements.

The rail heads have long bearing surfaces on the crossrail and are made right and left for close range. They are graduated for swiveling up to 90 deg. in either direction, and have automatic feeds in all directions, operative from either end of the crossrail. The down-feed mechanism is so made that the screws are under tension. The slides are hung on ball bearings and binder screws are provided on both saddles and slides.

The power elevating device is located on top of the column, and is operated by a lever-controlled saw-tooth clutch. The handle must be held in position while operating and any obstruction will instantly disengage the clutch to avoid breakage. All gears are idle when not in use.

The Side Heads

The side head is mounted on the front of the column, is counterbalanced, and can be moved below the top of the table when not in use. The control handles and micrometer collars move up and down with the heads, which can be swiveled up to 90 deg. in either direction. Binder screws are provided on both the saddle and slide, and the tool block is fitted with a self-releasing spring plunger.

The countershaft is equipped with Hyatt roller bearings throughout, and all pulleys are balanced. If desired, the machine can be converted into a double-housing planing machine, as provision is made for adding

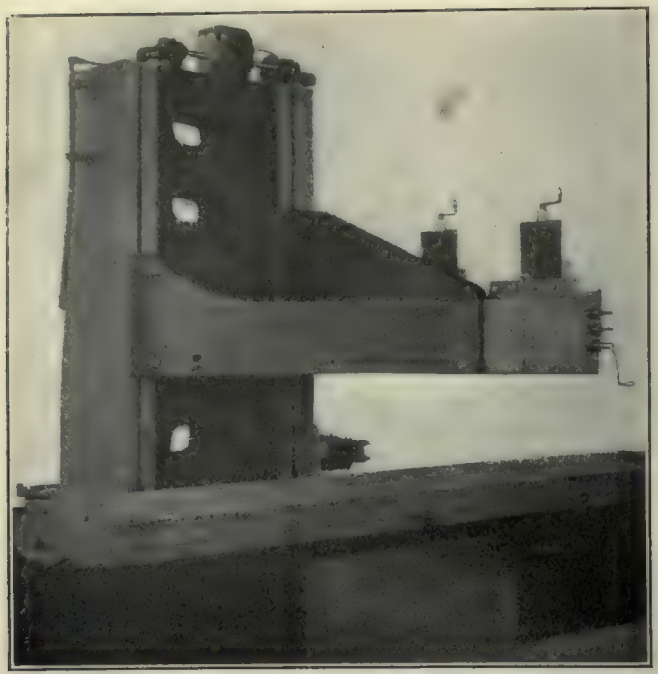


FIG. 2. REAR VIEW OF LIBERTY OPEN-SIDE PLANING MACHINE SHOWING THE CONSTRUCTION OF THE CROSSRAIL AND BRACE

the second housing to the left side. The machine can be furnished for either belt or motor drive. All parts are made to jigs to be interchangeable, and the unit system of construction is used throughout.

Professor Charles B. Richards

Charles Brinkerhoff Richards, Emeritus Professor of Mechanical Engineering, Yale University, died at his residence, 227 Edwards St., New Haven, Conn., on Apr. 20, in his eighty-sixth year.

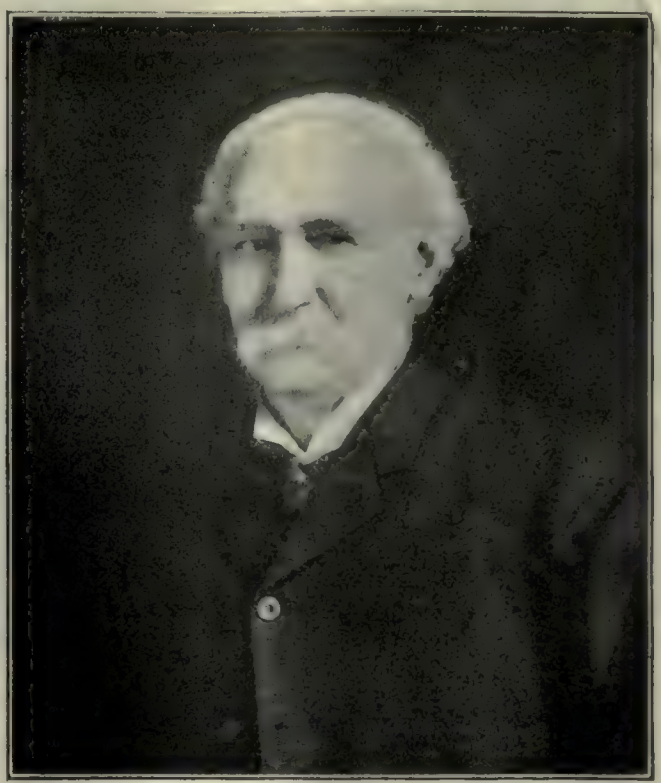
Professor Richards was born in Brooklyn, Dec. 23, 1833, and educated in private schools in that city. In his early days he moved to Hartford, Conn., and upon his removal from there to New York, came in contact with the late Charles T. Porter, by whom he was employed to assist in the preparation of drawings for a machine for drilling the arms and balls for his steam-engine governor.

Professor Richards afterward established himself as a designer of machinery and in 1861 was commissioned by Mr. Porter to design a steam-engine indicator that would overcome the faults of the instruments then in use, and which were only for use on engines of slow speed. After repeated attempts, young Richards became discouraged, but, goaded by Porter's insistance that he must have a high-speed indicator, renewed his efforts and the celebrated Richards indicator was the result. When asked to patent the indicator, Richards refused, saying "If I patent everything I think of I shall soon be in the poorhouse." He finally agreed to sell his right in the invention to Porter for one hundred dollars; Porter to patent it, employing Richards to obtain the patent.

For the achievement of inventing the indicator he was made a chevalier of the Legion of Honor of France.

For many years he was consulting engineer and assistant superintendent of Colt's Patent Fire Arms Co., Hartford, Conn., and while there designed and superintended the building of the two pairs of Porter-Allen engines.

The beds for these engines were cast in the foundry of one of the old engine builders in Hartford, who called on General Franklin, the general manager of Colt's Armory, to warn him that if Richards was permitted to put these engines in the second story of the building and run them at 100 r.p.m. disaster would be



PROFESSOR CHARLES B. RICHARDS

certain. These engines were started in 1867 and have been running continuously since that time.

Professor Richards was superintendent of the Southwark Foundry and Machine Co., Philadelphia, Penn., from 1880 to 1884 and was called from there to take the chair of mechanical engineering at Yale. He served as professor in that branch until 1909, since which time he has been professor emeritus.

He was United States Commissioner to the Paris Exposition in 1889, and has been consulting engineer for many public buildings, notably the State Capitol at Hartford. He was a member of the Société Industrielle de Mulhouse and a charter member of the American Society of Mechanical Engineers, being present at the meeting for organizing the latter society on Apr. 7, 1880.

Reunion of "Eighty-Niners"

Thirty years ago a party of American engineers, members of the American societies and institutions of civil, mechanical, mining and electrical engineers, with their families, sailed for Europe, visiting England and the Paris Exposition of 1889, and were the recipients of many high courtesies—official, professional and individual. Plans have been made for a reunion dinner to be held in New York about May 27, at which it is hoped that all the survivors, ladies as well as men, may meet again. It is requested that anyone who was in the party communicate with the secretary of the committee, Jesse M. Smith, Engineers' Club, 32 West 40th St., New York.

∴ EDITORIAL ∴

It's Our Turn

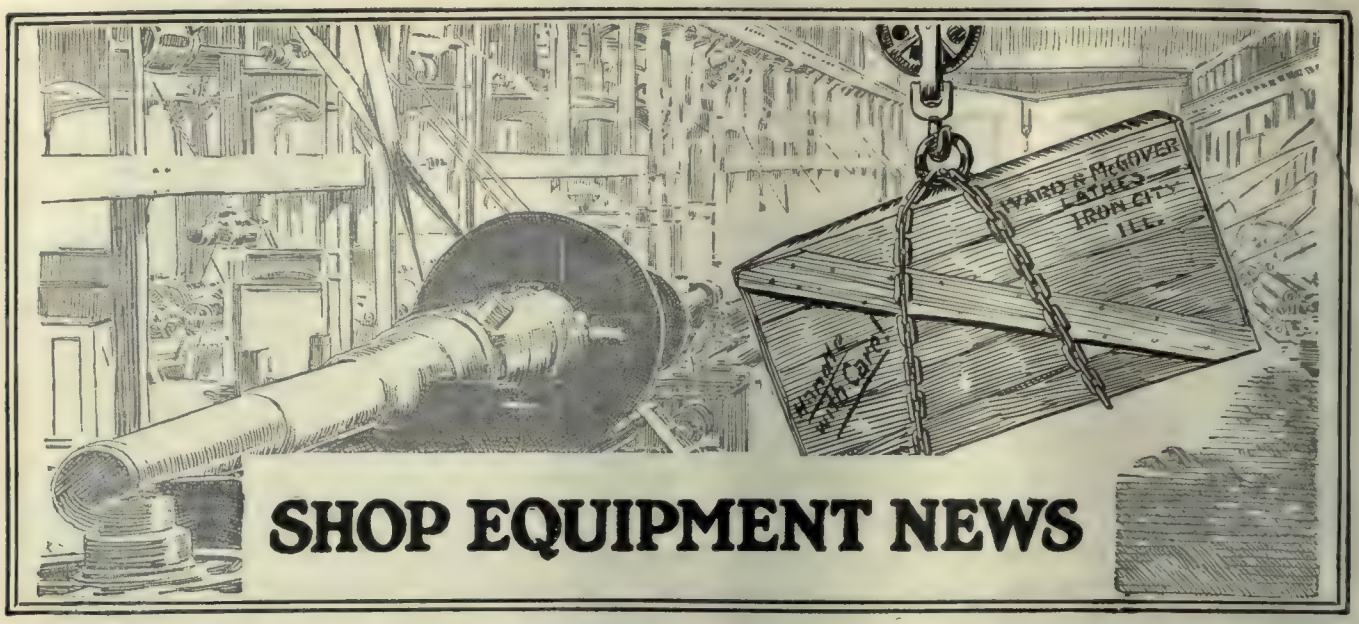
IN PARIS the stage is set for the final scene of the great war, and we are hoping for a quick curtain. Over here we are working for a goal hardly less vital—the over-subscription of the Victory Loan.

Our part in the war has taught us not only the fundamental need of united effort but also our enormous power as a nation when we go after something with all our might. We have seen what can be done when each one of us works his hardest for the common end and subordinates his personal aims. We must keep it up for the task of winning prosperity is, if anything, greater than that of winning the war. This time we haven't the fear of a Hun triumph to stimulate us, but we have the prospect of good round dollars in the pockets of all if we succeed.

Failure of the loan will result in depression, unemployment and hard times instead of the unprecedented prosperity predicted even by some of the most conservative and pessimistic observers of our business. Is such a chance worth taking when a determined effort will avoid it? Isn't it sound common sense to do everything in your power to maintain the get-together spirit of the other loans and push this last and greatest one for all you're worth?

There is also the war-debt balance of several billions. We still have well over a million men in Europe to be fed and paid, and they must be brought home. Don't forget the sacrifices they have made in the light of which your investment in a sure thing seems rather tame.

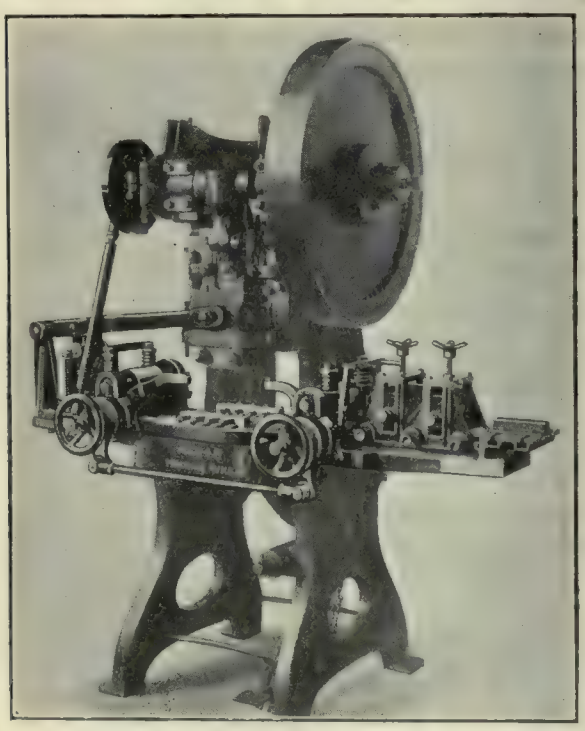
Continued unity of purpose is the strongest safeguard of business in the present crisis and a mighty weapon against Bolshevism. Remember that a property owner is inherently conservative even though the property be only a baby bond. For your own sake as well as for your country, get behind the loan. Talk it at home, in the office, in the factory, and *make* it go.



SHOP EQUIPMENT NEWS

Acme Roll Feeds for Press Work

The Acme Machine Works, 4125 Ravenswood Ave., Chicago, Ill., has announced a new line of roll feeds for power presses, one of which is shown in the illustration. It is believed to be the only roll feed on the market which is built in connection with a straightening device and which has a scrap cutter. The drive is



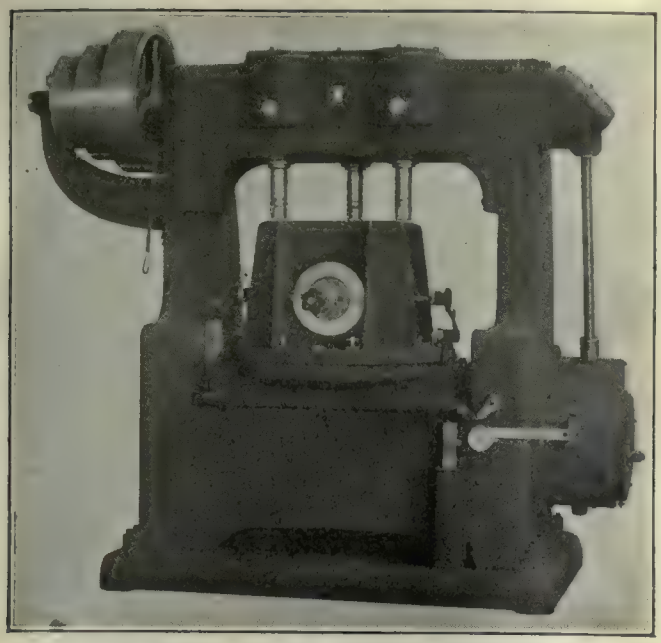
ACME ROLL FEEDS FOR POWER PRESSES

also stated to be a new feature. The roll feeds are mounted on their own bolster plates and are made to fit any make or size of press. The stock first passes through the straightening rolls to remove the curvature caused by coiling. These rolls are hardened and ground, run on roller bearings and are adjusted by means of handwheels for any weight or stiffness of stock. From the straightening rolls the stock passes to the feed rolls which are of large diameter and also hardened and ground. These are fitted with the Acme drive which has from five to seven pawls, each having a toggle grip action. With this driving device the pawls take hold the instant the direction of rotation of the driving housing is reversed, thus assuring accurate and noiseless feeding and an extremely fine adjustment at high speed. All working parts are hardened and ground. The scrap-cutting attachment cuts the scrap into small pieces which drop into a barrel or box relieving the operator from handling the stock, and avoiding the necessity of baling and having the floor littered with scrap. The automatic feed cut-out can be furnished in cases where the stock has to be fed up against a stop-pin; this feed cut-out eliminates the slippage of the rolls on the stock, which is of course undesirable.

Defiance Gas-Engine-Cylinder Boring Machine

The illustration shows a new vertical gas-engine-cylinder boring machine equipped with a circular indexing jig that is a recent product of the Defiance Machine Works, Defiance, Ohio. The speed and feed mechanisms of this machine are somewhat similar to those incorporated in other machines built by this concern, but the rotating-jig fixture, together with the arrangement of the spindles, is said to be a new method of boring gas-engine cylinders. This method allows the machine to produce constantly and saves the time ordinarily lost in loading and reloading the fixture. The machine is a single-purpose tool and is built in three sizes, taking 36, 48 and 60 in. between the housings. The machine can be fitted with either two or three spindles or with two or three groups of spindles. When fitted with three groups of spindles it will rough-bore, semi-finish and ream gas-engine cylinders of either single units or a number of units cast en bloc, these three operations being accomplished at one time. The circular indexing jig is designed to hold four units, this method of construction allowing the three above-named operations to be carried on at the same time the operator is unloading and loading at the fourth station.

Lubrication is secured by means of a force-feed and



DEFIANCE CYLINDER-BORING MACHINE WITH CIRCULAR INDEXING

splash system, this being made possible by the all-inclosed feature of the machine, both the feed and drive mechanism being tightly incased and practically submerged in a bath of oil, while the bearings are lubricated through individual leads from a force-feed mechanism.

The unit method of construction is followed throughout, each unit being accessible without disturbing other parts of the machine. The drive to the spindle is from a three-step cone pulley through steel worms and bronze worm gears, but instead of driving the spindles by means of keys, as in common practice, large tongue drives are cut integral with the spindles and mesh with grooves in the worm gears. This construction is located close to the spindle nose and as used in conjunction with the worm gear is said to effect a very smooth and powerful drive which reduces the possibility of torque in the spindle to a minimum and eliminates the chatter of the cutting tools. The spindles themselves are of hammered stock supported in three bronze bearings. The nose bearings are of conical shape with a means of adjustment, while end thrust is carried on two sets of SKF ball bearings. Momentum of the spindles can be overcome after the power has been shut off by a friction brake located in the drive pulley and operated by a lever within reach of the operator. The boring tools are fitted to the spindles by tapered shanks and are securely held in place by long bolts passing through the spindles, this method of construction eliminating the possibility of the tools being extracted from the spindle on the return feed.

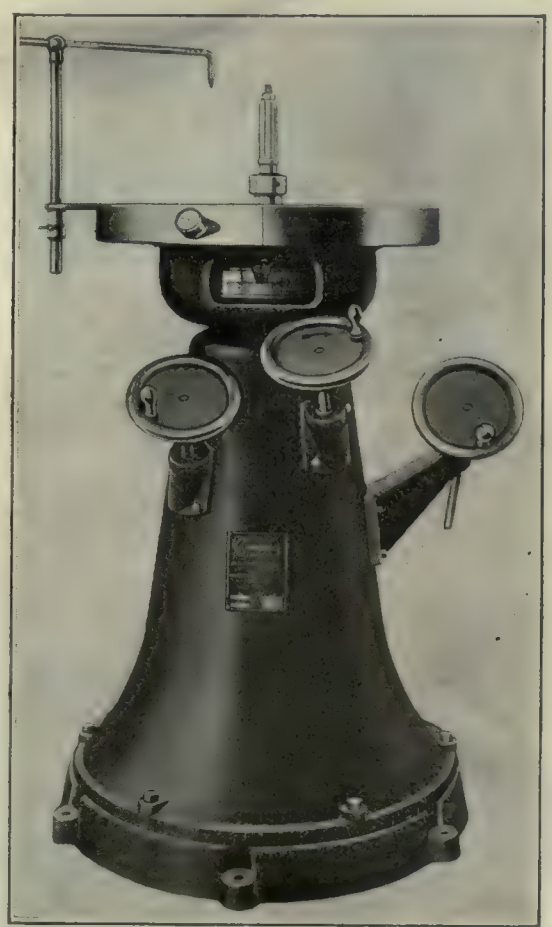
All feed-shaft bearings are bronze bushed while end thrusts are carried on SKF ball bearings. The feed changes can be made by removing the gear-case cover and changing two gears. A hand adjustment for the table is provided, and when in operation the table feeds the work to the cutters and when through, the cut automatically reverses on fast travel, returns to the loading position and stops.

The table is raised and lowered by jackscrews, each screw being retained in a jack and actuated by a worm and gear through a bronze nut which is sleeved to the worm gear. Each jack is a unit in itself, and its contents are packed in grease. A means is also provided for adjusting the screws independently to maintain alignment of the table. All thrusts are carried on SKF ball bearings. The jackscrews are located directly beneath the table and a vertical feed is obtained, eliminating side thrust.

The table, column and base are of cast iron, the table being gibbed to the column on both sides. The column and base are of box section, reinforced, and the base rests on the floor at three points only. The machines are built to specifications as best adapted to special requirements of individual customers.

Crawford Dynamic Balancing Machine

The Crawford Tool and Manufacturing Co., 1617 South Crawford Ave., Chicago, Ill., has just placed on the market the dynamic balancing machine shown in the illustration which is suitable for use on flywheels, pulleys, gearwheels, turbine rotors, waterwheels, connecting-rods, propellers, fans, separator disks, clutch-assembly parts, induction rotors, pistons and other such



CRAWFORD DYNAMIC BALANCING MACHINE

Capacity, work from 4 to 36 in. in diameter and weighing up to 600 lb. at 500 r.p.m.; speed of machine, 250 to 900 r.p.m.; tight and loose pulleys, 4 x 3 in., 1150 r.p.m.; floor space, 3 x 6 ft.; height of table, 44 in.; diameter of table, 24 in.; diameter of base, 27 in.; horsepower for belt drive, ¾; horsepower for direct-connected motor drive, ½; weight of bare machine, 1175 lb.

bodies as must be put into dynamic balance. Other bodies can be balanced with the use of special fixtures. In handling any of the above bodies they need not be in static balance before being operated upon. The machine will indicate by means of the vibration the

place and the weight of the counterweight that must be added. It is stated that the accuracy of the machine is well within $\frac{1}{8}$ oz. and that the sensibility is such that the machine will show the vibration caused by a weight of $\frac{1}{8}$ oz. placed at a radius of 5 in. with the machine revolving at 900 r.p.m.

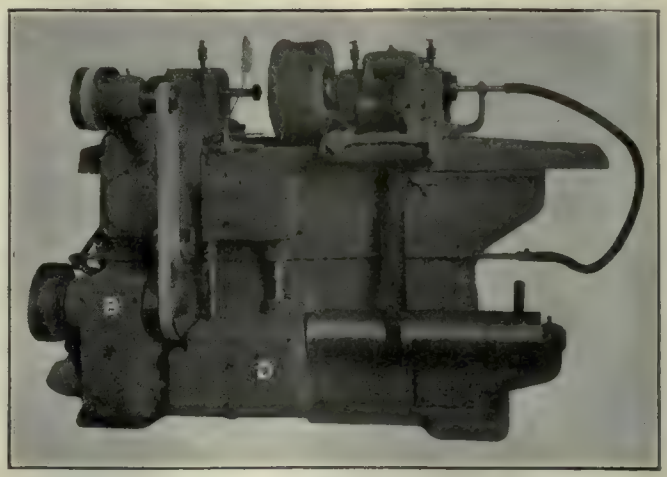
The principle of the machine is stated to be such that the so-called critical speed of the rotating body does not affect the indications of the machine. The operation is said to be very simple, there being little chance for the operator to make mistakes in the indication. The actual indication of the unbalanced body takes 15 to 25 sec., and the time required to place the body on the machine and remove it depends, of course, on the parts and facilities provided. The machine will handle parts from 4 to 36 in. in diameter weighing up to 500 lb. at 500 r.p.m.

Taylor & Fenn Bore Grinding Machine

One of the latest bore grinding machines to make its appearance on the market, and one that is said to have a number of features that are not incorporated in other machines, is shown in the illustrations. It is the product of the Taylor & Fenn Co., Hartford, Conn.

Fig. 1 is a front view of the machine, while Fig. 2 shows the right end. The machine is entirely self-contained and may be driven from a lineshaft, or an intermediate jackshaft may be used if desired. It will be noticed that the crossfeed instead of being placed under the wheel head, is placed under the work head. This wheel head remains in a fixed position in regard to the base or body of the machine, and is integral with the bridge that spans the table. Both the cross and longitudinal movements are on V- and flat-ways, doing away with all gibs. It is believed that this is the first time this construction has been incorporated in an internal grinding machine. The construction of the V- and flat-ways for the longitudinal movement can be seen in the end view of the machine, Fig. 2.

Another feature which is said to be of great convenience to the operator is the placing of the handwheel for controlling crossfeed. This can be seen just in front



MACHINE SHOWING THE LOCATION OF GEAR BOXES AND OTHER MECHANISMS

Capacity of machine, holes 8 in. long and 8 in. deep, it being possible, however, to grind slightly larger holes in emergency; diameter of inside of chuck guards, 12 in.; swing of machine without chuck guard, 14 in.; work speeds, four, arranged in geometrical progression; table feeds, three, arranged in geometrical progression; speeds of wheel spindle, two for each size of spindle, spindle speed furnished ranging from 6000 to 25,000 r.p.m.; width of main driving shaft belt, $1\frac{1}{2}$ in.; travel of automatic crossfeed, 3 in.; floor space, 42 in. wide, 95 in. long.

of the work head in Fig. 1 and is mounted at an angle so as to be very convenient for the hand of the operator when he is leaning over, watching the work. The pawl lever for the crossfeed is operated at both ends of the longitudinal stroke and receives its motion through the swinging leaf just below the table. This swinging leaf is operated by the trip lever, for the longitudinal feed; this construction making it possible to operate the crossfeed and table reverse with one set of dogs, these being visible on the front of the table to which they are fastened by bolts in a T-slot running along the front edge. The stroke of the pawl lever for the crossfeed is controlled by means of an adjustable nut and screw mechanism just back of the handwheel.

Longitudinal feeds are obtained through a rack-and-pinion mechanism driven from the gear box placed on the back of the machine as shown at *B* in Fig. 3. This gear box gives three feeds, these being changed or con-

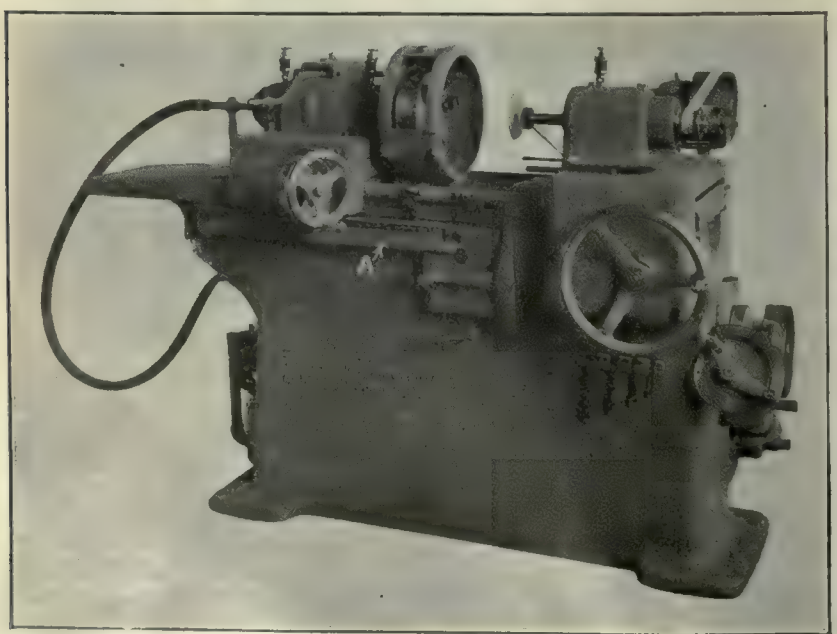


FIG. 1. FRONT VIEW OF TAYLOR & FENN BORE GRINDING MACHINE

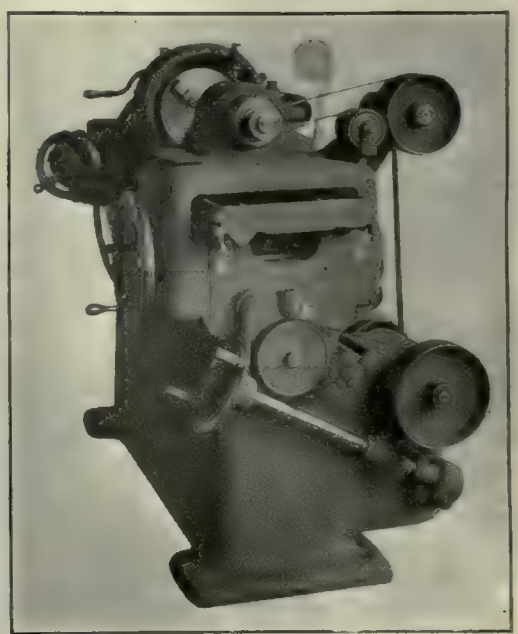


FIG. 2. END VIEW OF THE MACHINE

trolled by the short lever at the left of the sector at the right end of the machine in Fig. 1. It will be noticed that all gear boxes are mounted on the outside of the machine, this method being used in order to overcome the necessity of cutting holes through the base of the machine in order to allow for the installation of parts on the inside. This method of construction is claimed to make the machine considerably more rigid than where the gears and other apparatus are located in the inside.

The work spindle is started or stopped by means of the lever seen projecting from the front upper part of the work head in Fig. 1. This lever operates a brake for stopping the spindle quickly when pushed to the limit of its travel. The spindle is of large size and runs in tapered bronze bushings provided with means for taking up wear. The oiling is by means of sight-feed lubricators. Another feature of the machine is that all shaft holes coming through to the outside of the machine are plugged, in order to prevent dirt getting into the bearings. To prevent dirt or grit from getting on the ways, the table is cupped down over the bed as may be seen at *C* in Fig. 2.

As previously stated, the complete wheel-spindle unit is carried on top of the bridge, which is ribbed and bolted to the bed for solidity. The spindle is belt-driven from the main shaft through a jackshaft located at the back of the head, the belt being of the endless variety in order to prevent vibration caused by lacing.

The speeds of the work spindle are four in number and are controlled by the long lever on the right of the sector located at the front right corner of the machine in Fig. 1. The gears for these changes are also located in the gear box *B* at the rear of the machine in Fig. 3. All gears in this box are lubricated by a bath of oil. The reverse-gear box shown at *D*, Fig. 3, is also oil-tight, lubrication being by means of an oil bath. A notable feature of the machine is that all horizontal shafts connecting these boxes are inclosed in tubing to prevent dirt getting into the bearings, while the hole for each vertical shaft is covered by a sleeve fastened to the shaft and projecting down over a piece of tubing set in the top of the lower box. Fig. 3 also shows how the drum providing for longitudinal motion of the work head is mounted at the back of the machine, obviating the use of a countershaft for this member. It will also be noticed that all gear boxes, etc., are placed at the back and in this position do not interfere with the operator while at work at the front of the machine.

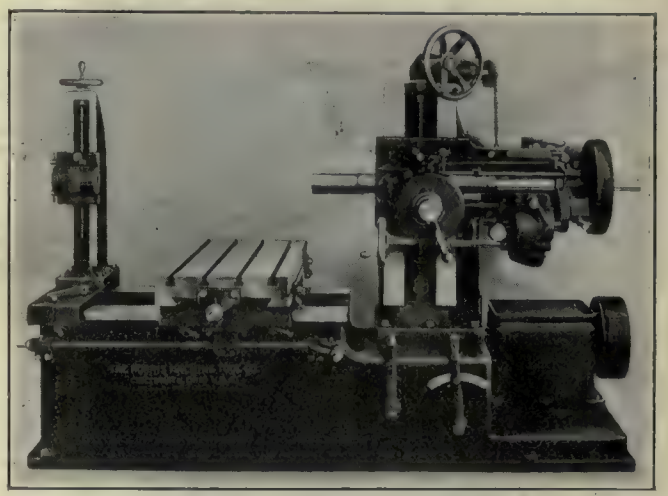
All high-speed shafts turn in ball bearings, while the slow-speed bearings are of bronze. The wheel guard is automatically controlled and may be set from the front of the machine. The large handwheel at the right in Fig. 1 is for hand movement of the table, but this is automatically disengaged when power feed is being used. The machine shown is for belt drive, but a motor-driven machine can be furnished if desired, in this case the main-drive pulley being replaced by a coupling which connects directly to the motor that is mounted on an auxiliary base.

The water pump is just inside of the base of the machine at *E*, Fig. 2 and is of the centrifugal type. A novel feature is the top of the table, which acts as a sediment pan. This is cast with a number of baffle walls and the water or cutting lubricant must travel twice the length of the table before returning to the tank in the base of the machine.

Another feature that might be mentioned is the method of fastening the gear boxes to the bed of the machine, a ledge planed on the bed of the machine locating the boxes in a vertical direction, while a pin placed at the top locates in a horizontal direction.

Morris Horizontal Drilling and Boring Machine

The horizontal drilling and boring machine shown in the illustration has just been placed on the market by the Morris Machine and Tool Co., Cincinnati, Ohio, in answer to a demand for a machine for drilling, boring, facing and tapping operations. The bed is of one-piece box section, ribbed internally and runs down to the floor. The column is also a box section and is bolted to the base. The bed moves on ways arranged with taper gibs, adjustable for wear, and is counterbalanced, the handwheel at the top of the column serving to raise or lower the head. A steel scale graduated in sixteenths of an inch is set into the column, and this in connection with the micrometer column on the head elevating screw enables readings in thousandths to be obtained for the full travel of the head.



MORRIS HORIZONTAL DRILLING AND BORING MACHINE

Smallest diameter spindle, 1⅛ in.; diameter of spindle nose, 3½ in.; taper in spindle nose, Morse No. 5; spindle traverse, 17¼ in.; maximum distance between spindle and outer support, 48 in.; size of table, 20 x 36 in.; longitudinal feed of table, 31 in.; crossfeed of table, 28⅜ in.; height from table to floor, 31 in.; feeds, six, 0.006, 0.009, 0.012, 0.017, 0.022, and 0.030 in. per spindle revolution; spindle speeds, 18 through speed box, 15 on pulley, 20 to 350 r.p.m.; driving pulley on speed box 14 x 3⅜ in., 400 r.p.m.; size and speed of motor 5 hp., 1200 r.p.m., net weight, 6500 lb.

The spindle is of forged high-carbon steel ground to size, the thrust being carried on ball bearings. The sleeve is graduated and provided with a direct-reading depth gage. The spindle drive gears are helical, this construction giving smoothness of action and the elimination of chatter. The back gears are of 3½ per cent. nickel steel, heat-treated and hardened, and are fully inclosed and mounted as a unit on the back of the head. The speed box is mounted on the bed with the gears fully inclosed and running in light grease. Six speeds are provided controlled by two vertical levers on the front of the bed below the column. The lever at the left controls the double friction clutch and pulley shaft, and the other lever the three sliding gears. The feed box is also a unit mounted on the head, the gears being inclosed and running in oil. Six speeds are provided that can be automatically tripped at any depth within the traverse of the spindle.

The bearings throughout are of bronze arranged with oil chambers, the oil being drawn into the bearings by felt wipers. The machine shown is for belt drive, but motor drive can be furnished if desired. In this case a three-to-one variable-speed motor is connected to the lower shaft by one pair of gears or a constant-speed motor used in connection with the speed box.

Gale-Sawyer Self-Tightening Inserted-Tooth Milling Cutters

A line of self-tightening inserted-tooth milling cutters, similar to the ones shown in the illustration, has just been placed on the market by the Gale-Sawyer Co., 36 Oliver St., Boston, Mass. The features claimed

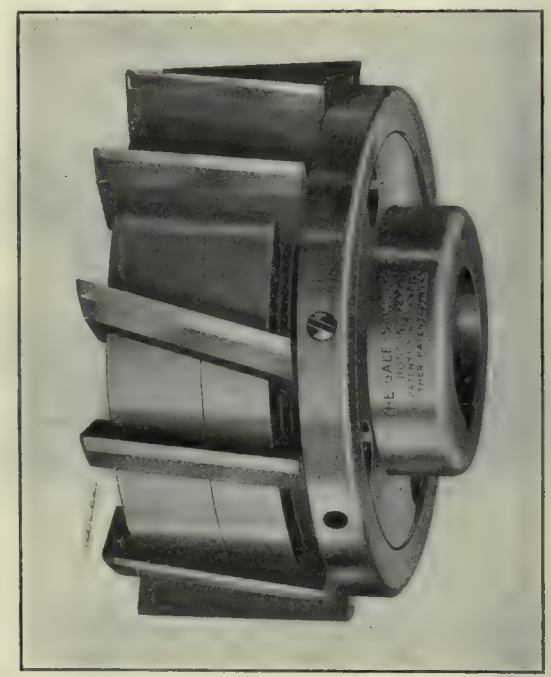


FIG. 1. GALE-SAWYER INSERTED-TOOTH MILLING CUTTER

for the new line of cutters are that the pins and other small parts generally used in fastening the teeth in place are done away with; the method of holding the blades makes it impossible for them to become loose or change position while the cutter is in operation; the harder the cutter is driven the tighter the blades will be held, and that it is impossible for the cutter to become frozen on the arbor or shank due to excessively heavy work.

The body is made in two sections. These two sections are slightly separated and the slots for the cutters or teeth are milled for the insertion of the blades, the alternate slots being at angles of 7 and 15 deg. with the center line. Fig. 1 shows an exterior view of the cutter while Fig. 2 shows a cross-section. After the slots have been milled and the blades put in place, the cutter is screwed onto the spindle or adapter, this operation serving to press the sides together, and to clamp the blades securely on account of the differing angle of alternate teeth. It will be noticed that about midway between the spindle and the outside edge are screws, four in number, these serving to loosen the cutter when removing from the spindle or adapter. By turning the four relieving screws to the right about one-quarter of a turn the shank or adapter is released and can be easily removed. To remove one or all of the blades, the relieving screws *A* are tightened by turning to the right about one-quarter of a turn. The shank or adapter *B* will then turn out easily and should be backed out four turns. The relieving screws *A* are then turned to the left until they strike the bottom of the hole *C*, after which the further motion of one-quarter of a turn will release the blades, the exact point at which these will slide easily corresponding to the position of the two sections when the slots were originally milled.

It should be stated that the bottom of the tooth is made wider than the top, this construction preventing

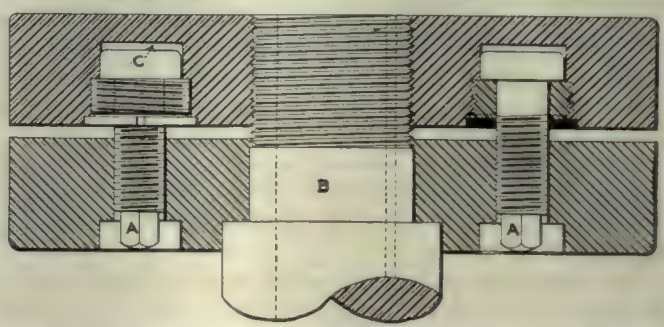
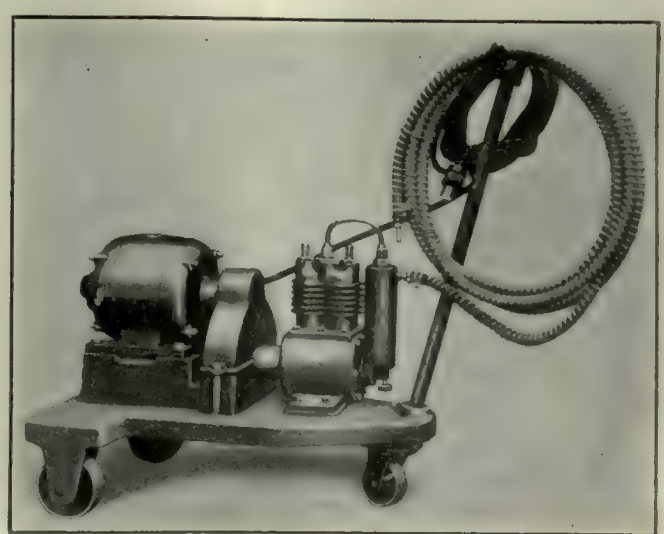


FIG. 2. A CROSS-SECTION OF THE BODY OF THE CUTTER SHOWING THE METHOD OF FASTENING AND RELEASING THE BLADES

the tooth moving out in a radial direction. The construction of the cutter lends itself readily to all methods of fastening on the nose of the spindle on any milling machine, as any type of adapter can be readily made to suit conditions. The company is prepared to furnish adapters of any type as required to suit the machines on which the cutters are to be used.

"Master" Portable Air Outfit

The illustration shows the "Master" portable compressed-air outfit on which a number of changes have recently been made by its manufacturers, the Hartford Machine Screw Co., Hartford, Conn. The outfit is said to be very useful in cleaning machine parts and can be readily transported from place to place about the shop and connected to any regular electric-light socket. A new motor is now being fitted. The pump is a two-



"MASTER" PORTABLE AIR OUTFIT

cylinder machine, a small expansion chamber being used instead of a regular tank. The bore of the pump is 1¾ in., the stroke 2 in. and the motor is of ½ hp. The outfit shown is mounted on a metal truck with three wheels, but a stationary outfit is also manufactured.

American Parallel-Grip Master-Hinge Collet Chuck

The illustration shows a new type of collet chuck being manufactured by the American Pneumatic Chuck Co., Chicago, Ill., and marketed by Neidow & Payson Co., 9 South Clinton St., Chicago, Ill. The important departure from the usual type of collet chuck is that



PARALLEL-GRIP MASTER-HINGE COLLET CHUCK

with the parallel grip the work is held with the same pressure the full length of the gripping surface, irrespective of any variation up to ¼ in. in size or taper. The device is made with an open rear end for bar work. The pull of the draw rod is directly on the jaws, the hinge pins not being subject to stress, causing the pin holes to become elongated or the jaws to lose alignment. A long slow taper bearing on the front end of the jaws is provided to insure a powerful grip and long wear, but the gripping power may be adjusted so that thin walls will not be crushed. All parts subject to wear are hardened and ground and the regular equipment includes master jaws with open rear end. False jaws either blank or shaped to the work, and an adjustable stop, can be furnished as extras. The chuck can also be made with two or four jaws instead of three if desired. It is regularly made in 2-, 3-, 4- and 6-in. sizes with outside diameters of 4⅝, 5¾, 6⅞ and 9 in. respectively, and lengths of 4, 4½, 5¼ and 6½ in. respectively.

Beaman & Smith Slot-Milling Machine

This machine was designed for milling internal grooves in gun carriages, but can be readily adapted for slotting any hole over 7 in. in diameter within practical limits. The bed is of the box type and carries individual motors for the cutter and feed, as well as the milling-bar supports and a revolving table for cutting two slots with one set-up of the work. Fast forward and reverse motion are provided for the milling bar. The cutter is carried on a vertical spindle in a steel bar and is driven through reduction gearing by a variable-speed motor, allowing the spindle speed to be adjusted to meet requirements. The spindle is mounted on New Departure double- and single-row ball bearings at the head and tail end respectively. The bar is ground to a sliding fit in the support brackets, and the end which carries the cutter is clamped securely in a bearing on the saddle after being located by a dowel pin in the bearing. Adjusting screws in the bottom of this bearing work against the pin in the bar, which turns sufficiently to allow accurate alignment of the cutter, this device locating the dowel hole in successive bars when it is desired to take more than one cut in the same slot. The dowel pin has a threaded end to allow its quick removal, and when once the dowel hole is located the cutter bar can be quickly set.

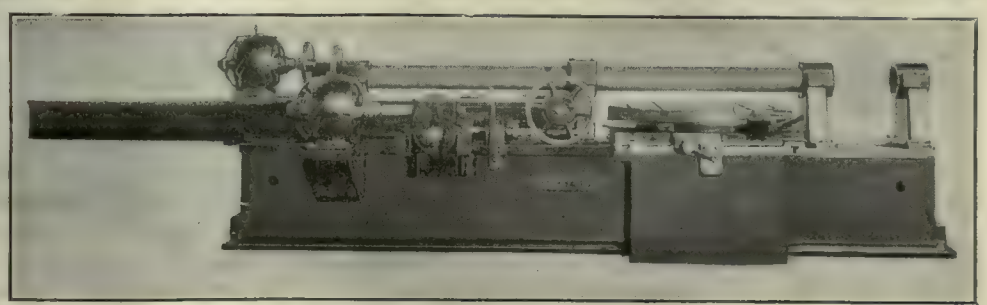
The spindle-drive shaft in the bar is connected to the main drive shaft by a coupling located immediately behind the clamp bearing on the saddle, this construction allowing for the rapid changing of cutter bars. The saddle carries the cutter-bar motor and reduction gearing and travels on flat-ways on a slide attached to the bed. The bearing surface is more than three times as long as it is wide, to insure accuracy of alignment, and wear is taken up by a gib. The feed nut attached to the bottom of the saddle is of bronze.

The feed and rapid traverse are by means of a motor carried at the front of the machine, the rapid traverse being operated by friction clutches controlled by a lever at the front. Close beside this lever is the feed handwheel, power being applied to the feed screw by a clutch in this wheel. With the clutch out, hand feed or rapid traverse in either direction are available, and with the clutch in, power feed in one direction only is available. Two changes of feed are secured through change gears and a large variety through the variable-speed motor, ranging from ½ in. to 4½ in. per minute, the rapid traverse giving from 4 ft. to 12 ft. per minute.

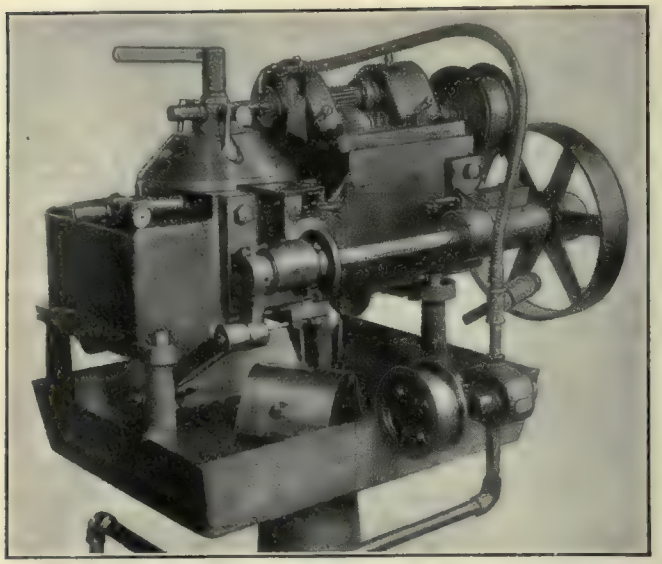
The revolving table carries the work and is operated by hand. It is attached to the bed and set so that the top is the proper distance from the cutter. The function of the table is to turn the work around in order to slot the opposite side without changing the set-up. The table is carried on ball bearings, when in motion, but when in working position it is clamped flat upon a large bearing. A taper latch serves to locate it accurately. The Beaman C. Smith Co., Providence, R. I., is the manufacturer.

Porter-Cable Differential-Cross Centering Machine

The machine shown in the illustration is shown centering the arm of a differential cross. This machine bores and reams the center holes through the hubs and faces the ends, and is the product of the Porter-Cable Machine Co., Syracuse, N. Y. The work is clamped to the indexing turret by means of an arbor through the hub and the indexing mechanism is arranged to turn



BEAMAN & SMITH SLOT-MILLING MACHINE



DIFFERENTIAL-CROSS CENTERING MACHINE

the cross 90 deg. after each operation. The centering tool is a regular combination drill and countersink. The indexing and feed of the tool are automatic and a circulating pump provides lubricant. The capacity of the machine is said to be approximately 90 crosses per hour.

Cincinnati 30-Inch Special Forge Planing Machine

The Cincinnati Planer Co., Cincinnati, Ohio, has just brought out the special new planing machine shown in the illustration, which is known as the company's special forge planer. It is a 30-in. machine and is said to have been designed throughout for extra-heavy duty, special care having been taken in the design of the side heads. The bed is heavy, of box section, and strengthened where the gearing and uprights are mounted. Oil reservoirs are cast in the girths at each end of the bed, and catch the oil used and hold it until drawn off through the plug in the end of the bed. The table is also of the box type, heavy and deep, the bottom being entirely closed so that no chips can go through the table. Ribs tie the top and bottom together at short intervals to prevent springing, either when clamping the work or when the table is at the limit of its travel. The table is also gibbed to the bed to prevent any tendency to rise as the tools enter a heavy cut.

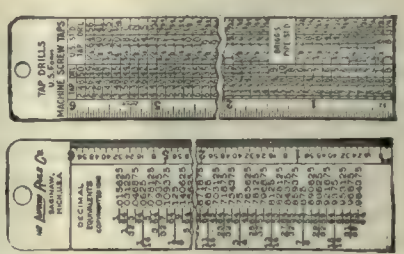
The housings are of box type and are keyed, bolted, and pinned to the bed, and tied together at the top by a heavy arch. The side heads can be run down completely out of the way of the rail, which has a box brace on the back to give additional stiffness. Two heads are provided, right and left hand, so that they can be run close together. The slides have a full bearing on the harp at all times and the heads are equipped throughout with taper pins to compensate for wear.

The tool blocks are of heavy design, arranged so that the tool will be held in a perpendicular position at all times. The construction of the side heads is massive, as is also that of the saddles, which have extra supports on the inside of the housings. These saddle supports are angle plates bolted to the inside of the housing, and not only furnish a bearing but carry an inside clamp for the saddle. In designing the side head, the harp was dispensed with and the slide given a square-gibbed bearing directly in the saddle, this construction decreasing the number of parts and increasing the strength and rigidity of the head. The heads are counterbalanced by a self-contained system of weights.

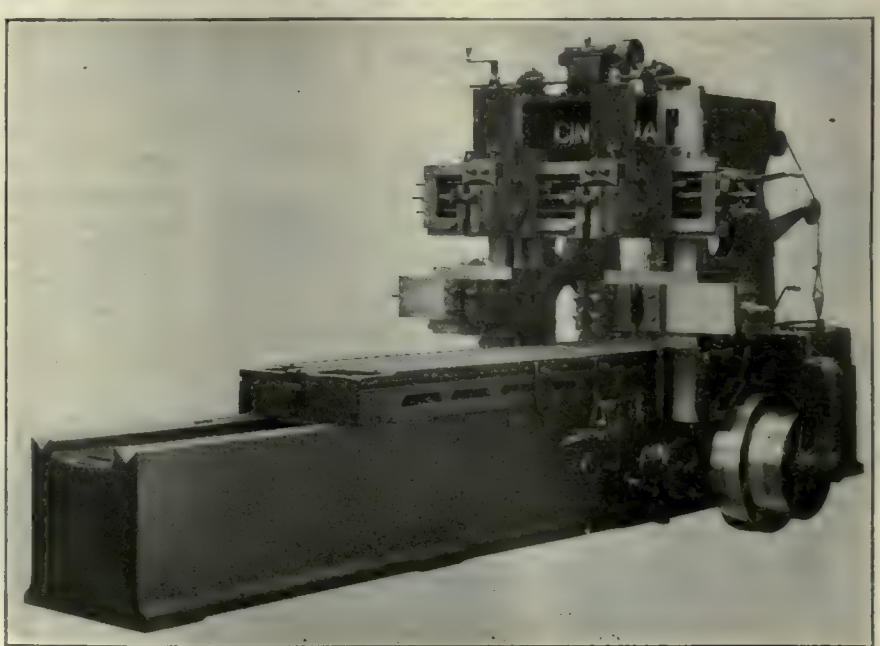
Vertical and horizontal power feeds are supplied to each head from the same friction that operates the rail heads. All gearing and racks are of steel, the driving gears being of chrome-nickel steel, and the high-speed bearings of bronze. The machine has been arranged for motor drive from the top of the housing, but any type of drive desired may be obtained.

Lufkin Mechanic's Steel Reference Table and Scale

The Lufkin Rule Co., Saginaw, Mich., has just placed on the market a mechanic's steel reference table and scale, the two sides of which are shown in the illustrations. This is known as the company's No. 97½ rule. As may be seen, the device carries on one side tables of tap and drill sizes, U. S. Standard, including frac-



LUFKIN STEEL REFERENCE TABLE AND SCALE, SHOWING THE MARKINGS ON BOTH SIDES

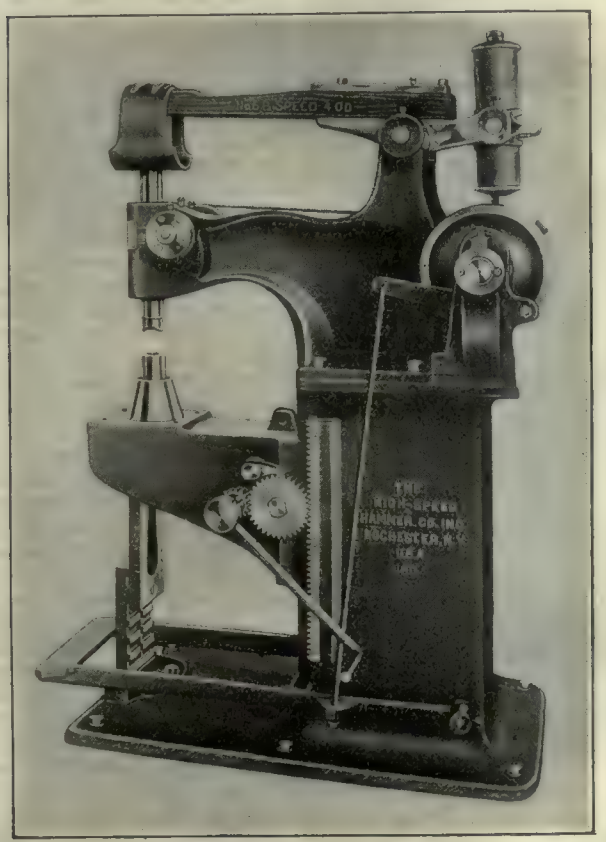


CINCINNATI HEAVY-DUTY SPECIAL FORGE PLANING MACHINE

tional as well as numbered sizes; also S. A. E. and Briggs pipe standard, and a 6-in. scale graduated in 32nds of an inch. The other side carries a 6-in. scale graduated in 64ths of an inch, with the improved feature of readable graduations, and a table of common fractions and their decimal equivalents. The device is in the form of a semi-flexible 6-in. steel rule, 1¼ in. wide, and has legible figures throughout. It is convenient to be carried in the pocket and also has a hole at one end so that it may be hung up.

High-Speed Riveting Hammer

The High Speed Hammer Co., Inc., Rochester, N. Y., has just placed on the market the new riveting hammer shown in the illustration which will produce full round heads cold from ⅝ to ¾ in. and oval heads of from ⅞ to 1½ in. The machine is said to be sufficiently heavy to stand up under the constant vibration required, the bronze vibrator, which is the connecting link between the hickory helve and rubber cushions, constituting the member through which all shock is transmitted to the helve where it is absorbed. This vibrator is of solid bronze and weighs 40 lb. The eccentric and rear main shaft are made from one solid piece of special steel ground to size and mounted on ball-thrust bearings. The bearing between the eccentric and eccentric strap is of the Hyatt roller type. The anvil block is provided with rack and pinion and gear for easy adjustment. The peen is revolved by a worm and worm gear, this feature being incorporated to produce a finish on the rivet heads.



HIGH-SPEED RIVETING HAMMER

Capacity, round heads, ⅝ to ¾ in. in diameter, oval heads, ⅞ to 1½ in.; height, 6 ft.; length of hickory helve, 2 ft. 8 in.; horizontal gap, 16 in.; vertical gap, 16 in.; dimensions of base, 2 ft. x 3 ft. 8 in.

The Electric Drive of the Battleship "New Mexico"

The successful application to the driving system of the battleship "New Mexico" of the results of experiments with electric motors on the collier "Jupiter" is cause for congratulation of the Navy Department and its engineers and of the General Electric Co., who built the units.

For some years small boats have been driven by direct-current electric motors. For larger craft the installation of induction motors receiving current from high-speed turbine-generators where maximum efficiency could be combined with minimum weight has seemed very attractive to engineers. The ease of operation and improved maneuvering qualities of the "Jupiter" when so equipped were so marked that the decision was made to obtain the same advantages for our largest fighters. The requirements for the application of the system to the "New Mexico," a 32,000-ton ship, were for highest economy both at high speed and full power at 21 knots, and at medium speed of 15 knots where the maximum cruising radius without refueling is of the greatest importance. To meet these conditions a changeable-pole motor was mounted on each of the four shafts, all four motors taking power from two generators when at full speed and from one when cruising.

New Type of Winding

As the motors and generators were to be designed especially for this job and were to work together, it was feasible to devise a new type of winding, the coils of which were so grouped that a change in the connection at the motor terminals would give a balanced quarter-phase distribution for either 24 or 36 poles. At speeds from 8 to 15 knots the four motors are operated on the 36-pole connection from one generator with its winding connected in parallel, the switching being arranged so that either generator can be used. At speeds from 15 to 17 knots the motors are thrown over to the 24-pole connection, still on one generator. Above a speed of 17 knots two generators are used, connected in two squares. For reversing, the 36-pole connection is used. At a speed of 21.5 knots the screw is brought to full-speed astern in 20 seconds. The speed variation is obtained by steam control on the turbine.

Elaborate safety devices and interlocking switches are provided to prevent accident, and adequate arrangements for cooling the motors and generators have been made.

The electrical units are very similar to land machines of the same capacity except that, owing to the different operating conditions, it has been possible to reduce the weights considerably by substituting steel for cast iron in some places and by modifying the design.

The trials of the "New Mexico" were attentively watched by the naval experts and the designing engineers who were invited to be present and all were impressed by the manner in which the various parts stood up to the tests and exceeded the requirements. The accompanying table gives an idea of the relations existing between the calculated and the actual performance.

Speed in Knots	Estimated Horsepower	Actual Horsepower	Estimated r.p.m.	Actual r.p.m.
10	2,550	3,200	75.0	78.4
15	8,350	10,350	112.0	115.6
19	18,650	24,350	144.5	149.2
21	26,300	32,480	161.0	166.7



Sparks from the

Special Board for War Contract Claims

Established by the War Department and Known as Board of Contract Adjustment for Hearing Appeals

The War Department authorizes the following statement from the War Department Claims Board, of which Hon. Benedict Crowell, Acting Secretary of War and Director of Munitions, is the president:

The attention of the War Department has been directed to the fact that several privately owned organizations or agencies have been created for the purpose of preparing or presenting to the War Department for adjustment, payment or discharge, contractors' claims arising out of the suspension or termination of contracts.

While the War Department, of course, can have no objection whatever to contractors availing themselves of any facilities for the presentation of claims which may seem desirable to them, it is important that it be clearly understood that the organizations and agencies referred to above are of a purely private character and have absolutely no official connection with the War Department.

There has been set up within the War Department a comprehensive organization for the consideration and disposal of all claims arising under contractual relations, implied or expressed, with the War Department.

There has also been set up a special board known as the Board of Contract Adjustment for the purpose of hearing appeals on petition of the contractors from any decisions made by the bureau boards. Any contractor, who, after due negotiation with the settlement board of any supply bureau, feels that the award of settlement offered to him is not just has the right to file a petition on appeal with the Board of Contract Adjustment, which will then review the case, making settlement direct or returning it to the bureau board with directions as to basis of settlement. The contractors, submitting their claims to the Board of Contract Adjustment, are not required, in any degree, to waive their right of appeal to the Court of Claims in the event they are unwilling to accept the decision of the Board.

It is therefore believed that every facility has been afforded contractors for the prompt and efficient determination of their rights as claimants. Every claim, whether under express or implied contract, will receive careful and full consideration while settlements in every instance will be made as promptly as possible.

The War Department, at all times, will give claimants full information concerning the presentation and handling of claims and no one should feel that any information at the disposal of the War Department may be more readily obtained through the intervention of a privately owned organization or agency.

Claimants may apply either personally or in writing to Maj. Erskine Bains, Recorder of the War Department Claims Board, Room 2402, Munitions Building, Washington, D. C., for any information concerning filing of claims against the War Department and this information will be given promptly and in as full detail as possible.

The War Department desires especially to point out that claims presented direct by contractors will receive the same attention as those presented through a claims organization or agency.



Colonel Hayden Eames Delivered the Goods

Col. Hayden Eames who has traveled all over the world may be said to inherit his taste for travel. He was born in Shanghai, China, his parents having gone there from the State of Maine, U. S. A. He came to this country when he was about eight years old. At the age of 14, he entered the U. S. Naval School, graduating in 1882. After having served in the naval service on this coast, in Northern Europe, the Mediterranean, the West Indies, South America and West Africa, Colonel Eames resigned on Mar. 14, 1894.

Since his resignation he has been either in charge of, or financially interested in, industrial and mercantile enterprises of various kinds. Upon his return in the summer of 1917, from a business sojourn in Russia, he immediately volunteered his services to the Navy Department, but on account of his experience in small arms, machine guns and ammunition production for the Navy, he was sent for to take charge of production for this class of articles for the Army Ordnance Department. How ably Colonel Eames succeeded in handling this task is evidenced by the remarkable achievement of the small-arms section in the matter of production, for which he was very largely responsible. Everybody is familiar with the rifle situation as it was when we entered the war. Apparently there was no hope for an adequate production of rifles. Yet in spite of this alarming outlook every soldier of the A. E. F. has been adequately armed with small arms and the accomplishment of the Small Arms Section in so doing represents one of the most creditable pieces of work of the Ordnance Department.

* * *

Clubs Hold Joint Meeting

The Machinery Club and the Rotary Club of Chicago held a joint meeting in the club rooms of the Machinery Club on Thursday evening, Apr. 10. The meeting was held with the view of increasing the acquaintance of the members of these two large business men's clubs. A dinner was served in the dining room of the Machinery Club and a program of home talent from both clubs furnished the entertainment.

World's Industrial Forge

By E. C. Porter, News Editor

Joint Convention of Two Drop Forge Associations

The American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh. The convention headquarters will be the William Penn Hotel.

The following are the officers of the American Drop Forge Association: President, E. J. Frost, Frost Gear and Forge Co., Jackson, Mich.; vice president, J. F. Connelly, Champion Machine and Forging Co., Cleveland; secretary, A. W. Peterson, *American Drop Forger*, Pittsburgh; treasurer, E. B. Horne, Packard Motor Car Co., Detroit.

The officers of the Drop Forge Supply Association are as follows: President, H. N. Talyor, N. & G. Taylor Co., Philadelphia; vice president, Charles Harmon, Jr., National Machinery Co., Tiffin, Ohio; secretary-treasurer, A. L. Wurster, Sizer Forge Co., Bourse Building, Philadelphia.

The local entertainment committee is as follows: For the American Drop Forge Association, A. W. Peterson, *American Drop Forger*, Pittsburgh, and T. W. Siemon, Union Switch and Signal Co., Swissvale, Penn.; for the Drop Forge Supply Association, Floyd Rose, Heppenstall Forge and Knife Co., Pittsburgh, and Charles E. Hill, Crucible Steel Co. of America, Pittsburgh.

Technical papers on the following subjects will be read and discussed: "Electric Welding as Applied to the Forging Industry"; "Testing of Materials"; "Powdered-Coal Developments in the Forging Field"; "Sand Blasting versus Pickling"; "Heat-Treating Problems That Originate in the Forge Shops"; "Forge-Shop Profits"; "The Die Factor in Selling Forgings"; "The Low-Pressure Exhaust Steam Turbine," and "The Bonus System in the Entire Forge Shop."

* * *

Enlistments for the Air Service

The Air Service of the Army, as reorganized by Maj.-Gen. Charles T. Mencher, has been given authority by the General Staff to include enlisted men up to about 15,000. Under the terms of the draft act, the men who are now in the Air Service, will be discharged, and if flying is to persist as a major branch of the army, some of these men must reënlist, or others must be attracted to fill their places. To this end the Air Service has begun a nation-wide recruiting campaign, the work in the Eastern Department being under the direction of Major J. McClintock, 104 Broad St., New York City.

"At the present time," says an Air Service statement, "enlisted men constituting the Air Service Forces are men who have been in for the period of the war and most of them are extremely desirous of severing their connection with the Army. It is thought that from among this number who desire to get out of the service, if the proper inducements the Air Service is able to give, were presented to them in the right light, they could be induced to stay in for a period of one year."

It is possible at this time for these men to take their discharge, receive the $60, that is allowed each discharged man, reënlist in the Air Service for one year, then be given one month's furlough, and in most cases it will be perfectly possible for that man to retain the non-commissioned grade that he has attained, and upon this reënlistment, in addition to the $60 allowed each discharged man, be allowed five cents per mile to his home. Inasmuch as he can obtain a one-cent-a-mile rate when going on a furlough and return to his proper station, he can save from this amount a certain nominal sum.

There is not any particular advantage for enlisted men who have not had previous experience, to enlist for one year, because the Air Service cannot guarantee teaching them any trade. However, for men who have had service in the army, it is believed that there is a decided advantage for the period of one year enlistment.

The Air Service enlisted personnel is composed of the following skilled workers: Chauffeurs, auto mechanicians, auto-engine repair men, carpenters, radio operators, electricians, instrument repair men, coppersmiths, armorers (machine-gun repair men), sailmakers, photographers, machinists, blacksmiths, motorcycle repair men, stenographers, cabinet makers, draftsmen (mechanical), magneto repair men, metal workers, automobile engine testers, rope riggers (cordage workers), propeller makers (airplane), riggers (airplane assemblers), telephone linemen, toolmakers, vulcanizers, welders, telephone operators, motorcyclists, plumbers, painters, tailors, gas works employees, molders, patternmakers, telephone adjusters, truck masters, propeller testers (airplane), boat builders, saddlers, and stock-keepers (experts).

* * *

Ordnance Circular for Recruits

A circular has been issued by the Ordnance Department entitled "Information for Recruiting Officers and Applicants." This circular contains information on what ordnance is; what ordnance pays its soldiers; what sort of men ordnance needs; what the projected ordnance training courses are; and what ordnance experience means to men.

The National Metal Trades Association

The Committee on Industrial Education Makes Its Report—Other Papers Read, and Election of Officers

The twenty-first annual convention of the National Metal Trades Association was held in New York on Apr. 23 and 24, and was well attended. After the usual reports of officers, Harold C. Smith of the Illinois Tool Co., chairman of the committee on industrial education, reported on a tour of inspection made by members of this committee to various plants in Providence, Worcester, New Haven, Bridgeport, Stamford and Buffalo; they are unanimously agreed as to the necessity of more intensive training in the metal-working industry.

The training of workers is now carried on under five general plans: Apprenticeship, trade and continuation schools, instruction by foremen, special training in plant, and vestibule schools.

The apprenticeship systems and trade schools have for their object the manual and technical training of boys and young men in a particular craft or trade which they may select. These methods have been covered by previous committee reports and it is the opinion of the present committee that their value has already been proved. They emphasize the desirability of each member training apprentices in proportion to the number of journeymen craftsmen employed, and supporting the trade and continuation schools wherever they are in existence.

The committee desires to point out, however, that apprenticeship and trade schools are particularly designed to take care of young men who wish to learn a trade in all its branches, and are not generally adaptable to the instruction and up-grading of unskilled workers.

The system of instructing by foremen is perhaps most universally employed and consists in putting the workmen directly under the supervision of the foreman in charge, who is entirely responsible for their success or failure. The observation of the committee is that the particular objection to this method is that the foreman, being responsible for the success of his department, in a great many instances, has not the time nor the patience to properly instruct the worker, nor the ability to impart his own knowledge.

There is also the possibility that prejudice on the part of the foreman may prevent him from properly instructing the worker in the performance of the required operations, the result being a lack of efficiency and consequent loss to both the employer and worker.

A system of special training in the plant consists of training in the department by a general instructor. This has some of the advantages of the vestibule school, and in the opinion of the committee is preferable to instruction by foremen.

The vestibule-school plan came into prominence during the war. As the name implies, it is intended to be the worker's entrance to the factory, and while by no means supplanting apprenticeship, it is adaptable in some form in every shop and goes far toward solving the problem of the shortage of skilled labor. It has been applied very largely to the intensive training of workers for repetition work, and has also been used to train specialists as operators of particular types of machine tools. To this school should be sent all accepted applicants, where their fitness or unfitness is determined. The length of time spent in the school depends upon the skill students possess at the start, their aptness, and the character of the work they are to be taught. The committee found in the schools visited that the training time varied from three days to three months.

Many of the thousands of men and women from all walks of life, trained to high efficiency as specialists in the vestibule schools during the war, continue to retain their positions, and in numerous instances surpass in production workers trained under other systems.

A system so wide in its scope and so general in its application can be only outlined in such a report as this. It must also be remembered that local conditions will determine the adjustment of the course to the members' needs. The committee is strongly of the opinion that intensive training will in a large measure assist in successfully meeting the competition of the world. It has, therefore, decided to recommend to the national executive committee the employment of a man specially qualified in this work, whose duty will be to further industrial training in the individual plants of the members. In the meantime, the committee hopes to receive the individual expressions of the members as to their experience in the various forms of training which may already be established in their plants, and the desirability of the association becoming more active in carrying on a campaign for the intensive training of workers.

A Successful Meeting of Gear Makers

American Gear Manufacturers' Association Held Its Annual Convention in Cleveland and Was Well Attended

The annual convention of the American Gear Manufacturers' Association, held in Cleveland on the dates of Apr. 14 and 16 inclusive, was exceptionally well attended. More than three-quarters of the member companies were represented and some of these by four to five officials from each. An exceptionally interesting program had been prepared so that in addition to giving the members of the association an opportunity to get together and become better acquainted, they also had a chance to discuss many of the trade problems which they meet in connection with the conduct of their regular business affairs.

The standardization committee reports show that while nothing as yet can be considered in its final form in this respect, still the amount of work which this committee is performing is stupendous, and will eventually lead to remarkable results in obtaining a better standard for gear users and gear manufacturers. The standardization of inspection was also extensively discussed and will eventually lead to uniform practice in regard to this matter, especially in regard to complaints by users of gears for claims which are in no way the fault of the gear manufacturer. A standard form of contract providing for all eventualities is also under consideration.

The technical papers which were presented at the Tuesday morning session of the association included: "Gear Steels," by Dr. J. Heber Parker, of the Carpenter Steel Co.; "Worms and Worm Wheels," by G. W. Carlson, of the Timken-Detroit Axle Co., and "Proper Sizes and Materials for Gears for Tractor Construction," by E. J. Frost, of the Frost Gear and Forge Co. The papers were all very interesting and led to lengthy discussions.



F. W. SINRAM
President



H. E. EBERHARDT
Vice President



F. D. HAMLIN
Secretary-Treasurer



B. F. WATERMAN, Chairman
Standardization Committee

In order not to interfere with the full attendance of the members at the convention meeting, no shop-visitation trips were planned during the course of the convention, but a great many invitations were extended to the members to visit plants of the different machine-tool and machinery manufacturers of Cleveland on the day following the close of the convention.

The following officers were reëlected to serve for another term: President, F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, Ohio; vice president, H. E. Eberhardt, of the Newark Gear-Cutting Machine Co., Newark, N. J.; secretary-treasurer, Frank D. Hamlin, of the Earle Gear and Machine Co., Philadelphia, Penn. The three vacancies on the executive committee were filled by the election of E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich.; Wm. Ganschow, of the Wm. Ganschow Co., Chicago, Ill., and J. B. Foote, of Foote Bros. Gear and Machine Co., Chicago, Ill.

The semi-annual meeting of the association has been fixed for Boston, Mass., for the dates of Oct. 6, 7 and 8, 1919. The general committee reports, and especially that of the standardization committee, will not be given out until they have an opportunity to put these into more concrete form and refer them to the associations for full consideration before adoption.

Following this were talks on "Our Constitution, the Antidote for Bolshevism," by Harry F. Atwood; "The 'Dust' in Industry," by Frank Jewel Raymond; "Work of the Department of Commerce and Its Relation to Business," by Hon. Wm. C. Redfield; "Problems in Shipbuilding," by Howard Coonley, vice president, U. S. Shipping Board, and "Industrial Democracy," by Rev. Charles Aubrey Eaton.

The officers for the ensuing year are: President, John W. O'Leary, Arthur J. O'Leary & Son Co., Chicago, Ill.; first vice president, Murray Shipley, the Trailmobile Co., Cincinnati, Ohio; second vice president, Albert E. Newton, Reed-Prentice Co., Worcester, Mass.; treasurer, F. C. Caldwell, H. W. Caldwell & Son Co., Chicago, Ill.

Government Gets New Plan for the Sale of Tools

Machine-Tool Builders Want Larger Commission, Claiming 7½ Per Cent. Offered by Present Plan Inadequate

At a conference held recently in Washington between the representatives of the National Supply and Machinery Dealers' Association and the officials of the office of director of sales of the War Department, a plan was drawn up by a committee of the machine-tool dealers for the disposal of second-hand tools owned by the Government. It is understood the plan will soon be submitted to Government officials as a substitute for the Government proposal, which the dealers regard as unacceptable because the compensation offered is only 7½ per cent. Under the plan to be proposed by the dealers, the Government is asked to pay a total of 15 per cent.

While the machine-tool dealers assert they are not making any attempt to dictate to the Government what it shall pay, it is stated unofficially by some of the dealers that nothing less than a 15-per cent. commission will be accepted. The plan is to divide the country into 25 selling districts, these districts to be generally recognized by machine-tool builders in their selling arrangements with dealers. A dealer would be appointed in each district to be solely responsible to the War Department for all sales in his district, his compensation to be 2½ per cent. on gross sales. He is to have the right to enlist the coöperation of other dealers in his district, the idea being to sell various makes of tools through the distributer who handles new tools of the same make. The commission to be paid to these other dealers, as proposed, is 12½ per cent. The Government is asked to furnish warehouse space free until the tools are disposed of.

The following committee is in charge of the arrangements: George H. Cherrington, president of the Brown & Zortman Machinery Co., Pittsburgh, chairman; W. J. Radcliffe, E. A. Kinsey Co., Cincinnati, and J. W. Wright, Colcord-Wright Machinery and Supply Co., St. Louis. A special committee on the disposal of Government tools consists of M. A. Sherritt, Sherritt & Stoer Co., Philadelphia; H. W. Strong, Strong, Carlisle & Hammond Co., Cleveland, and Thomas A. Fernley, secretary and treasurer of the National Supply and Machinery Dealers' Association, Philadelphia.

Disposal of all new tools, which were bought by the War Department and not used, is to be arranged, if possible, through the machine-tool builders, each builder being asked by the Government to take back and resell his own tools on a 7½ per cent. commission.

Some of the builders, however, object to the commission as inadequate, especially as they pay their distributers 10 per cent. or more on all sales.

Business Items

The Wetmore Reamer Co. is the new name of the Wetmore Mechanical Laboratory Co. of Milwaukee. The company has taken more floor space and enlarged its offices. P. H. Dorr, recently released from service, has been made secretary and sales manager.

The Aborn Steel Co., Inc., has arranged to have the Charles A. Dowd Sales Co. of San Francisco, Calif., as representative on the Pacific Coast.

The Foster Machine Co., Elkhart, Ind., has secured the rights and privileges of a patent issued to W. A. Barker for the manufacture and sale of the Barker wrenchless chuck. Mr. Barker the inventor and patentee of the wrenchless chuck is now associated with the Foster Machine Co., as manager of the chuck department. He was formerly with the Thomas Elevator Co., Chicago, Ill., as general superintendent.

The Bailey Meter Co. has removed its main office and works from Boston, Mass., to Cleveland, Ohio. The Boston office, with Mr. H. D. Fisher as manager, is retained to handle sales and engineering service work in New England district. For the present New York and Philadelphia districts will be covered from Boston and all other districts will be covered from Cleveland.

William K. Stamets of Pittsburgh, Penn., is opening a new office in Cleveland, Ohio, under the management of Wm. S. Dickson, formerly general manager of the Greaves Klusman Tool Co., Cincinnati, Ohio.

* * *

Lathe Firms of Syracuse Consolidate

The Porter-Cable Machine Co., with a large, new plant, five stories high, at Nos. 1708-12 North Salina St., Syracuse, N. Y., has taken over the Mulliner-Enlund Tool Co., of No. 541 South Clinton St., it is announced by the officers of both concerns. This is a consolidation of the only two industries in Syracuse making lathes.

The plant of the Mulliner-Enlund company, manufacturing machinery and other equipment, will be moved to the Porter-Cable Machine works, and G. N. Enlund and R. H. Mulliner will join the enlarged company. Mr. Enlund has been president and Mr. Mulliner, treasurer of the former company.

As a result of the merger the working force of the Porter-Cable Machine Company will be practically doubled, 150 persons being employed there now, and the Mulliner-Enlund force amounts to 135 persons.

The officers of the Porter-Cable Machine Company are: President, Walter A. Ridings: vice presidents, George G. Porter and Robert Love; treasurer, Frank E. Cable; secretary, Stewart F. Hancock; superintendent, L. J. Schuyler; chief engineer, W. H. Hafermalz.

Sixth National Foreign-Trade Convention

A Number of Papers Were Presented on the Foreign-Trade Outlook, and Extracts Are Here Given

The Sixth National Foreign-Trade Convention was held Apr. 24, 25 and 26 at the Congress Hotel, Chicago. The convention had a very interesting program and extracts are given from the various papers which are of interest to our readers.

A speech by Edward Prizer, president of the Vacuum Oil Co., entitled "Export of Industrial Products," in which he pointed out the needs of foreign trade, was delivered at the first general session on Thursday, Apr. 24. In this speech he said: "We are now facing an industrial crisis unless we can largely and rapidly increase our exports of finished products; for in no other way can our great industrial capacity be utilized. The export of raw or semi-finished articles unquestionably adds to national wealth but gives little aid to industry. We must export cotton in fabrics and not in the bale; iron and steel in machinery and implements; leather in shoes and other finished articles; use our coal in our own factory boilers; and in every way multiply the overseas movement of products of hand and brain which our recognized manufacturing and inventive skill, unequaled by any other country in the world, so eminently fit us to produce."

In addressing the opening session, William Pigott, president of the Seattle Car and Foundry Co., said: "In my opinion there is very little difference between the basic fundamental principles necessary to the development of foreign trade and the methods commonly used in the successful development of our home business. The elaborate training for foreign trade is much discussed, but I believe in the final analysis the salesman with the lowest cost and better quality of goods, speaking good plain American English, and possessed of average American honesty, application, and intelligence, will in the end book more orders than the man who wastes his time and his company's money aping foreign habits, customs and peculiarities. Manufacturers, business men and salesmen of the United States must cut down to plain living and high thinking before we can expect to secure any great proportion of competitive foreign trade."

J. W. Hook, president of the Allied Machinery Co., of America, opened a plea for a definite foreign-trade policy based upon the allotment of a certain proportion of product to foreign trade and on the establishment of all-American sales agencies.

"Can American Fabricated Products Hold Foreign Markets?" was the title of a paper by William E. Peck, president of W. E. Peck & Co., Inc., and which was delivered at the group session of the convention on foreign-trade merchandising.

Trade Catalogs

P. C. GUNION has recently been appointed advertising manager of the industrial division of the General Motors Corp., New York City.

JOHN BOSSERT, formerly in the local sales department of the Hart-Parr Co., Charles City, Iowa, has been appointed manager of the branch office at Wichita, Kan.

AMOS E. CARLE has recently been appointed to the machinery sales office of the Cadillac Tool Co., Detroit, Mich.

J. R. ASPLEY has been appointed head of the salvage department of the Hart-Parr Co., Charles City, Iowa. This is a new department at the Hart-Parr works, having been established since the close of the war, to take care of the machinery and material no longer needed for war manufacturing.

N. CLAUSEN, formerly superintendent of the Gillespie Loading Co., Morgan, N. J., has taken a position as engineer with the Epping-Carpenter Pump Co., Pittsburgh, Penn.

LIEUT. L. K. GOSS, Ordnance Department, U. S. A., recently discharged, has become associated with the Manufacturers Equipment Co., Chicago, Ill., as assistant to the president. Previous to his enlistment, Mr. Goss was in the employ of the Warner & Swasey Co. as a western representative and manager.

CHARLES A. DOWD has been released from the Production and Inspection Division along the Atlantic Coast. For the last three months he has been in charge of 17 plants in northern New York, as gage inspector. Mr. Dowd returns to San Francisco to take up the business under the name of the Charles A. Dowd Sales Co., under which name he did business before the war. He will represent the following firms: The Napier Saw Works, J. T. Slocomb, Thomson Welding Co., C. Johannsen, Vixen File Co. (Heller line), Cox Brass Co. All of his employees have been in the service and are going back into the firm with him.

New Publications

The Turnover of Factory Labor.—By Sumner H. Slichter. Four hundred and sixty 5½ x 8-in. pages; bound in dark-red cloth boards. Published by D. Appleton & Co., New York. Price, $3.

In the average plant the annual terminations of employment by discharge, resignation, or other causes approximate the average number of workers employed. Such a turnover involves a huge expense, and in an era such as the present, when industrial and economic conditions have assumed abnormal aspects, an understanding of so important a phase of the labor problem as is embodied in the present volume becomes an invaluable asset to the business man and manufacturer. The author was special expert on labor turnover for the Federal Commission on Industrial Relations. The book is based on the results of his extensive investigations for the commission, supplemented by many private inquiries. It suggests and explains methods for reducing the turnover by the application of right principles in the employment and training of employees and the adoption of the proper attitude in the handling of men. The book is constructive in its criticism; informing and timely. The book is divided into four parts. In Part I, the chapter headings are: What Is Labor Turnover? The Size of the Turnover; The Effect of Different Factors upon the Size of the Turnover; The Effect of Different Factors upon the Turnover Rate; The Numerical Importance of Resignations, Layoffs, Discharges and Miscellaneous Causes of the Turnover. Part II is divided into: The Cost of the Turnover to the Employer, and the Cost of the Turnover to the Workman. Part III: Survey of the Causes of Turnover; Causes of the Turnover Pertaining to the Job; Causes of the Turnover Arising from Relations between the Men and the Management; Causes of the Turnover Pertaining to the Men, and the Turnover Due to More Attractive Opportunities Elsewhere. Part IV: Survey of What a Number of Establishments Have Accomplished in Reducing the Turnover; The Fundamental Prerequisites for Reducing the Turnover; Hiring; Breaking in the New Worker; The Handling of Men; The Supervisor of Labor. Index.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An engineer in France wishes to secure an agency for the sale of machinery of various kinds, equipment for carrying on public works (road-making machinery, etc.), and products and machinery for use in the chemical industry. Correspondence should be in French. No. 28949.

A man in Sweden wishes to secure an agency for the sale of cheap structural iron and iron shipbuilding material. Payment against bill of lading. Correspondence may be in English. Reference. No. 28952.

A company in China desires to purchase woodworking machinery for pencil making, such as planing machine, grooving machine, polishing machine, and double cutting off machines. Catalogs with full descriptions and prices are requested. No. 29152.

A firm in this country with a branch in Italy, and also proposing to open offices in other European countries, desires to secure agencies for the sale of electrical railway equipment, metal goods, and other electrical supplies, and especially insulated wires, cables, rubber goods, and all the machinery and materials for their manufacture. No. 29153.

A firm in England desires to purchase and secure an agency for the sale of railway rolling stock, mild steel sections, railway rails, cast steel castings, light railway equipment, railway stores generally, asbestos millboard, asbestos roofing, railway sleepers, French and Belgian standard, pressed steel work, built-up girder work, bridge work of a standard pattern, steel structures for building, wheels and axles, and all requirements for railway rolling stock and permanent railway equipment. Terms, cash against documents. References. No. 29109.

A company in Algeria desires to purchase a complete outfit of lathes, drills, tools, etc., for automobile repair work, and automobiles, motor trucks and tires. Correspondence should be in French. Reference. No. 29136.

An American firm with established connections in Denmark is in the market for automobiles, both trucks and pleasure cars, motorcycles, automobile parts and accessories, marine engines, tractors, aëroplanes, pneumatic and solid tires and tubes, brake lining, and tools and machinery for automobile shops and garages. References. No. 29068.

A firm in Italy desires to secure exclusive agencies for the sale of special tools, small machine tools, technical articles for various industries, and novelties of any kind which will obtain a ready sale in that country. No. 28980.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago. C. E. Drayer, national secretary, 29 S. La Salle St., Chicago, Ill.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13 with headquarters at Hotel Traymore. C. Wood Walter, secretary, Cincinnati, Ohio. C. E. Hildreth, manager, Worcester, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Southern Metal Trades Association will hold its annual convention at the St. Charles Hotel, New Orleans, La., on May 5 and 6. W. E. Dunn, Jr., Chandler Building, Atlanta, Ga., is the secretary.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month Oscar S. Teale, secretary, 240 Broadway, New York.

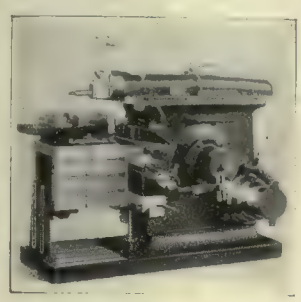
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Shaping Machine, 20-Inch

Mattison Machine Works, Rockford, Ill.

"American Machinist," April 10, 1919



Actual length of stroke, 21 in.; horizontal travel of table, 24 in.; vertical travel of table, 15 in.; maximum distance from table to ram, 18½ in.; maximum distance from base to ram, 38 in.; top of table, 16 x 17 in.; top of table, including apron, 16 x 22 in.; depth of table, 15½ in.; down-feed to head, 7 in.; diameter of head, 8 in.; length of ram without head, 46 in.; ram bearing in column, 37 x 11 in.; crossrail bearing on column, 16 x 20 in.; keyseating capacity, 3½ in.; size of vise jaws, 2⅜ x 12 in.; opening of vise, 12¼ in.; size of tools, ⅝ x 2 in.; cone pulley, 8 to 14 in. in diameter, four step with 3¼-in. faces; tight and loose pulleys on countershaft, 14 x 4¼ in.; speed of countershaft, 330 r.p.m.; speeds of ram, eight, 8 to 100 strokes per minute; single gear ratio, 7 to 1; back gear ratio, 26 to 1; size of base, 24 x 66 in.; floor space, 48 x 92 in.; weight for domestic shipment, 4800 lb.

Broaching Attachment for Lathes, "Velco"

V. E. La Pointe Manufacturing Co., 17 Hungerford St., Hartford, Conn.

"American Machinist," April 10, 1919

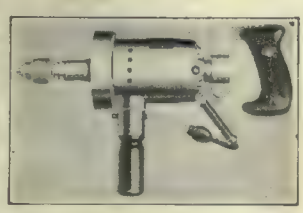


For use in connection with an ordinary engine lathe, and intended for use in shops where the expense of a regular broaching machine would not be warranted. Consists essentially of three heads, one sliding and two stationary. The latter rest on the ways and are held a fixed distance apart by means of the two compression members shown at each side. The sliding head at a center serves as a guide for the screw and the broach, and also holds the mechanism connecting these two parts. The lathe spindle serves simply as a means of driving the attachment, and does not carry any of the thrust which is taken up in the compression members. The bronze nut which moves the screw lengthwise is carried in the head at the left. The machine has as many speeds as the lathe, and when the bronze nut is turned on the screw, it pulls it back to the left through the hole in the spindle.

Drill, Electric Hand, Type A

Arnold Electric Tool Co., Inc., 902 Chapel St., New Haven, Conn.

"American Machinist," April 10, 1919



A portable hand drill for use on either metal or wood. The motor runs at high speed and the reduction gearing is of the planetary type, giving a six-to-one reduction. The transmission is inclosed in a tight aluminum case, and either grease or heavy oil is used to insure proper lubrication. A pin-operated switch is mounted in the handle at the side of the motor. The handle at the rear can be removed in case it is desired to replace it with a taper shank, so that the drill can be used in the tail spindle of a lathe. Length over all, 13 in.; weight, 6 lb.; capacity, ¼-in. in steel; motor, universal type, 110-120 volt, 25-60 cycle; chuck, Jacobs.

Milling Machine, No. 2-B Plain

Davenport Manufacturing Co., Meadville, Pa.

"American Machinist," April 10, 1919



Table, 38 x 10 in.; longitudinal movement, 23 in.; cross movement, 9 in.; vertical movement, 19 in.; spindle, 2½ in. in diameter x 4⅜ in. long in ground bearing; No. 10 B. & S. taper hole; 1⅛ in. hole through; 2¼ in. diameter nose, threaded 10 per in.; three-step cone; 12 speeds; back gear ratio, 4.57 to 1; feed box, 12 changes; tripping mechanism plunger type; overhanging arm steel bar, 3¼ in. in diameter; countershaft, two speeds; 10 x 3½ in. pulleys; arbor, 1 x 10 in.; vise, steel jaws, 6½ x 1½ in., 3½ in. opening; equipment—vise, 1-in. arbor, end support brace, wrenches and overhead works; weight, 1900 lb. net; 2000 lb., domestic shipping; 2250 lb., export.

Tool Chest, Garage

Union Tool Chest Co., Inc., Rochester, N. Y.

"American Machinist," April 10, 1919

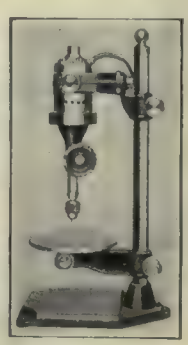


Intended especially for mechanics and shops doing automobile repair work. Is made of kiln-dried oak, is lock cornered and has glued joints, the backs of the chests being rabbitted or shouldered to the frame as well as glued and nailed in place. Metal corners are used to protect against damage. The handle is covered with leather and has a heavy steel wire through the center, the weight being carried by rivets extending through the top of the chest. The drawer pulls are of the flush type. Two drawers, 4 in. long, 7⅞ in. wide, ⅞ in. deep; one drawer, 4 in. long, 7⅞ in. wide, 2⅛ in. deep; two drawers, 12⅞ in. long, 7⅞ in. wide, ⅞ in. deep; one drawer, 12⅞ in. long, 7⅞ in. wide, 2⅛ in. deep; one drawer, 18¼ in. long, 7⅞ in. wide, 2⅛ in. deep; and one tray 18 in. long, 7⅞ in. wide, 3⅛ in. deep. Outside dimensions, 20¼ in. long, 9¼ in. wide, 13¼ in. high. Weight, 23 lb.

Drill, Electric Sensitive

Arnold Electric Tool Co., Inc., 902 Chapel St., New Haven, Conn.

"American Machinist," April 10, 1919



This machine is of the motor-driven, sensitive type and is mounted on double trunnions in such a manner that the complete unit of motor and drill can be swung at any desired angle to the table. Graduations are provided on the trunnions so that the drill can be set quickly to any angle, after which it is locked in place by means of knurled hand screws. Base, 12 x 8 in.; distance from center of table to post, 4⅝ in.; diameter of table, 6½ in.; total height, 23 in.; feed, rack and pinion type with 1½-in. travel; clearance from base to bottom of shaft, 11 in.; capacity, ¼-in. in steel; weight, 30 lb.; motor equipment, Hamilton Beach universal type, 110-120 volt, 25-60 cycle; chuck, Jacobs.

Grease Cups, "Rohr"

Tes-Tite Piston Ring Co., Freeport, Long Island, N. Y., Manufacturers; B. E. Carpenter, 1328 Broadway, New York City, Selling Agent

"American Machinist," April 10, 1919



The features of this cup are, that as the top cannot be taken off, there is no danger of losing it or crossing the thread in trying to replace it, and the fact that there are no coil springs, ratchets or other complicated parts to get out of order and cause trouble. To fill the cup it is simply necessary to turn it to the left with the thumb and finger by means of the handle until it comes to a stop, when the cover will turn in the cup-body and come off. After filling the cup with grease, the cover is simply pressed down tightly and turned to the right, the first half-turn serving to secure the cover in place while further turning places pressure on the grease.

Chuck, Drill, Twin Screw

Marvin & Casler Co., Canastota, N. Y.

"American Machinist," April 10, 1919



The Casler chuck has two adjusting screws, one *E* to set the jaws *B* against the drill shank and the other *D* to force the floating nuts *C* against the ends of the products in the jaws to strengthen the grip. The cast-iron body is fitted with tempered high-carbon steel jaws and screws and has a steel cap to prevent spreading under strain. It is claimed that the chuck can exert twice the grip of the single-screw type and thus allow the drill to be forced up to the limit of its strength.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$34.60
Northern Basic	27.55	31.80
Southern Ohio No. 2	28.55	32.80
NEW YORK, Tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	36.15
Southern No. 2 (silicon 2.25 to 2.75)	34.70	39.95
BIRMINGHAM		
No. 2 Foundry	26.75	31.00
PHILADELPHIA		
Eastern Pa. 2X (silicon 2.25 to 2.75)	31.90*	36.15*
Virginia No. 2	33.25†	38.10†
Basic	29.65*	33.90*
Grey Forge	29.65*	33.90*
CHICAGO		
No. 2 Foundry Local	26.75	31.00
No. 2 Foundry Southern	33.00	37.25
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.25	31.00
Basic	25.75	30.00
Bessemer	29.35	33.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57					
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For $\frac{3}{16}$-in. plates the extra is 30c. per 100 lb.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	New York			Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	4.35	5.50	6.22	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	6.12	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	6.07	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	6.02	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	5.37	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	5.27	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	5.17	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.57	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.27	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	7.12	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
$\frac{1}{8}$, $\frac{11}{32}$, $\frac{5}{16}$, $\frac{1}{4}$, $\frac{7}{32}$, $\frac{3}{16}$ No. 8, $\frac{5}{32}$ and No. 10	25.50 to 33.00	$\frac{3}{16}$ by 12 in. long	14.00
$\frac{1}{8}$		$\frac{1}{4}$ by 19 in. long	12.00
No. 12		$\frac{5}{16}$ by 19 in. long	10.00
$\frac{3}{32}$, No. 14 and $\frac{1}{16}$		$\frac{1}{2}$ by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		$\frac{1}{8}$	33.00
Domestic 20c. for $\frac{1}{16}$, 15c. for $\frac{1}{8}$ to $\frac{1}{4}$.		$\frac{5}{32}$	30.00
		$\frac{1}{16}$	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4 c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼, and ⅜	50½%	24%	⅜ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	⅜ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.25	17.00	23.50
Tin in 5-ton lots	72.50	72.50	85.00
Lead	4.70	5.10	7.25
Spelter	6.40	6.85	7.50
ST. LOUIS			
Lead	4.95	4.80	7.10
Spelter	6.05	6.50	7.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	22.50	24.50–27	31.50–33	23.50	35.00	26.00	35.00
Copper wire (carload lots)	23.00	25.00–28	32.00	23.00	34.00	22.00	34.00
Brass sheets	18.75	23.75–28	30.75	23.00	30.00	21.50	35.00
Brass pipe	28.00	34.00–37	36.50	30.00	41.00	31.00	41.00
Solder (half and half) (case lots)	46.50	38.00–41	62.00	43.00	41.50	39.00	48.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	35.00


ALL OTHER INDUSTRIES
AND
PRODUCTS
MACHINE
TOOL
INDUSTRY

The Basic Industry; Or the Industry on Which All Else Depends

WE ALL know that the building of machine tools is the basic industry, and yet how many of us realize what this really means. Do we fully realize that without the lathe, the planing, the drilling, the boring and the milling machine and all the rest we should have none of our modern industries?

Without machine tools we should be tilling the soil by the methods of bygone centuries. In place of the mowing machine, the harvester, the thresher and the tractor we should have the scythe, the pitchfork and the ox or horse. We should have the spinning wheel, the hand loom and knitting needle instead of the great textile industry of today. The old hand-hewn wooden waterwheel would furnish our power, as steam engines and electrical machinery would be unknown. The transportation would be confined to canal boats, sailing vessels and horse-drawn vehicles. The motor vehicle and the airplane would still be dreams instead of actualities. The quill pen would be doing duty in place of the typewriter and the adding machine, but this would not be such a hardship as there would not be enough business to need them.

This list only skims the high spots and might be extended in many directions. It merely goes to show how dependent the world is upon the machine tool, and that it is well for us to realize just how important it is. Some do not yet appreciate how the war brought its great importance to the front or how widely the War Industries Board recognized it in the matter of priorities.

Perhaps a better idea of its importance may be had by analyzing a few figures. The population of the United States of America is assumed to be 110,000,000. Those engaged in the manufacture of machine tools are estimated at 72,000. In other words the comfort and well-being of 110,000,000 people depend on 72,000 workers. Less than one-tenth of one per cent. of the population make possible the possession and use of the modern appliances of civilization by all the rest.

The real position of the machine-tool industry should be thoroughly recognized and appreciated by all who are engaged in it for two important reasons; first, for the opportunities it presents and second, for the services which it can render. For unless we realize both, the industry will not thrive as it should.

The opportunities which it presents should be utilized in obtaining the pick of men from the whole country. Its comparatively small size gives it the chance to select only the very best men for the different branches. This in turn means that it must recognize its own importance to the extent of raising its standard of remuneration to its good men to at least the equal of that of the industries which are dependent on it. It is certainly inconsistent to find men who design and build machine tools on which other industries depend for their existence, receiving less remuneration than the men who use them. When we consider the thousands of dollars of product turned out by a machine costing only a few hundred those engaged in the building of such machinery should certainly be as well rewarded as those who use it.

Taking the automobile as a good example we find that its enormous growth has been made possible by the builder of machine tools. Without the development of special or improved machines for making pistons, flywheels, cylinders and other parts, the cost of the automobile would make it prohibitive to at least half of its present users. Is it not reasonable that the men who design and produce the machinery which makes such an industry possible should earn at least as much as those in similar capacities in the industry which depends upon them?

It is an old saying that a man's value is judged largely by what he considers himself worth—this of course not applying to the bluffer but to the man who can make good. Is it not time the machine-tool industry set a truer value on its services to the world at large? Has it not overlooked its importance to the rest of the metal-working industry and been left behind in the general advance which has taken place?

There can be no question as to the importance of the machine-tool industry to the world. We have greatly underestimated its value in the past. Is it not time we brought it up to where it belongs? By so doing we can offer the best men opportunities which are now often impossible and raise the importance of the industry still more. We can then render still greater service to the other industries and make possible a more widespread use of mechanical devices of all kinds.

On the sturdiness of the trunk of the tree of manufacturing, the size of the branches and the quality of the fruit depend. The more vigorous the trunk the greater the yield of fruit. It is time to put the tree in the healthiest condition possible—and keep it so.

May 8, 1919 American Machinist Vol. 50, No. 19

A Mechanical Mathematician

By Ellsworth Sheldon,
ASSOCIATE EDITOR, AMERICAN MACHINIST





IN THE days when business was spelled in ordinary lower-case letters the multiplication table was considered a quite useful adjunct to the business office. Everybody in the office, from the old man down (or up) to the office boy, was supposed to have a working knowledge of this table, and the more thorough the knowledge, other things being somewhere near equal, the better was the possessor's chance for advancement.

The clerk who could dissect this table, work it upside down, inside out, forward or backward, generally attained early to the exalted position of "head bookkeeper," and in a manufacturing plant the head bookkeeper was a personage of importance, not infrequently being the paymaster, the purchasing agent, the factory manager, the employment bureau and pretty much everything else in the way of management—a regular "pooh-bah" around the place, whose good graces it was well to cultivate and whose displeasure was a thing to be avoided.

Later, since business has come to be spelled with a big B, the mathematical adjunct has grown in importance to a point where the multiplication table, from being a tool with which to demonstrate one's skill, has become the ruling power, the fetish before which all else must make obeisance. In short, from being their master, business has become the slave of figures.

The hurry and bustle of business offices, the enormous amounts, whether of money or material, represented by the figures, the magnitude of disasters consequent upon error long since indicated the necessity for the elimination of the human element of fallibility, and for nearly fifty years certain mathematically inclined minds with a genius

I. Development of the Machine

Of all the mechanical appurtenants to modern business, few occupy a more substantial or fundamental position than the computing, or calculating machine. The volume of figures to be handled; the necessity for speed and accuracy; the serious losses that may, and probably will, attend upon error, all demand that the burden of computation be lifted from the human brain. The machine described in this article is one of many that will shoulder this burden and, entirely eliminating the personal factor, carry out its exacting and intricate details with mechanical certainty and precision.

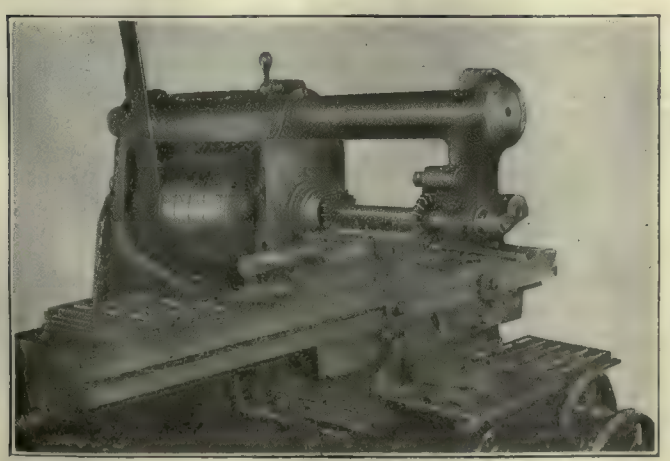


FIG. 1. MILLING THE FRAME SPACERS



FIG. 2. TESTING FOR STRAIGHTNESS

for mechanics have been experimenting, developing and perfecting the means by which the burden of computation may be shifted from the overworked and not always sure brain of the mathematician to the unemotional and inexorable certainty of the machine.

Early Computing Machine

One of the earliest practical attempts to shift the drudgery of mathematical computation from man to machine is recorded in the United States patent granted to Frank S. Baldwin in 1874. A model of the machine on which this patent was issued is shown to the right in the headpiece and was built at the Reliance Machine Works, Philadelphia, Penn.

During the intervening years Mr. Baldwin has been at work developing and perfecting his machine, which has passed through many stages and assumed varied appearances, each housing some mechanical modification of the one general principle, until the present stage of its evolution is reached in the machine shown at the left.

The purpose of this article is to give a summary of the construction and action of the machine, and in so doing take up each detail that may involve or suggest difficult or unusual methods of production, describing the way in which it is manufactured and in some instances illustrating the tools used.

One General Principle

All calculating and computing machines are built on one general principle, and that a very simple one. Each key movement sets certain parts of the machine in position to bring corresponding dials to designated figures when the crank or lever is moved, and when by addition or multiplication a dial figure becomes more than nine, or by subtraction or division, less than 0, certain other parts are brought into action to pass along the job of registering to the next higher or lower dial as the case may be.

Some machines are made to print each operation step by step on a paper ribbon after the manner of a typewriter, while others indicate only the result on a dial or, as in some cases, all the factors that produce the result. For instance, the machine under discussion will, when multiplication is performed, show, through the medium of keyboard and upper and lower dials respectively, the multiplicand, multiplier and product when the work is finished. In division it will show in the same order divisor, quotient and remainder. In performing addition it shows not only the sum but the number of items added together to produce it. These machines will perform any mathematical computation involving any combination of the four fundamental functions of arithmetic and will show the result with unerring certainty in less time than would ordinarily be required to set down the principal figures by hand.

The machine here described is built by the Monroe Calculating Machine Co. at its factory in Orange, N. J. The buildings now occupied by the company were taken over from a concern in an entirely different line of endeavor, and while they are not ideal for the purposes of their present owners they have been well adapted to the work in hand.

They are of modern mill construction and are practically fireprof. The main buildings are of brick, four stories high, with concrete floors which are overlaid with maple, giving all the advantages of a wooden floor and the fire protection of concrete. Two brick-and-concrete towers have been added, which house the stairways, elevators and lavatories.



FIGS. 3, 4 AND 5. FLATTENING PLATES, STRAIGHTENING SMALL PARTS AND THE FLATTENING MACHINE
Fig. 3—Flattening a keyboard plate. Fig. 4—Straightening small parts. Fig. 5—A flattening machine

A power plant occupies a detached building, which also contains the hardening and the enameling departments; thus all elements that might be a source of danger from fire are segregated in a building in which there is nothing combustible except the fuel, and as far enough removed from the main buildings to eliminate the fire hazard. The power transmission is entirely electric.

The principal material from which the machine is constructed is cold-rolled steel, and this is received at the factory in the form of sheets, bars and coils. A small amount of brass is used, some iron castings and a quantity of die castings. The storage rooms are separate buildings and are so located that the stock goes directly to the first operations in the press and automatic departments on the ground floor whence scrap material can be removed direct without the expense of hoisting the extra weight above ground level and without tying up elevators in useless work.

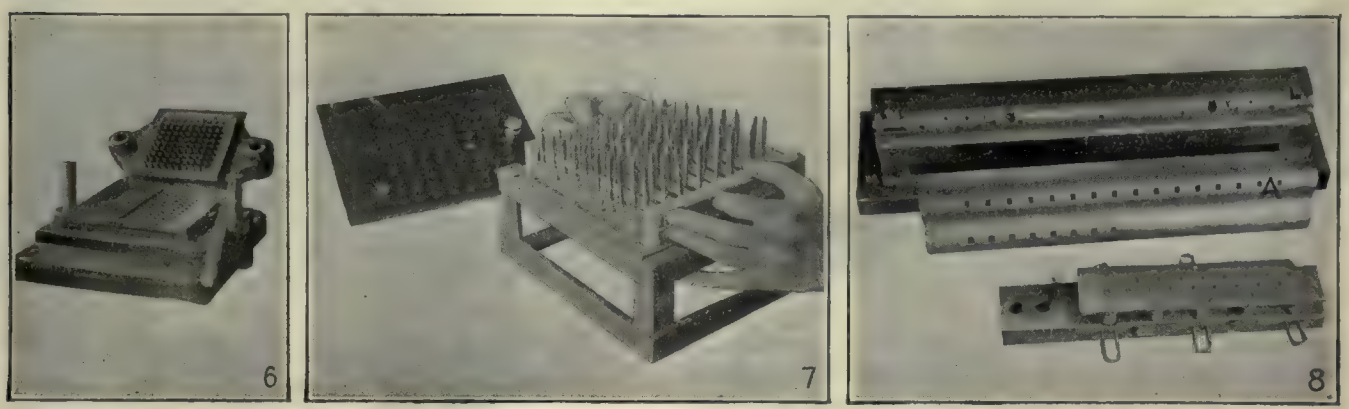
The general plan is to have the work progress steadily from the ground level to the top floor where under the best conditions of light the final assembling and testing are done. Thus there is nothing to be brought down by the elevators except the finished machines, and these of course represent the smallest possible weight which the material can assume.

The main frame of the machine is built up from sections of sheet steel of 0.072 gage held together by

spacers of gray iron. The spacers are milled to length by passing between a pair of side milling cutters and are held to very close limits. The operation is shown in Fig. 1. Bearing spots on the sides of the spacers are also finished, the work being done on Pratt & Whitney vertical grinding machines.

The larger parts of the case, which are made of cold-rolled steel, are cut to size on a roll shear, it having been found more practicable to produce many of these parts in this way than to maintain the heavy presses and costly dies that would be necessary to blank them. There is also less waste of material.

Cold-rolled sheet steel, although apparently flat is far from being accurately so, and as the pieces that go to make up the frame or case of this machine are required to be flat to a considerable degree of accuracy there is a department devoted entirely to the flattening and straightening of them and to straightening the



FIGS. 6, 7 AND 8. PIERCING TOOLS AND KEYBOARD PARTLY ASSEMBLED
Fig. 6—Tools for piercing the keyboards. Fig. 7—Keyboard partly assembled. Fig. 8—Tools for piercing carriage cover

rods and shafts of which the operating part of the machine is comprised.

It is no easy matter to flatten a piece of sheet steel so that it will stay flat, as will readily be acknowledged by any amateur who has tried it, and to flatten such pieces rapidly and accurately is an operation that requires skill and judgment acquired only through years of experience. This fact was primarily recognized by sawmakers, who by acquiring proficiency in this art brought into existence the craft known as sawsmithing.

The average man who desired to flatten a warped piece of sheet steel (and there are none that are not warped, regardless of the manner in which they are produced) would probably lay the offending piece on an anvil or bench plate and hit the high spots with a hammer, gaging the truth of the sheet as he proceeded by looking along its edge and by rocking it on the bench plate. If he succeeded at all, the surface of the sheet would probably be full of minute depressions caused by the hammer and the flatness would be the result of opposing surface strains induced by the peening action. When the surface was polished, the marks would be glaringly apparent if left in, while if taken out the surface strains would be removed and the sheet assume its original shape.

Sawsmithing, or as it is sometimes called, saw hammering, has for years been looked upon as an art rather than an exact science, and its acquirement a matter of instinct and temperament rather than the following of cut-and-dried rules. This idea is rather intensified to the casual onlooker by the mysterious manner in which the old-time sawsmith goes about his work and the altogether surprising and (to the uninitiated) unexpected results that follow a series of blows delivered anywhere but what appears to be the right place. One old sawmaker when asked how he knew where to hit a crooked saw, replied that he "carefully figured out the most likely place to hit it, and then hit it somewhere else."

In the straightening department at the Monroe plant are employed a number of these old-time sawsmiths who learned their trade in such shops as Disstons, Simonds, Atkins, etc., and who by virtue of long experience are able to flatten a piece to test true in less time than the before-mentioned average man would require to determine where to hit it.

All of the plates, shafts and rods of the operating mechanism and even the gears and counting wheels pass through this department and are flattened, straightened or otherwise manipulated to make them function properly in the machine, the work being tested for truth with special gages, straight-edges and surface plates. Figs. 2, 3, and 4 show some of these operations.

While much of this work is done with the peculiar shaped hammers of the sawsmith a new method has been developed by the foreman, Mr. Grant, for flattening the plates used to make the case. A standard make of foot press was used as a basis for the flattening machine; the lever was taken out and a pinion substituted which meshes with a rack on the press gate, and a new treadle connection provided so that while only a comparatively light blow may be delivered the action is very quick and not so tiresome to the operator as a regular foot press.

The "tools" used are made of wood faced with leather, and with this rig an operator familiar with the work may flatten a warped plate in an astonishingly short space of time. This method has the advantage of doing the work without marring the surface, and there is less liability of the plates returning to their original shape when subjected to further operations. The machine is shown in Fig. 5.

One of the pieces to be flattened is the keyboard plate. This part is in fact two plates, each pierced with 81 rectangular holes for the key stems as well as several holes for other purposes. These plates are not subjected to the flattening process until after the piercing operation. One of the plates may be seen in Fig. 3.

The tools for piercing the keyboard plates are shown in Fig. 6. They are of the pillar type and pierce all



FIG. 9. A SET OF KEY STEMS

holes for the key stems at once. The punches are removable and any required combination of them can be used for piercing keyboards other than standard. The holes pierced by this tool are slightly smaller than is required in the finished plate.

It is very desirable to have the key stems a close fit in the plate, and for that reason the holes are made smaller than is required and are later subjected to an individual broaching operation, which is done in a foot press with a broach that has a pilot to fit the pierced holes. This broach leaves the holes smooth and exactly to size. In Fig. 7 is a partly assembled keyboard showing the jig in which the assembling is done, the key stems, springs, lock-washers and key locks, also the cast-iron spacers which separate the two plates comprising the board.

The cover of the machine carriage is made from sheet steel rolled to the required shape at the mills. One of the sets of tools for piercing the little windows in this part is shown in Fig. 8, one of the covers being shown at A. As will be noticed in this picture the punch covers only a portion of the die. The work passes these tools twice, with the punch in different positions. Only alternate holes are pierced at each setting, and this method permits a much stronger die construction than would be possible if the holes were as closely spaced in the die as they are needed in the work. It also enables the body of the die to be made of soft material while the actual cutting edges are supplied by tool-steel bushings. The ends of the carriage are die castings.

A considerable portion of the "works" of a calculating machine consists of toothed wheels which to the uninitiated would seem to be gears, but most of these are counting wheels and the mating member is either the pins on the "clutch" or the "dogs" on the "carrying shaft." There are, however, a number of bona fide gears in the machine, and these are cut in the usual manner.

The counting wheels are blanked and pierced in compound dies, each piece coming from the tools complete, including the teeth and all necessary holes in the web. They are then straightened and flattened and are ground to thickness on a Bristol surface-grinding machine, after which they are subjected to a shaving operation in a compound die, which is very much like the blanking die, but which takes off but a small amount of stock, leaving the wheel exact in size and perfect in form.

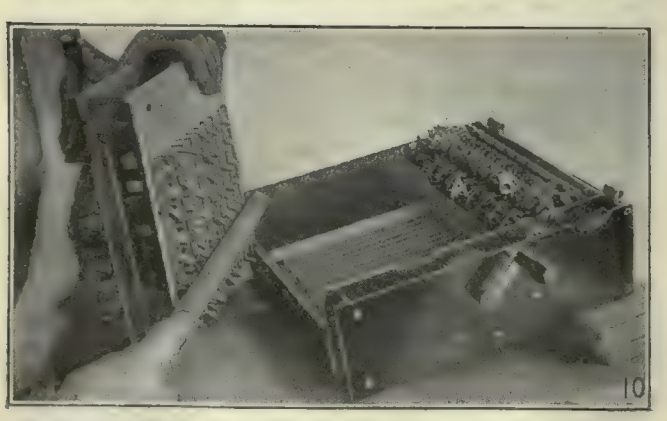


FIG. 10. FITTING UP A KEYBOARD

The wheels of the "clearing-out train" as well as some of the operating wheels are in effect intermittent gears and are produced in the same manner as the counting wheels except that the smooth portion of their periphery, which must be perfectly concentric, is finished with a small profiling cutter, the work being held in a fixture which feeds the gear to the cutter, turns it about its own center until the cutter has milled the smooth portion and then withdraws it.

Another product of the press department requiring great accuracy is the key stems shown in Fig. 9. There are nine registering keys and a clearing key to each column, and there is the general clearing key to the right of the key bank, making 11 kinds of key stems.

From one of the lower corners of each first registering key stem, or "1" key, there extends a narrow wedge-like projection the office of which is to move or "set" a part which directly affects the counting wheel. On the stems of keys "2," "3" and "4" this wedge is increasingly wider, the resultant movement of the "set" corresponding. On the "5" key there is no projection from this corner, but there is one on the opposite corner, which is repeated without variation on keys "6," "7," "8" and "9." These last four keys all have two projections each, one corresponding to the "5" key and the other corresponding relatively to the "1," "2," "3" and "4" keys, so that for all keys above the "5" the "set" is a combination of two movements.

It will be evident therefore that accurate methods of production are required, as the range of movement is quite limited and it must be divided by at least five to differentiate one key from another. The method of production is the same as in the case of the counting wheels, the stems being blanked and shaved with compound dies.

Fig. 10 will serve to show the arrangement of the keys in the key bank with reference to the various wedge-shaped projections. In this cut the workman is adjusting a keyboard after assembling to correct any error that may interfere with the accurate registering of the keys.

The assembling of the machine will be taken up in a subsequent article and further operation described.

How Would You Prevent This Grinding Trouble?

By J. S. Damon

Referring to the query on page 705 of the *American Machinist*, I believe that the work can be done on a Simplex grinding machine. The grinding medium in this machine is a belt to which the abrasive (emery, corundum, or similar material) is affixed by glue or cement. This rapidly moving belt is supported from the inside by a plane surface of cast iron, therefore presenting a broad flat surface completely covering the surface of the article to be ground. The grinding is accomplished all at once instead of removing the metal a little at a time by a point of contact moving to and fro as in the wheel type of grinding machine. It is my opinion that the piece described by Mr. Vernon can be handled satisfactorily on this machine.



XI. Low-Pressure Acetylene and Thermalene Generators*

The details of the latest type of low-pressure acetylene generator will be of interest to every mechanic having anything to do with gas-torch welding. Thermalene generation is a very unique proposition and was first noted in the "American Machinist," Aug. 10, 1916.

THE use of a low-pressure acetylene generator, the pressure of which is limited to 1 lb. or less, makes it possible to use a gasometer for the storage of the generated gas, with its accompanying advantage of absolute volumetric or pressure control. A phantom view of a typical low-pressure generator, made by the Oxweld Acetylene Co., is shown in Fig. 102. The carbide-feeding mechanism and tank closely resemble that of the pressure type, and with the exception of the gasometer and its mechanism, the rest of the apparatus resemble it also.

The possibility of loss of gas through ordinary leakage in the line and connections is practically eliminated with the low-pressure system. The gas bell *A* provides storage for gas and effectively guards against the loss due to after-generation. Control of the carbide-feed mechanism is accomplished through the rise and fall of the gas bell, giving a very constant gas pressure. The movement of the gas bell gives a dual motor control, first through a carefully adjusted friction brake, which provides for gradual starting and stopping, and, second, through a positive jaw clutch. Special provision is made for shutting off the motor feed when the gas bell is in its lowest position, which might result from a severe leak in the line or connections.

Operation of the generator is effected by a small but efficient weight-driven motor *B*, which is automatically started and stopped in proportion to the amount of gas being used. The motor weights *C* always lower approximately the same distance for each pound of carbide used, and constitute a reliable indication of the amount of carbide remaining in the machine at any time. The generator requires no attention whatever other than periodic recharging with carbide and water. By the use of a positive forced feed, it is impossible for more than the proper quantity of carbide to be fed to the water at a time. In order to secure cool, and hence efficient, generation, it is necessary to have not less than one gallon of water capacity per pound of carbide charge. This requirement is met by all of these generators.

A complete and efficient system of interlocking safety devices prevents mistakes in operation due to carelessness or forgetfulness when charging the generator. The hydraulic back-pressure valve with three distinct water seals, prevents the possibility of any oxygen entering the generator.

The generator is equipped with an agitator *D*, which churns the residuum thoroughly, allowing it to flow out freely and quickly when the residuum outlet is opened for recharging. These low-pressure generators use the nut, or 1¼ x ⅜-in. size carbide.

The Oxweld Duplex Generators

The duplex form of generator, shown in Fig. 103, is designed to meet the requirements of many industries, where continuous operation of the generator, without interruption for cleaning or repairing, is essential. It is made up of two of the low-presure generators, both delivering to the same gasometer. Either generator can be operated independent of the other, allowing one to be used while the other is being recharged. The

*For the author's forthcoming book, "Welding and Cutting." All rights reserved.

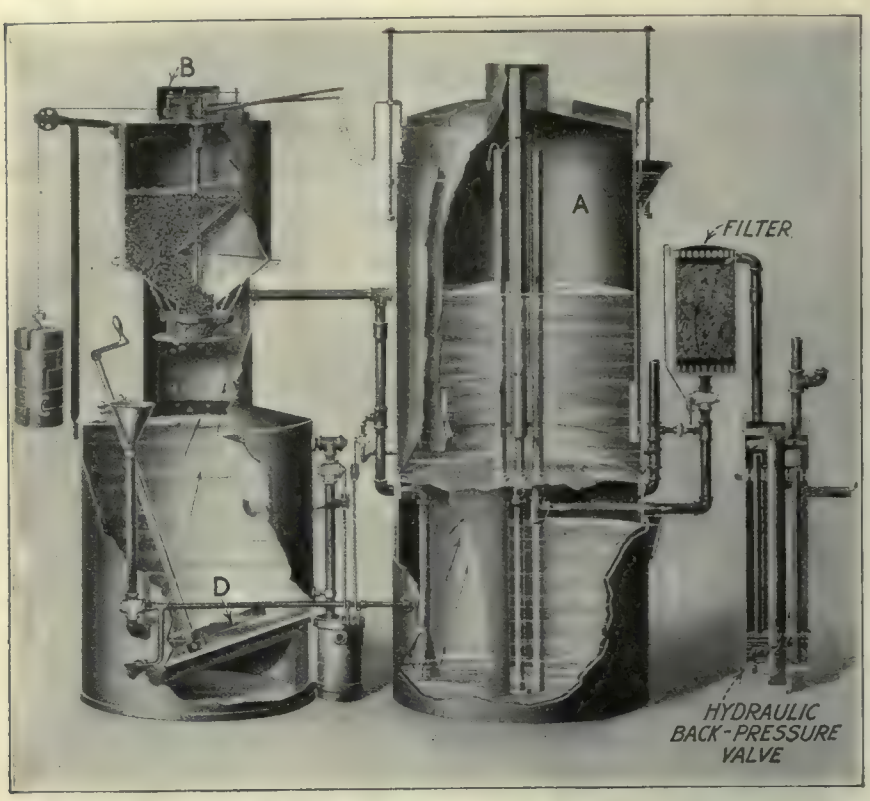


FIG. 102. SECTIONAL VIEW OF OXWELD LOW-PRESSURE GENERATOR SHOWING INTERIOR ARRANGEMENT AND DIRECTION OF FLOW OF GAS

low-pressure generators are made in a number of sizes, details of which are given in Table VIII.

Reputable manufacturers always supply detailed instructors as to the care and maintenance of their generators. These should be posted in a permanent

TABLE VIII. OXWELD LOW-PRESSURE GENERATOR SIZES

Carbide Capacity in Pounds	Single or Duplex	Gas Capacity Cu. Ft. Per Hour	Approx. No. of Blow-pipes	DIMENSIONS			Approx. Shipping Weight, Complete Plant	Min. Width of Door Through Which Gen. will Pass
				Height	Length	Width		
50	Single	50	3	7′ 4″	5′ 7″	3′ 2″	1400	29¼″
50	Duplex	50	3	7′ 4″	8′ 10″	3′ 2″	1800	29¼″
100	Single	100	6	7′ 6″	6′ 2″	3′ 7″	1900	33″
100	Duplex	100	6	7′ 6″	9′ 8″	3′ 7″	2400	33″
200	Single	200	12	9′ 4″	8′ 0″	5′ 0″	2500	41″
200	Duplex	200	12	9′ 4″	13′ 0″	5′ 0″	3500	41″
300	Single	300	18	10′ 1″	8′ 10″	5′ 4″	4100	48″
300	Duplex	300	18	10′ 1″	14′ 1″	5′ 4″	4800	48″
500	Single	500	30	11′ 7″	11′ 3″	6′ 6″	4800	62″
500	Duplex	500	30	11′ 7″	18′ 0″	6′ 6″	6500	62″

place near the generator and should be strictly adhered to in setting up, starting, and refilling.

The following general precautions should always be observed:

In charging a generator never use anything but the hands or a wooden stick to poke the carbide, on account of the danger of causing a spark.

As far as practicable do all charging, cleaning, adjusting, and manipulating of the generator by daylight.

Avoid as far as possible the introducing of air into the generator, or the circulation of air through it. Never leave any opening in the machine open longer than is necessary and never have any two openings, such as the carbide charging door and the sludge valve, open at the same time.

Keep the generator full of water at all times, even when not in use. When the sludge is drawn off and the machine flushed out, do not do anything else until it has been refilled as directed in the instructions for recharging it.

Never open the carbide filling plug, charge the machine with carbide, do any adjusting or manipulating, or make repairs, unless the generating chamber is full of water, as directed in the instructions for operating the generator.

Renew the water in the generating chamber each time any carbide is placed in the hopper. Never run more than one charge of carbide into the generating chamber without refilling with fresh water. Do not experiment.

If water in any chamber of the generator should freeze, do not attempt to thaw it with anything but hot water; and then examine the generator carefully for any damage which freezing may have caused.

If the generator should ever require repair: First, remove all carbide; second, drain all water from the generating chamber, then refill the generating chamber as if for recharging; third, disconnect the generator from piping and remove it to the open air, then fill all the compartments with water and thus force out all mixtures of gas and air before applying soldering irons or any tools that could cause a spark. See that the workmen removing or repairing the generator understand this thoroughly.

Familiarize yourself thoroughly with the directions for operating your generator, which are furnished by its makers; and when recharging the machine follow them in the order in which they are given.

In composition and method of production, thermalene differs from any gas previously used for welding pur-

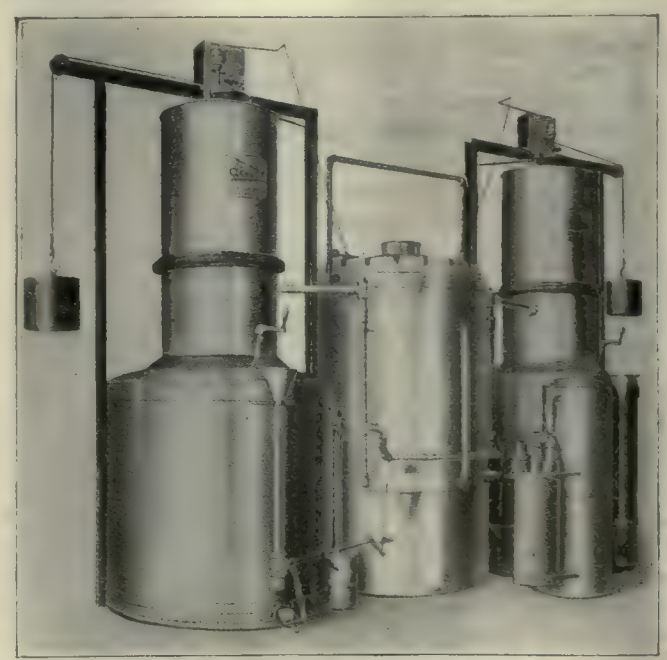


FIG. 103. OXWELD LOW-PRESSURE ACETYLENE GENERATOR, DUPLEX TYPE

poses. It is a combination produced by the decomposition of calcium carbide and hydrocarbon oils, the heat generated by the carbide being used to vaporize the oil. It is the discovery of Karl Frederich Linus Wolf, of Zurich, Switzerland, and is handled in this country by the Thermalene Co., Chicago Heights, Ill.

At present thermalene is principally used for welding or cutting metals, in which it is used together with the proper mixture of oxygen. The nature of the gas will be better understood by first giving a description of the method by which it is produced.

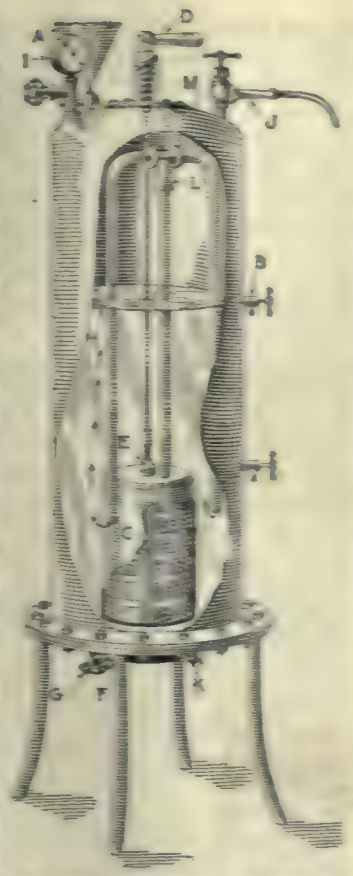


FIG. 104. PHANTOM VIEW OF THERMALENE GENERATOR

A phantom view of a generator is shown in Fig. 104. To prepare this generator for operation, water is poured in through funnel *A* until it will run out of pet-cock *B*, which fills the casing about two-thirds full. The generating mixture is carried in a tin can or cartridge that is inserted from the bottom into the cartridge chamber, as shown at *C*. Previous to inserting the cartridge, however, care is taken to pull down the cam lever *D*, which pulls up the rod and closes the water valve *E*. This prevents any water entering the cartridge chamber. After the cartridge has been inserted through the door in the bottom of the chamber, the door is closed and the bar *F* brought up and locked by means of the handwheel *G*. To generate gas the cam lever on top is pulled up as far as it will go. This admits water from the water chamber *H* into the cartridge chamber through the center tube to the bottom of the cartridge, from where it begins to work upward.

How the Cartridge Is Packed

The cartridge is packed with alternate layers of calcium carbide and crude oil mixed with sawdust. The water as it rises slacks the carbide and generates acetylene gas. The heat caused by the slacking of the carbide layer vaporizes the oil in the layer of mixed oil and sawdust immediately above the layer of slacking carbide and generates oil-gas. When the gas pressure as indicated by the gage is up to 5 lb., the valve *J* is opened, which lets the gas enter the hose leading to the storage tank or torch. The pet-cock at *K* is used to drain off the impurities, such as phosphor-hydrogen or ammonia, which have been separated from the carbide gas in the process of generation. At *L* is a check valve, which allows gas to escape from the cartridge chamber, but effectually prevents any return of either gas or water. As soon as a cartridge is exhausted it is easily removed, carrying all of the dirt and sludge with it.

With the use of a storage tank, enough gas is carried to run a torch while a new cartridge is being put in place in the generator, if needed. The pressure limit for welding or cutting is 15 lb. When this pressure is reached, a regulating diaphragm at *M* automatically cuts off the water feed and stops the generation of gas. This diaphragm is placed at the top of the generator, on the inside, where the gas pressure acts directly on it. The diaphragm is connected to the feed-valve rod in the center, so that as the diaphragm is forced upward by the gas pressure, the water valve is partly or wholly closed. It is so arranged as to be easily set for various desired pressures.

As previously stated, the cartridges are made up of alternate layers of calcium carbide and oil-soaked sawdust. Now it is well known that the volume of lime into which calcium carbide is converted by the slacking process is greater than the volume of the carbide. Therefore, when carbide is packed tightly in cartridges, as desirable, the expansion is liable to burst the case, and in some instances might cause the cartridge to jam in the chamber, as well as interfere with the successful working. One of the objects then is to so make the cartridge as to allow for the expansion of the contents. Another is to prevent the oil from coming in contact with the carbide, as this would interfere with the action and decrease the gas output. To summarize, the cartridge components must be so arranged as to promote free action of the carbide; free action of the heat evolved from the carbide on the volatile substance; to prevent action of moisture on the carbide layers not being acted upon purposely; and to promote the free discharge of the generated and volatilized gases.

All of these points, as well as a number of others, have been considered in the makeup of the cartridges, as shown in detail in Fig. 105. As made at present for commercial purposes, there are four sizes corresponding to the different outfits. The cartridges consist of a tin can of suitable size, the smallest being 4¾ in. in diameter and 8 in. high, weighing 6 lb. and having a gas-producing capacity of 25 cu.ft., sufficient to supply a welding torch from four to five hours. The largest size is 9¾ in. in diameter and 16 in. high, weighing 40 lb. This has a gas production of 200 cu.ft., or eight times the capacity of the smallest size which has been previously mentioned.

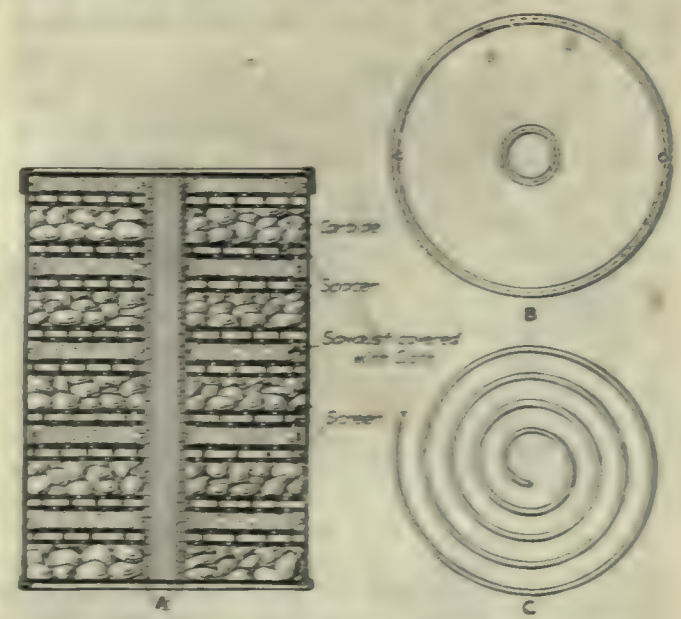


FIG. 105. DETAILS OF THERMALENE CARTRIDGE

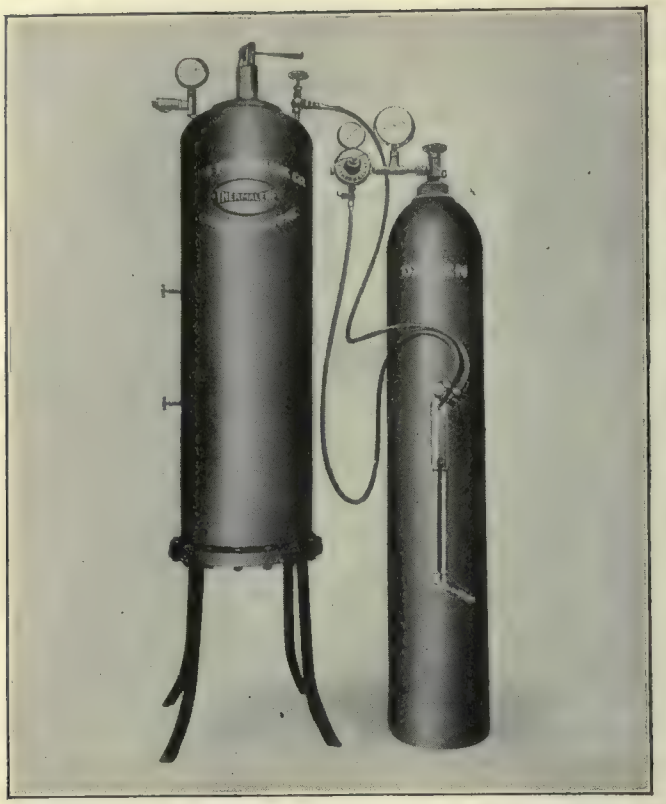


FIG. 106. THERMALENE OUTFIT FOR SHOP USE

Referring now to the illustration, a cylindrical screen *A* is first placed in the can to be filled and then a layer of carbide is placed in the bottom of the can around the screen tube. An unglazed carboard disk *B* is next placed on top of the carbide. A spacer *C*, made of thin metal bent so as to lie edgewise, is placed on top of the cardboard and then a disk of screen is put over it. Sawdust impregnated with crude oil in a cloth sack made of two cloth disks sewed together is laid on the screen. On this is another screen, then a spacer and a cardboard disk, and so on to the top, ending with a sack of oil-soaked sawdust covered with a piece of screen that has no hole in the center for the cylindrical tube. The end of the can is closed with a cover for handling, which is removed before placing in a generator.

As previously mentioned, the water feeding in through the valve in the cartridge chamber drips down through the cylindrical screen tube and starts slacking of the lower layer of carbide, the heat of which vaporizes the oil in the sack above it. The cardboard disks, while strong enough to hold the layers firmly in place while dry, begin to soak up as soon as the feeding starts, and consequently become soft, so as to give way under the pressure of the expanding carbide, allowing it to be forced into the spacing between the carbide and the oily sawdust. This space is so calculated as to keep the various layers firmly in place until the cartridge is exhausted. Another thing is that, as any liberated steam or water vapor must pass through the absorbent cardboard as well as the oil, before it reaches the next layer of carbide, action of the steam on the carbide above is prevented. This insures that the respective layers of carbide will not be acted upon until the water becomes level with them in turn. In consequence, a cartridge can remain in a generator a long time without becoming spent. The screen disks on top and bottom of each layer of oily sawdust furnish efficient volatilization and egress for the gas.

By the method of producing thermalene, the heat evolved by the generation of acetylene is absorbed, at the place of generation, in the production of the oil gas. This utilization of heat serves to keep the temperature down, since the heat generated is used and dissipated by the latent heat of the oil, so that radiation and absorption by water is not necessarily depended upon. The gas combination that results passes out through the T-pipe ends and bubbles up through the water into the upper part of the generator. The low temperature causes the impurities to drain back into the chamber, from which they are easily removed. The layers of carbide and oily sawdust are so proportioned as to cause only the vaporization of the lighter oils, such as benzine, naphthalene, kerosene and the like. The temperature is not high enough to vaporize the tar oils, as these are heavy and give a deposit of lampblack. These heavy oils are therefore not utilized, but remain in the cartridge. The temperature in the cartridge is maintained between 200 and 300 deg. C. (392 to 572 deg. F), depending upon the rapidity with which the gas is being used and the amount which is generated and delivered. It is not intended that an actual boiling take place at any time, for if the temperature is too high there will be a vaporization of the heavy oils, causing deposits in the pipes and also an increase in the impurities. The gases passing through the pipes cooled by the water of the generator are kept between 60 and 70 deg. F. In the passage through the cooled pipes the impurities are removed in the following manner: Acetylene has a comparatively high specific heat, so that its rate of cooling when passing through the pipes is low. The specific heat of oil gas is, however, only one-eighth of that of acetylene, so that its cooling effect will be eight times as great. Now if the two gases are passed together along a cooling surface, the temperature of low specific heat will decrease rapidly and cause a rapid lowering of the temperature of the other gas. This causes a deposit of the vapors suspended therein. So this action results in the deposit of the sulphur, phosphorus and silicon compounds, and of the ammonia. In order, however, to bring about this precipitation the temperature must be

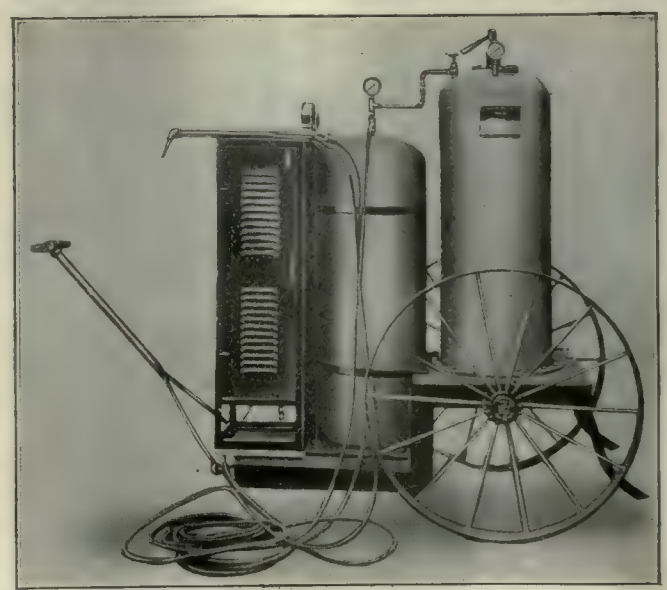


FIG. 107. PORTABLE THERMALENE GENERATOR OUTFIT

sufficiently low—that is, as stated above, between 60 and 70 deg. F. If the gas finally issuing from the pipes and water was too hot, the impurities would not be thrown out.

In this process the acetylene and oil gas, generated and cooled, will combine in the pipes after the impurities are removed. It is important, however, that the impurities be removed and the product sufficiently cooled, since no real combination will take place at too high a temperature. For instance, if the water is above 180 deg. F. the oil burns and no proper combination results.

The combined gas produced, named thermalene, possesses marked characteristics that distinguish it from oil-gas, from acetylene, and from the usual mixture of the two. The density is greater than air, being 1.1 taking air as unity. The issuing gas can be seen to sink when thrown through a sunbeam. The specific heat is low, being a little over one-eighth of that of acetylene. Thermalene liquefies at between 1400- and 1500-lb. pressure per square inch at room temperature, and in its liquid state is nonexplosive and stable. A very noticeable thing is the odor, which is not at all like the odor of either acetylene or of oil-gas, but is a soft, sweet smell, not strong or offensive in any way. The color is white, but with a predominating proportion of the red and yellow parts of the spectrum. The maximum flame temperature, according to H. McCormack, professor of chemical engineering, Armour Institute of Technology, Chicago, Ill., has been found to be about 6500 deg. F. The high density of the gas has a number of advantages. It has more body than acetylene and does not need so much oxygen. Moreover, it mixes better with oxygen. It does not explode as readily as acetylene, so can be mixed with greater proportions of air. In a Bunsen burner it is possible to mix as much as 32 per cent. of air without causing a flareback. It can readily be turned down without causing a flareback, and it can be used with a Welsbach mantle to advantage. The upper and lower explosive limits are 12 per cent. and 30 per cent. It averages approximately 13.97 cu.ft. per pound.

Some Advantages of Thermalene

When used for welding and cutting, thermalene has numerous good points. It does not require an excess of oxygen, and the flame, therefore, produces a soft weld, especially in cast iron. When welding it is noticeable that less sparks are thrown off than when using acetylene. It can be used at a lower pressure also, owing to its greater calorific value. Owing to the removal of the various impurities, there are no corrosive effects on fittings, nor poisonous effects. It is also for this reason that there is little or no danger of explosion. Neither does the spent cartridge give off explosive gases, for the reason that the gases liable to cause explosion are separated and drained off from the generator chamber. Corrosion of interior walls, due to water action, is prevented by the oil vapor which is always present and forms a protecting and sealing effect throughout.

A thermalene generator may discharge its gas into a storage tank, or the gas may be used direct from generator to torch. A welding or cutting outfit, suitable for shop use, where it will not need to be moved frequently, is shown in Fig. 106. Here the gas is used direct from generator to torch. The smallest generator like the one shown is 10⅛ in. in diameter, stands 3 ft. 9 in. high, and weighs about 60 lb. An apparatus mounted on a truck is shown in Fig. 107. As a rule a No. 2 generator is used for this purpose. This size is 16 in. in diameter, stands 6 ft. high, and will produce 70 cu.ft. of gas with one charge, the generator weighing 225 lb. and the storage tank 120 lb. The largest size generators will produce 200 cu.ft. of gas per charge, and they may be coupled in batteries where a large amount of gas is desired. These can be arranged so that part of them can be recharged while the others are working, or storage tanks of sufficient capacity may be used to allow for recharging.

Former-Plate Construction for Shell Turning

By A. R. Melloy

The construction of former plates for turning shells in a lathe involves a few points that are bound to puzzle the designer in his first attempts at former-plate design. The following description will probably be of some help to shell men in general:

Let it be required to turn the shell *A* in the figure, using two former plates *B*1 and *B*2 to guide a roller *C*. The roller *C* operates the tool *D* by means of rigid connections to the cross-slide of the lathe so that *D* cannot pivot around *C* and can only travel parallel to it.

Consider for the present that the shell has only one curve of radius *E*, then the following rules will apply:

a. The radius of the plate *B*2 will be the radius *E* of the shell.

b. The radius of the plate *B*1 will be the radius *E* plus the diameter of the roller *C*, or $K = C + E$.

c. The tool for finishing must be ground to the radius of the roller *C*.

d. The roughing tool must bear a definite relation to the finishing tool.

In order to prove rules a and b, imagine a finished shell to be in the machine and a roller *G* replacing the tool *D*. The center of this roller is rigidly fixed to the center of the roller *C*; therefore these two centers will travel in an arc of a circle of radius *H* which is the same for both. It is important to establish clearly in mind the fact that the roller *G*, in traveling parallel to *C*, must pivot around a center *J*, which is quite different from the center *I* around which *C* pivots.

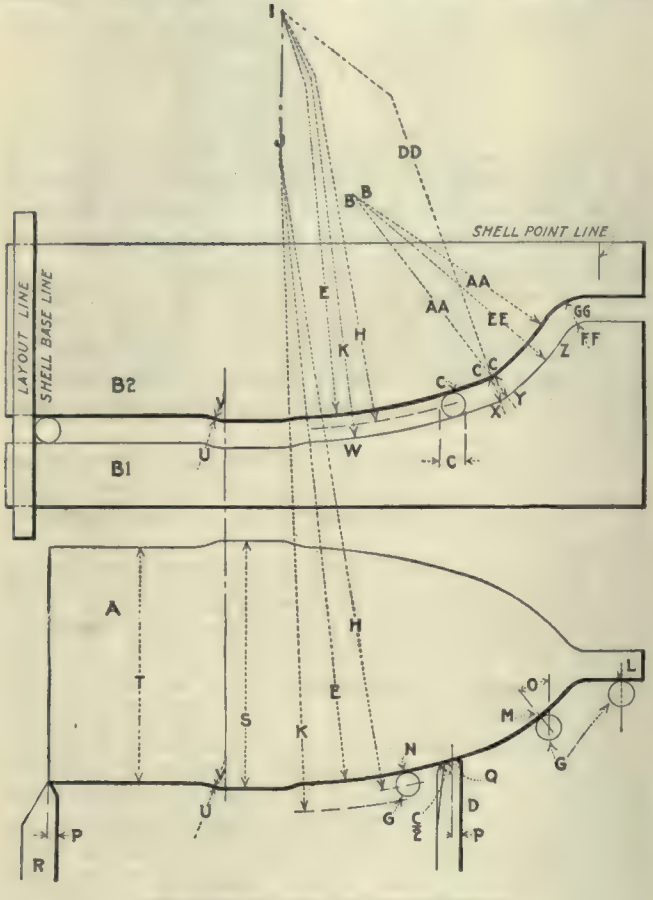
The radius *H* is equal to the radius *E* plus the radius of the roller or $H = E + \frac{C}{2}$ and the radius *K* is equal to the radius *E* plus the diameter of the roller or $K = E + C$. The radius *K* of the shell layout corresponds to radius *K* of the plate *B*1 and radius *E* of the shell corresponds to radius *E* of the plate *B*2 by reason of the parallel motions of the two rollers.

In considering rule c the roller *G* is seen to touch the shell at various points *L*, *M* and *N*, which are really points of tangency of the two circles, and the cutting point travels on an arc through an angle *O*. Consequently, the cutting edge of the tool must be the arc of a circle which passes through those points and has a radius $\frac{C}{2}$.

Some firms use circular tools held by a special holder, but every grinding of such a tool changes the diameter of the tool and consequently changes the profile of the shell. If a lathe tool is ground with a gage to the

radius of the roller it is always the same, will always give the same results and is the simplest possible.

In considering rule d it is necessary to study *D* in the figure, which shows the roughing tool superimposed on the finishing tool. In both of these tools and in a set-up gage, to be described later, a distance *P* must be established which is the same for all tools and gages, and forms the basis of an "interchangeability" system. The radius $\frac{C}{2}$ necessary for good finishing, will be found too great for roughing and a smaller radius *Q* must be used in the roughing tool



FORMER-PLATE CONSTRUCTION

which may be made to suit the designer, remembering that the smaller the radius *Q* is made, the more metal the roughing tool leaves on for the finishing tool to remove. Conditions might arise where it would be desirable to use two roughing tools in which the second tool might have a radius intermediate between the first and the finishing tool.

For setting up a machine a gage *R* may be used, which is an ordinary threading tool in which the dimension *P* of the tools *D* corresponds to dimension *P* of the gage.

It is necessary that the toolholder shall have a firm side against which the tools can be lined up firmly before clamping. This side constitutes a positive stop for setting the tools and is the reason why the dimension *P* is established in the tools and gage.

The shells should be cut off to a definite depth of cavity so that the shell base can be used as a working point. In mounting in the machine a stop should always locate the base in the same position. Then all that is necessary is to clamp the gage in the toolholder and bring the point touching the base of the shell.

In the former plates three lines are laid out, one corresponding to the point, one to the base and one at a distance equal to the radius of the roller to the rear of the shell-base line.

With the gage *R* at the base of the shell move the former plates till the roller just touches a straightedge laid on the layout line on the formers. Then clamp down the formers, remove the gage and the roughing and finishing tools may be interchanged and shells changed without further setting up. Any variation in the shape of the tools will be sure to cause trouble.

It is evident that a sharp corner cannot be cut with this former, and where a step is made from diameter *S* to diameter *T* it must be done by means of a double radius as at *U* and *V* on both shell and former. The smaller radius *V* should not be less than the radius of the roller and the larger radius *U* is equal to the smaller radius *V* plus the roller diameter, or $U = V + C$.

In certain kinds of shells the point is not one curve, but a compound curve. In these cases the shape of *B*2 is as before the shape of the shell, but the shape of *B*1 is complicated.

Consider four points in plate *B*1 as *WXYZ* and let *BB* be the location of the center of the new radius *AA* involved. From *BB* extend the radius *AA* through the point *CC* and let it pass indefinitely through *Y*. From *I* draw *DD* (equal to *E*) through *CC* and indefinitely through *X*. As before the arc *WX* has a radius $E + C$ or *K*. Arc *YZ* has a radius $AA + C$ or *EE*. Between the points *XY* a new curve is introduced. The center of this arc is *CC* and its radius is equal to *C* or the diameter of the roller.

Radius *FF* may be made any convenient size, its purpose being merely to prevent the corner from wearing. Radius *GG* will then be $FF + C$.

To Prevent Splattering of Workers

By W. D. Forbes

Every once in a while I run across things in piping that amuse me, and once in a while I make a mistake in judging too hastily. I was astonished, one day, to notice that six milling machines were supplied with soda water from a trunk line, 1½ in. in diameter, but the leads from the line were two inches. Well, I laughed myself almost sick over it, and pointed it out to one of the directors of the company, who joined in the laugh. The super was called to the office and was questioned as to how such a thing could happen in such a well regulated and efficient company. It did not seem to disturb the super at all. He said, "I do not see why the piping was done that way, but I will find out, as my piper is a man that rarely goes wrong and I would like to hear what he has to say about it." So the piper was called, a man well over 50. To my surprise he was not a bit flustered when asked why a 2-in. lead was taken from a 1½-in. run.

"Yes, that looks strange, but I had to do it that way as the men on the millers said they did not want to put up their unbrellas while running the machines. You see," he said, "½-in. pipe was called for, but the soda water came in at such a velocity that it almost drowned the men by splattering, so I cut in "bull heads" and reduced the velocity and we had no more kick."

The next time I see a queer job of piping I will not laugh quite so early in the game.

The Aims of the American Gear Manufacturers' Association*

By F. W. SHERAM

President of the American Gear Manufacturers' Association and Vice-President of the Fox Lock & Burton Co.

WHILE our annual has assumed you in Cleveland in its customary pleasing manner, I would act in behalf of the Cleveland gear manufacturers that we appreciate the good will evidenced by your desire to meet here, and are pleased indeed to have you with us. Although our sessions promise to be very busy ones, we hope to have the opportunity of showing you at least some little part of our great city, which is justly entitled to the appellation it has achieved for beauty and substantiality.

A trade organization—now generally recognized as a part of the plant of modern business—proved a vital factor in the successful prosecution of the war, and promises to be of equal value during the re-adjustment reconstruction period.

Jos. Lam, the eminent New York banker, in an address before our local Chamber of Commerce recently said, "The United States is facing the greatest era of prosperity in its history." Agreeing of the future, and in harmony with what I have said, he stated, "We have new problems to face, but the American common sense will solve them." Quoting from the same address, Mr. Lam said further, "This country will meet fast to matter what happens in Europe. The laws governing business must be modified. The Sherman Law and the Clayton Act had the right motive behind them, but business has outgrown them."

Nearly a year ago at White Sulphur Springs, in opening of our association I remarked, "The foundation has been completed and is substantial." Notwithstanding the unprecedented demands upon industry during the time that has intervened the American Gear Manufacturers' Association has made progress. Membership in the association has become a valuable asset to the gear manufacturer.

Our second year closes with over 40 interests privileged to use its membership, representing more than 150 makers of the art. Few are the representative manufacturers of "our" gears who are not affiliated with the association. This membership evidences a desire and willingness to cooperate, and an appreciation of the value of the exchange of ideas on subjects of common interest.

Our association includes the producers of all kinds and classes of "our" gears. Every American Gear Manufacturers' Association gathering demonstrates the value of the comprehensive organization. The association is placing the gear business on the plane merited by its character, scope and importance.

There have always been problems in the gear industry. Two years ago it was considered pessimists and semi-pessimists. Through the association these have been converted into optimists.

I have mentioned a few of the achievements of the association. What further has it accomplished, and what should be its aims for the future? Let's use the stated objects of the association as a basis of investigation.

Article II of our constitution provides that the "The discussion of subjects of interest and value to the industry in which its members are engaged." In the several meetings held during the past two years subjects technical, practical and commercial have without exception been very interesting. The experiences and ideas freely exchanged in the discussions that have followed have been of great value. This has led to further discussion and exchange of ideas among the individual representatives. In this manner many troublesome problems have been solved.

> *We bring our second convention year to a close, and upon we start with our country and business confronted with many large problems. For instance that the future will demand radical changes in many directions. In the evolution which is already under way, organization will light the way to many of the problems that will arise. The character and extent of this organization will measure the influence of the American Gear Manufacturers' Association, and have a foremost bearing in the stability of our industry. Our association may be of great value to the individual units represented in it.*

The success of our meetings is the personal responsibility of every representative. What subjects have you in mind which could be presented and discussed in the interest of the industry and the trade? Communicate your suggestions to the president or secretary in order that the executive committee may be guided by your desires in the preparation of programs. When the subjects are announced give them some consideration so that you may come prepared to contribute something of real value in the discussion that takes place after each presentation, all to the end that our meetings of the future may be of even greater profit than those of the past.

Next in order in the stated objects of our association is "the advancement and improvement of that industry." Can we not justly claim that the gear business as an industry has advanced and improved to a greater degree during the past two years than during any similar period in its existence? It will continue in advance and improve to the extent that our organization progresses. To advance and improve the industry is again the first responsibility of each and every representative. The advancement and improvement of our industry is two phased—technical and ethical. Some can assist in the former—all in the latter. As to the ethical, we cannot place our standard too high. The advancement and improvement of the industry demands standardization—technical and commercial.

The third of the stated objects of our association is "The collection and dissemination of statistics of interest and value to its members." This is a phase of association endeavor possessing possibilities for value to our membership second to none. If developed to the scope possible, the gear manufacturer (member company) will ultimately actually need but one other association affiliation, namely, that relating specifically to labor. The association may at the same time distribute information in this connection which would be of great value.

Any information which may be of interest to our members as manufacturers, and more particularly as gear manufacturers, may properly be distributed among them. Our sources for securing information and data are manifold. Our committees have information and data to disseminate. Occasions arise where the representatives informally receive information which could be advantageously passed around. Other manufacturers as we will come to us in increased volume through the engineering societies. The Chamber of Commerce of the United States, with which we are affiliated, is supplying much valuable and timely information, especially during these fast-moving times when conditions change over night. The Government itself is another source of information in many connections. A library committee is a new addition to our committees. While originated primarily in the interest of standardization, it will in the course of its operations undoubtedly gather statistics and information on many subjects which might be distributed advantageously.

As to the distribution of statistics and information, four

* Address given at the convention of American Gear Manufacturers' Association, Cleveland, May 1, 1919.

means readily suggest themselves, namely, our present loose-leaf sheets with complete minutes of meetings, including addresses and discussions; loose-leaf sheets for standardization and technical data of all kinds; our present system of bulletins, which you have no doubt found of interest, and a periodical organization publication.

The bulletins would naturally be the means employed for circulating such matter which by its very character should be distributed in this form. Also that in which the element of time is important. On the other hand, a periodical publication could be used to advantage in distributing news pertaining to the industry and a considerable volume of interesting information and data of various kinds.

Fourth in the list of stated objects is "The standardization of gear design, manufacture and application." At White Sulphur Springs I originated the slogan "A gear standard to be a recognized standard should be an American Gear Manufacturers' Association standard." If we are to qualify as an industry we must make progress to this end. The evolution of gear standards is an obligation we owe not only to ourselves but the collective gear purchasers and the engineering world.

While gear standardization in the aggregate is a task of considerable magnitude, a start with the simpler phases will form the foundation on which we may build successfully. To this end our organization for standardization will undoubtedly have some definite and specific standards to recommend for your consideration in the near future.

The demands of the war and other conditions restricted our progress during a part of the year just closing. However, a most successful meeting was held in Buffalo in February solely in the interest of standardization. This meeting and the sessions to be held here promise to be the start to standardization accomplishment.

Last on the list of stated objects of our association is "The promotion of a spirit of coöperation among its members for the improved production and increased application of gears." Every meeting evidences an ever-increasing spirit of coöperation, and has advanced the improved production of gears. As a consequence the business is being more ably conducted. Better gears are being made, and gears are being more economically produced. As to the increased application of gears, individually many of those represented in the association have not been inactive. The very character of the times since our inception has restricted any concerted action.

So much for the defined objects of the association. I would also comment briefly and make some observations on other association activities.

Our commercial standardization committee also met in Buffalo recently. As a consequence definite and specific recommendations will be submitted for your consideration where it is believed the uniformity of practice is desirable.

In addressing you in April last I remarked that "Sooner or later the association must give serious consideration to uniform cost accounting," adding further that the time was probably not far distant when the Government would itself provide in this connection for such industries as did not work out the problem to its satisfaction for themselves. Your committee on uniform cost accounting gave considerable time and thought to this subject, and at the semi-annual meeting in September presented a detailed report with recommendations. Your executive committee should give this further consideration. As in view of the conditions under which we operate now the desirability of uniform cost accounting grows in importance.

Some consideration has been given to a division or bureau to adjust controversies as to product between supplier and purchaser—a plan to insure equitable settlement without litigation. Assist your executive committee with suggestions so that they may recommend some definite plan to the membership for consideration.

While an increasing number of representatives have contributed in no small degree to the progress of the year just closing, our association is especially indebted to Mr. F. D. Hamlin, its secretary and treasurer, and Mr. B. F. Waterman, chairman of the general standardization committee. You all appreciate the extent to which our secretary, ably seconded by his assistant, Miss Benton, has increased the efficiency of his office. As the directing head of our standardization activities Mr. Waterman has the necessary vision and is steadily building for productive results.

Times and conditions considered, the association is to be congratulated on its progress and the present state of the organization. A successful industry organization has been developed under most abnormal conditions and is now available for service when the industry that is not organized will be at a great disadvantage.

To be of greatest benefit to the membership now demands activity in practically every phase of association endeavor. Again, "the success of the association is the responsibility of every representatve."

It has now been my privilege to serve as your president for two years, or since the inception of the organization—an honor in which I shall always take pride. The task has been a pleasant one because of the confidence reposed in me and the consideration accorded me. I shall never forget the evidences of true friendship, loyalty and esteem on the part of the gear men reflected in resolutions, letters, telegrams, etc., from all parts of the United States, when there came to me but a short time since probably the greatest trial I shall ever be called upon to bear.

This sentiment and the loyalty of my associates and friends in general, coupled with my little son, the precious legacy of the one who was ever an inspiration—accomplished, lovable, kind and considerate, a real partner, an ideal mother and a true friend—is lighting the way and helping me to "carry on."

In the interest of the association, may I ask for my successor the same confidence and consideration?

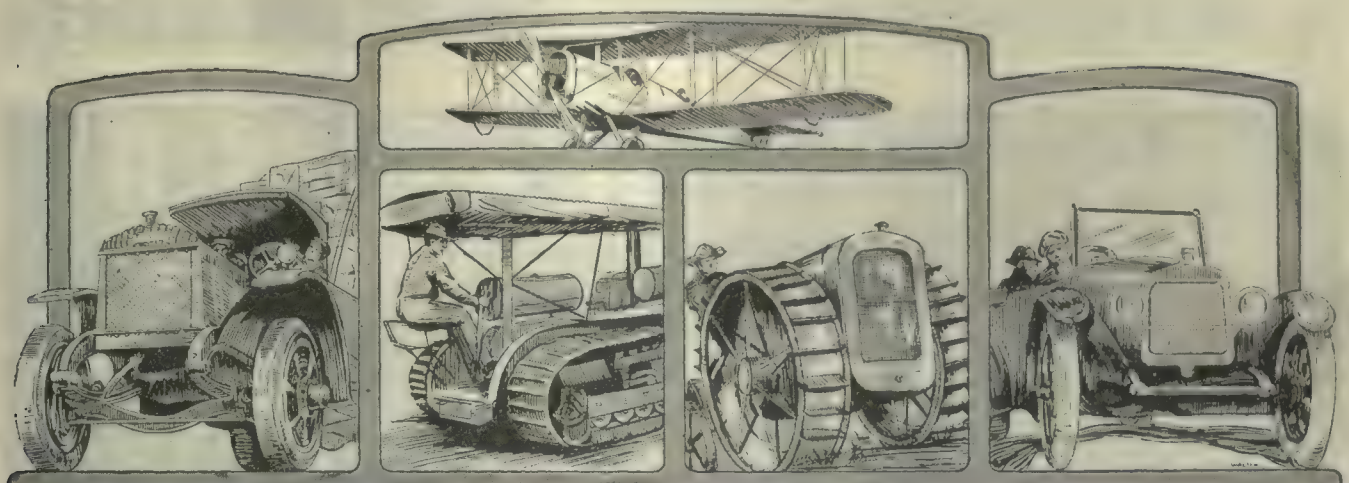
How Would You Prevent Oil From Discoloring Finished Surfaces?

By Harry Senior

Replying to your query on page 802 of the *American Machinist* as to how the finished surfaces of machine tools may be kept free from the molasses-colored discoloration due to the drying on of oil, the only application known that will positively prevent this is "elbow grease." It must be vigorously and persistently applied to the affected surfaces, preferably through the medium of cotton waste or similar material. Firemen and assistants in engine rooms, apprentices and helpers in machine shops, housemaids in charge of door knobs, etc., have been searching for a substitute for this well-known and justly celebrated reagent ever since Jim Watt discovered that steam came out of a tea kettle, but so far it remains without a serious rival in its field.



It might possibly lessen to some extent the quantity of the aforementioned "grease" required to reduce the molasses-colored discoloration of which you complain if you did not use molasses-colored oil on your machinery but the necessity for it cannot be wholly eliminated even though you use no oil at all.



AUTOMOTIVE CONSTRUCTION

Machining a Six-Cylinder Motor—II

By J. V. HUNTER
Western Editor *American Machinist*

Attention to the smaller parts of this automobile motor has not been neglected in the development of the most efficient machining methods. The reader should ask himself whether or not some of these methods which employ the full capacity of each machine tool could be applied to different types of work in his own machine shop.

AN EXTENSIVE study of tooling has been made at the plant of the Falls Motor Corporation, Sheboygan Falls, Wis., and some of the methods they employ for loading every machine tool to its full cutting capacity might be applied to other lines of manufacture. No opportunity has been neglected wherever this study has shown that the output of a milling machine can be increased by running a large number of different castings through the machine for each cut by changes which improve the capacity or character of the work-holding fixtures.

The quantity and character of work simultaneously machined on a large Ingersoll milling machine is shown in Fig. 9. There are seven fixtures mounted on the table, which are not identical because they have been adapted to the different pieces they are to carry. The total load at one complete setting of the table consists of six oil pans, 24 cylinder heads, six manifolds and 12 flywheel housings. The cylinder heads require four cuts to finish and the flywheel housings require two, so that after each run, the positions of 12 cylinder heads and six housings must be transposed to bring the other sides up for cutting. By this arrangement after the third run of the milling-machine table six complete sets of these parts are produced on each succeeding run. The time required for one complete travel of the milling-machine table is 25 min., and the runs are followed through continuously by loading and unloading the table while the cuts are being made. Three men are employed in handling the work on this machine.

The milling fixtures used for this work are rather



FIG. 9. MILLING MOTOR PARTS IN MULTIPLE

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FIG. 10. STORAGE OF CASTINGS

intricate in detail, necessarily so because of the variety of pieces which each carries. The end fixture *A* is devoted to the flywheel housings which rest on suitable stops and are fastened by the clamp *B*. The heavy adjustable screws *C* are provided to take the heavy thrust of the cut. The oil pans are held against the sides of other fixtures by the heavy crossbars *D*, from which small jackscrews *E* extend to the top and bottom to prevent the thrust of the milling cutters from springing them.

The neat and orderly manner in which the many castings are handled about the machines constitutes a lesson on elementary efficiency to machine shops where castings are dumped and piled indiscriminately. The illustration, Fig. 10, shows how hundreds of castings are neatly piled on conveying-truck platforms for transportation to and from the machines.

After the cylinder head has been milled it is carried through a series of Natco drilling-machine operations. The first of these, Fig. 11, is a series of four operations on the different faces by use of an indexing jig. The six drills must drill all 12 valve holes on this side of the piece. This is accomplished by first drilling the left-hand set of six holes with the sliding and revolving jig *C* in the position that it now stands in the main frame *D*. The aligning pin *E* is then lifted and the frame *C* slid to the left on its trunnions *F* until the pin *G* locks into place. This permits the right-hand set of holes to be drilled in their turn.

At the same setting of the cylinder head in the jig the holes on the other side of the castings (which are of identical size) are drilled by revolving the jig on its trunnions. For some of these holes it is necessary to slightly shift the drill spindles, which is accomplished

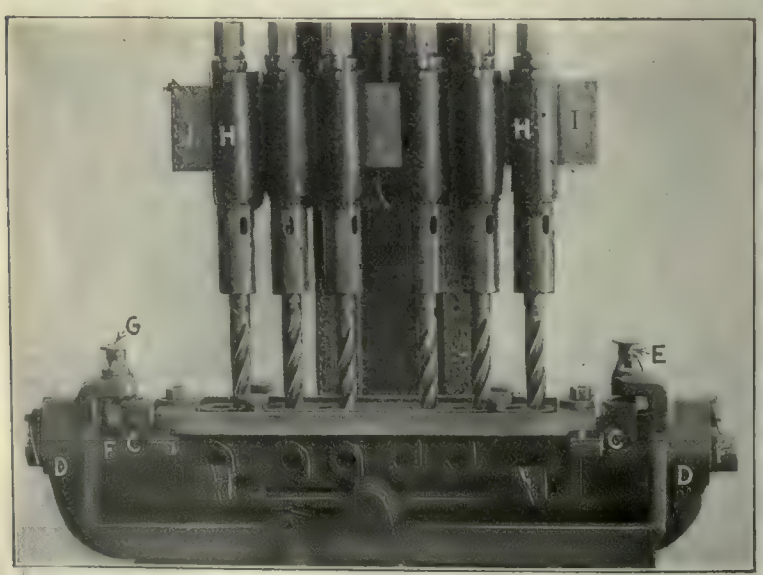


FIG. 11. DRILLING CYLINDER HEADS

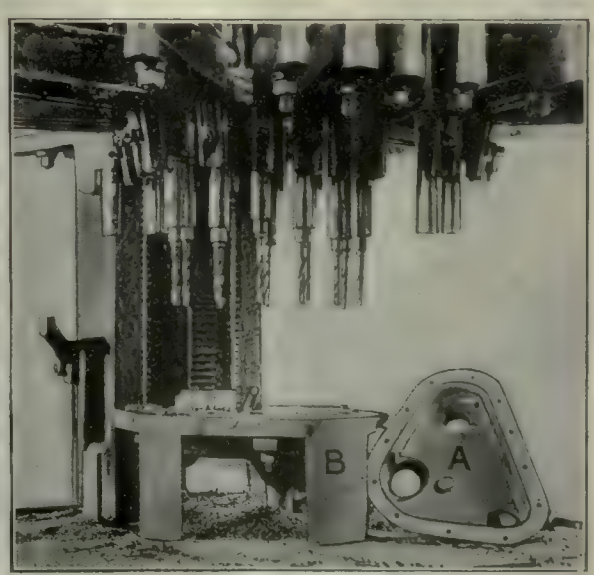


FIG. 12. DRILLING GEAR-CASE COVERS

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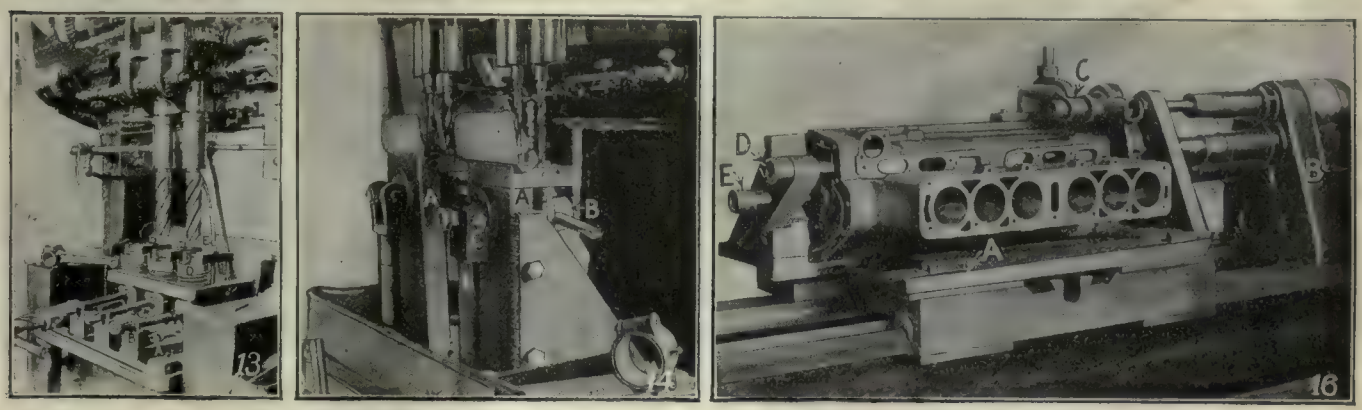
by releasing the clamping screws that hold the individual sleeves *H* on the crossrail *I*. For all heavy drilling operations on both the cylinder block and head the drills are run at a speed of 90 ft. per minute with a feed of 0.015 in. per revolution.

Another Natco drilling machine is used to drill the smaller bolt holes in the cylinder head. A simple jig plate is used for this operation and is held in line on the cylinder head by means of dowel pins which fit into some of the holes previously drilled.

Drilling Gear-Case Covers

The gear-case cover *A*, Fig. 12, has 12 holes drilled in its rim at one setting in the jig. It is clamped to the under face of the drill jig *B* and firmly held up into place by means of a bolt and a wing nut.

The large ends of the connecting-rods are bored in the Foote-Burt drilling machine, Fig. 13, which customarily



FIGS. 13, 14 AND 16. BORING, DRILLING AND REAMING OPERATIONS
Fig. 13—Boring connecting-rods. Fig. 14—Drilling for cap bolts. Fig. 16—Reaming crankcase bearings.

uses four spindles on this job. At the time this photograph was taken the machine was set up for some special work so that only two spindles and three jigs were in position. In regular production the four spindles are so set up that two drills are used for rough-boring and two for finish-boring. Three lip drills are used for making this cut and are furnished with a liberal flow of coolant. The main bodies of the drill jigs *A* have pins at their outer ends *B*, which serve as guides for the small end of the connecting-rod. At the point *C* is a three-pronged bearing, upon which the large end of the forging rests to provide ample space for chip clearance.

Very heavy bushings *D* have been provided for the double purpose of guiding the drill and acting as a clamp for holding the connecting-rod forgings in place. The clamping is done by tightening down on the bolt *E* of the clamp *F* until the bushing has been forced down tightly on the top of the forging. Springs are provided beneath the bushing heads, which serve to raise them when the clamp is removed and thus release the forgings.

In the standard connecting-rod the two bolt holes for attaching caps are simultaneously drilled on the Moline drilling machine, Fig. 14. The jig *A* has been provided in duplicate so that two connecting-rods may be drilled at a time. The connecting-rod is held on a tight spindle *B*, which passes through the previously drilled end, and is drawn up against the frame of the jig by the hand screw *C* on the front face, while the lower end is lined up by two dowel pins.

After the caps have been sawed from the large ends of the connecting-rods they are taken to a Victor casting machine, Fig. 15, where they are babbitt lined, the lining being secured in place by anchor holes drilled in both halves of the bearing. The cap *A* and rod *B* are shown after the babbitt lining has been cast and show the oil grooves which are cast in them.

In casting, the connecting-rod is placed about in the position *C* with the cap in place on the large end, a central mandrel passing through the bearing. By raising the handle *D* the cam *E* causes the levers *F* on each side of the machine to close the ends of the mold around the mandrel. The metal, which is melted in the rear part of the base of the machine, is squirted into the opening about the mandrel under heavy pressure.

All of the bearings of the crankshaft and camshaft are in the base-block casting and are reamed by a triple-spindle line-reaming device improvised from a heavy lathe. The fixture *A*, Fig. 16, fits on the carriage of the lathe and carries the block casting as indicated. A geared head *B* has been provided for driving the three spindles which carry the reamers. These spindles are supported at their outer ends by the three bearings *C*, *D* and *E*, which assure correct alignment and support. The operator standing in front of the lathe feeds the carriage against the reamers until they have passed through the bearings. One of the reamers used for this purpose is shown at *A*, Fig. 17.

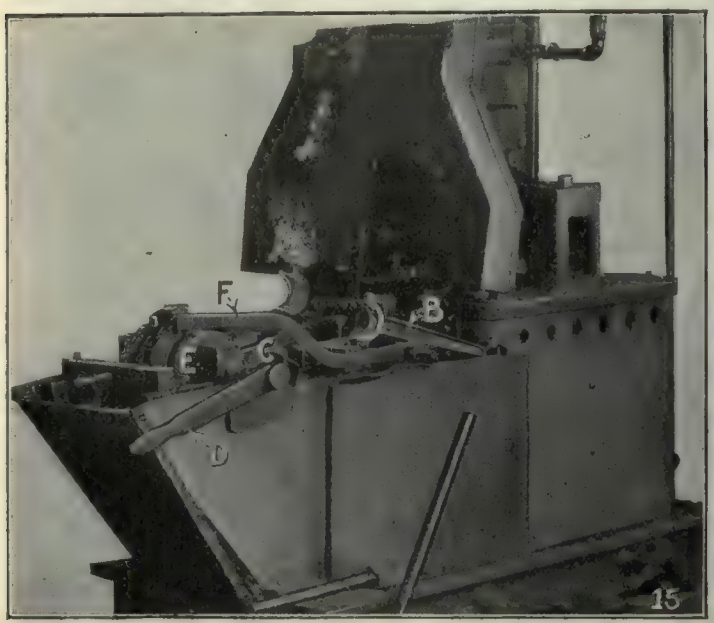
The Washing Machine

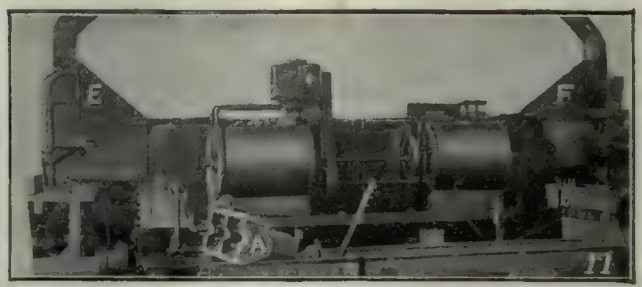
After all machine work has been completed on the cylinder block, it receives a thorough washing in a soda solution to remove the cutting grease and make sure no particles of steel or chips remain that might cause damage to the motor after assembly. The apparatus used for this purpose, Fig. 18, is the large hooded structure in the background. The pieces *A* are started at one end, and by a chain conveyor are carried through this structure very slowly, during which they are sprayed with a strong solution of caustic that removes all oil and dirt; they finally receive a washing with clear water to put them in good shape for assembly. Since both the caustic solution and washing water are

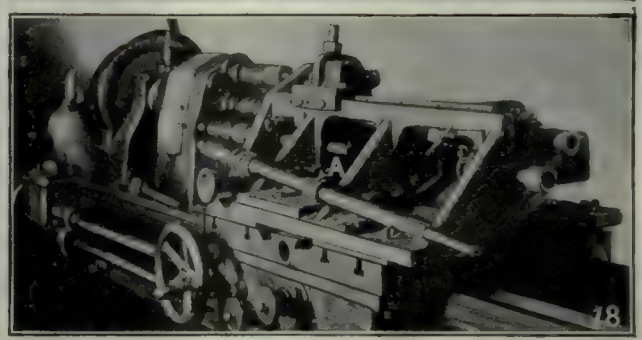
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very hot the hoods *E* and *F* have been provided at the ends to carry away the escaping steam.

After complete assembly the engines are placed on the testing block shown in the headpiece and there driven by shaft and chain drive from the large electric motor in the foreground until all bearings and working parts have been given a thorough test of some hours' duration to insure that all operating parts of the motor







FIGS. 15, 17 AND 18. BABBITTING, BEAMING AND WASHING
Fig. 15—Babbitting connecting-rods. Fig. 17—Apparatus for washing motor parts. Fig. 18—Reaming crankcases (showing one of the reamers).

are in good working order before it is taken to the final testing block. In the final test they are run for several hours under their own power to insure against trouble when sent out into actual service.

Production of Airplanes in England

According to the estimate of the British Advisory Committee of the Ministry of Reconstruction the existing airplane factories in England are capable of the production of 40,000 airplanes and 30,000 motors a year and are able to supply spare parts for an air force of that size.

Operation Cost of Motor Trucks

At a recent meeting of the Motor Truck Association of America, the operation cost of motor trucks was discussed to determine a proper cost-accounting system. As a basis for this determination, one of the largest operators of trucks has submitted the cost of operation for a five-ton truck which makes 50 miles per day and works 300 days in the year. The total cost per day operated was found to be $29.22. Average operation conditions as to the load were used in compiling this figure. Up to the present time these have equaled a full load one way, or for a 50-mile day transportation of 125 ton-miles at about 24c. per ton-mile. These are actual costs, no profit being included to cover risks, etc. These figures, as given, apply particularly to operation of trucks in large fleets.

The General-Purpose Tractor

A new type of tractor was recently placed on the market by the Allis-Chalmers Co., Milwaukee, Wis., called the "General Purpose Tractor." This tractor is rated at 6.12 hp., being of the two-wheel type, balanced in the rear by a truck wheel, which is removed in pulling certain machines. The tractor has a normal drawbar pull of 1000 lb. at a speed of 2½ m.p.h. The power plant consists of a four-cylinder L-head type engine, with cylinders cast en bloc, the head being removable, and with a bore of 3⅛ in. and a stroke of 4½ in. It weighs 325 lb. and is equipped with a centrifugal governor. It has the splash lubrication system and is equipped with a Kingston ⅞-in. carburetor, an Eisemann high-tension magneto and a Bennett dry air cleaner. The power is transmitted through a Bork and Beck dry plate clutch, sliding gear transmission, roller pinion and bull gear final drive. The transmission is lubricated by a geared pump mounted in the transmission case and directly connected with the sliding gear shaft, so that when the tractor moves oil is circulated through the case.

Altitude Adjustment Device for Airplanes Invented

An altitude adjustment device for airplane motors has been invented by a French engineer, Auguste Rateau. This consists of an arrangement by which the exhaust from the engine drives a small turbine which compresses air drawn into the engine to normal pressure, so that the engine develops full power no matter what altitude. It is claimed that a heavy day bombing machine whose speed at 15,000 ft. ordinarily did not exceed 80 miles an hour, made 140 miles per hour when fitted with M. Mateau's invention.

Problems of Our Foreign Trade*

By G. A. O'REILLY

FOREIGN trade as we find it treated ordinarily nowadays forms an almost ideal subject for discussion, that is, at least from the viewpoint of speakers upon this subject. Nobody seems to know enough about it to represent serious danger to anything anybody else may wish to say. The next speaker always may assume rather safely that nothing has been said by the last speaker which will disturb or interfere with any comfortable theory which it may be considered expedient or desirable to propound. Nearly everybody who touches the subject talks about foreign-trade problems, outlines problems, defines problems, shows problems against a proper background, calls attention to the dire things that will happen if these problems are not solved, and then, just not to be guilty of the sin of consistency, does not solve these problems, treating the whole matter as though the solution was to come later on, and in a different connection.

But the subject of foreign trade itself is serious enough and the problems it suggests difficult enough to demand our best and most serious efforts in their treatment. Speakers may find it simple and easy to interest audiences who wish to hear about foreign trade, and writers may find excellent space for their efforts outlining foreign-trade problems, even without solution, but the foreign-trade question itself—the big problem—in our commercial relations with other countries not only has not been solved, but, it sometimes appears, has not yet been even fairly well outlined.

With the exception of those engaged solely in export trade, very few know much about its details. As a nation we have in the past occupied, comparatively speaking, a back seat in the export game, and the reasons are not hard to find. Many manufacturers have sent representatives to foreign countries who not only could not speak the language but were not familiar with the trade conditions existing in those countries. We have tried to sell the foreigner goods made to our own standard specifications, giving little or no thought to the requirements of the purchaser. We were not prepared with foreign banking facilities that would permit giving the long credits customary in some countries. Our drastic shipping laws are such as to make prohibitive the carrying of ocean freight in American bottoms in competition with ships of foreign registry.

For a number of years our national life has been an exceedingly satisfactory one. We have developed institutions of our own, a few of them almost exclusively ours. We have quite properly abandoned our ancient position of "splendid isolation"—we have definitely accepted the fact that we must learn far more about other nations and other peoples and their institutions than we have known in the past; but through it all we have preserved a national individuality. We even went into this great world war in a spirit differing, we believe, from that which characterized the attitude of any other nation entering; and we believe, too, that we have come out of it with a few things at least not possessed by nations generally.

And now, in the face of all this, a danger presents itself—one which, if developed, is certain to seriously and unfavorably affect our national possibilities in the field of foreign trade. We had hoped, many of us who observed the splendid conduct of our soldiers and our people in the war, that we might emerge with a nationality which would be bigger and stronger and more effective for our own purposes, and for those of the rest of the world too, than any we had known in the past. In spite of this, we find ourselves engaging in such a wild rush for what we call internationality, that we are in danger of sacrificing, in the interest of the new thing, qualities of nationality which represent the strongest possibilities in the life of our country. That this danger touches our foreign-trade possibilities goes almost without saying.

Another problem, a serious one, too, comes to us in the form of a strongly developed tendency on the part of our people to read into the people of other countries qualities and characteristics peculiarly our own. Take gratitude, for instance—the gratitude of our friends abroad, because of the splendid part we have played in the war. Many of our people actually take the possibility of such gratitude seriously—believe that it will bear importantly upon our future success in foreign trade—expect the people of France and Belgium and England and Italy and the other nations with which we have been associated in the winning of the war actually to mix sentiment with business, and to give us preferential treatment in purely business matters, simply because they and we happen to have agreed upon the soundness of a particular great principle controlling men and nations. In other words, many of us are disposed to expect reward in the form of gratitude from these nations simply because we have done something which it was our obvious duty to do—because we have participated in a war which was just as much our war as it was theirs.

Or course, the nature of our participation in the war has been such as to confer upon us rather distinct advantages, even material advantages, which, if we are fortunate, will be utilized effectively in our foreign trade of the future. We now possess that which before the war was not generally conceded to us by other nations, that is, background. From now on, if we do not throw away the gifts which have come to us, the mere fact of being an American, of possessing an American representation, of having an American nation back of us, will be well worth while, even in ordinary everyday business. The best way to gain clear understanding of what this means is to try to imagine the position of the German commercial representative in his foreign-trade contact of the future. It is possible to imagine the time when hatred, disgust, and a desire to punish will pass from the hearts of men, but when can we expect that time when men will trust German honesty, German veracity, German consistency, as they trusted these things before the war? Merchandise will continue to be sold in the competitive markets of the world, largely upon a basis of quality and price.

Another of the important problems we must consider in the foreign-trade connection concerns our national financial situation. At last we have unloaded the responsibilities of a debtor nation and have taken on the not less serious responsibilities of a creditor nation. We got along very successfully under the old burdens and responsibilities—how shall we get along under the new? In the old situation the initiative was largely in the hands of the other fellow—our creditor—and it was necessary only that we comply with the reasonable requirements of the relationship; satisfy him as to our financial soundness and integrity, and work to the end that in time the obligation would be liquidated. Now the initiative is with us, as well as the responsibility of getting our world financial relations upon a proper basis.

The bearing of this question upon the future of our foreign trade is very important and most intimate. Whether or not the world money center of today is located in London or in New York does not matter particularly. We have the gold, the credit and the industrial and commercial health and vigor which mark financial responsibilities toward other nations which cannot be overlooked. If in the

*From an address before the Editorial Conference of the New York Business Publishers' Association in New York City, April 11, 1919.

future our world trade attitude leaves out of consideration the importance not only of being able to meet our own obligations, but also of making it possible for the other fellow, our customer, to meet his obligations to us, we shall find ourselves doing rather scant justice to our own foreign-trade possibilities. Of course, we cannot consistently give this other fellow, from whatever nation, all he wants, or may request.

In what we have referred to as our "big problem" in the foreign-trade connection, that is, ourselves, the question of national point of view appears conspicuously. Our outlook upon the entire field of foreign trade must undergo change. Trade with the world must be brought into the class of national institutions, national necessities. We must come to realize that, from whatever cause or causes, we are in foreign trade definitely and without the possibility of getting out of it. We were committed to this theory before the war, and conditions which have been produced by the war make the conclusion irresistible.

There is no good reason why our sales representative, or investigator, should become expatriate—should lose any portion of the privilege of Americanism merely because he crosses our frontiers and extends his activities into foreign fields. There is no reason why, assuming an intelligent attitude here at home, there should not be American "spheres of influence" in Latin America, and India, and China, and other fields in which our poorer world interests lie. These "spheres of influence" need take on no political color of any kind—they simply will form atmospheres which will be congenial to Americans who find it desirable to do business in these fields, and to the spirit of Americanism as we find it here in our own country.

These "spheres of influence" do not exist at present anywhere outside the United States, not because the people of the different countries concerned have any slightest objection to their development, but because we, good Americans, in the United States have not yet come to recognize the importance of a congenial atmosphere for those we send abroad to do our work and sell our goods. England and France and Germany and the other countries which have found foreign trade profitable have made no such mistake as this. They have gone into foreign lands fully nationalized, backed up by a national spirit which was definite and tangible; their commercial backbone, no matter what else it contained, was at least 80 per cent. British or French or German or whatever other national spirit was represented.

Necessity for Government Aid

In the development of this new national spirit not only must be included those of us who sell and those of us who manufacture for sale, but all other expressions of activity, not perhaps directly bearing upon foreign trade but in one way or another included in its support, or interested in its success. Most important of all, perhaps, government must be included. How futile it must appear for any government to talk about its interest in foreign trade, and about the facilities it is providing in the interest of foreign trade, while there remain in existence laws which make it impossible for American ships to carry merchandise to the markets of the world in competition with the ships of other nations.

There are those, not so many now as formerly, who believe that our great problem in foreign trade is salesmanship. This may be true, but only in the sense that one of our greatest problems in domestic trade also is the problem of salesmanship. Salesmen, like any other class of men, can be divided into good, bad and indifferent. If we keep the good ones at home and send the bad or indifferent ones abroad, we certainly shall encounter a serious salesmanship problem in our foreign efforts. Or, if we reverse this process and keep the bad ones here at home, we are sure to discover unexpected weaknesses in our domestic commercial situation.

If, in trying to secure an advantage in a particular foreign market we indulge in the very bad habit of "sending a boy to do a man's work" we must not expect best results. The representative of the New York concern who goes to Tokio, or Singapore, or Buenos Aires, in the hope of interesting the business men of these places in his wares, must be careful to avoid shocking sensibilities and disturbing existing conditions which the people of these countries take seriously. He must be prepared to encounter and understand new points of view quite different from those which are very common in good old New York. In other words he must "watch his step," and watch it continually.

Distance in Points of View

It is a long, long cry from commercial Boston, say, to commercial Singapore, Buenos Aires, if considered in terms of difference in points of view, but when we speak of points of view, we must realize that Boston, and Ipswich, South Dakota, or New York and Portland, Oregon, are not near neighbors after all, and there are New Yorkers who consider Newark, N. J., a long way off.

So why worry? Why try to make ourselves believe that the field of foreign trade presents nothing but new problems? Why not try to convince ourselves that in our domestic commercial experience we have been proceeding along sound lines; have had opportunity to deal with industrial and commercial fundamentals? And then, why not apply our experience in this domestic field to the very much over-estimated difficulties which must be encountered abroad? And, above all, why send a boy; why not attack this supposedly difficult foreign situation with the very best we have; the best that is in us?

If we do this we will find that the foreign-trade problem is not so terribly difficult after all. If we manufacture specifically for a foreign demand, as we do for domestic customers; if we find out what the foreign customer wants, and give it to him as he wants it and when he wants it, just as we do in the domestic field, and if, when confronted by a stiff salesmanship problem, as we are in the foreign field, we send abroad the best salesman instead of the ordinary or poor ones, again following our domestic plan of treating difficult sales situations, there is no reason why we should not succeed.

Of course, if this theory is to be carried out in a practical way we must eliminate certain tendencies at present appearing in our foreign-trade plans. These tendencies are not noticeable in the plans of those of us who are in foreign trade seriously; nor in the plans of those who have had opportunity to study foreign trade in a practical way, but in the plans of those who have gone into overseas trading, either with insufficient equipment, or in a spirit which does not include the elements we are accustomed to expect in substantial, commercial enterprise, foreign or domestic.

The most undesirable form assumed by these tendencies is a disposition to force our goods, our ideas, and our points of view upon the foreigner by a process practically of main strength. It is for instance assumed that a particular style of shoe, or fabric, or piece of machinery, or business method is good and sound, and hence should be acceptable to any man of sense and business judgment. It may be that in pursuing this dangerous policy we have been so impressed with the merit of our product that we have hoped in time that the foreign customers would come to see the product as we saw it.

Fortunately this tendency among manufacturers and salesmen has received a serious check in recent times. It is coming to us gradually that it is the other fellow's judgment, and not ours, that must control in the selection of what he purchases. We are rapidly approaching the conclusion that if we are not willing to play the foreign-sales game on a basis agreeable to the foreign customer and understandable by him, we are playing the wrong game and had better abandon the foreign field and stay right here at home where the difficulties incident to a getting together between manufacturers and consumers are not so serious as they are abroad.

So much for the gloomy side of the foreign-trade situation, the problem side. Now, what of the future? What possibilities and attractions does it hold out to us? Our present foreign trade in volume is quite satisfactory, or at least was until a very few weeks ago, but when peace after war, actual peace, becomes an established fact, and after the nations of the world, our competitors, get squared away again for action and competition, what then? How much of the war-conferred benefit we now enjoy will remain with us? Can we hold our present trade? Can we produce at a price which will enable us to compete with

the nations which, for many years, have been able to operate on a wage scale much lower than ours? Will the increase in our wage scale which has resulted from the war be met by a corresponding increase in scales of wages in competitor countries? Will the part we have played in the war help materially in our trade relations? Will the fact of our world supremacy in money matters give us an advantage which will continue?

These are the questions which are being discussed most seriously at the present time. And, on the whole, the situation, that is, the prospect for the future, seems at least hopeful. Some features of the case clearly are in our favor. For instance, because during the war we have fed the armies of the world, it is nearly certain that American food products in the future will enjoy a degree of popularity outside the United States which they did not enjoy in the past. Soldiers returning from the battlefields of Europe tell many and interesting stories about the experience of foreigners with our foods, and describe an entirely new attitude abroad toward Boston baked beans and brown bread, for instance, and a number of other institutions well known to the American table, but until the experience of the war practically unknown in many other countries. Another fact sure to be found to our advantage is that as the result of the increased purchasing power of the average individual in other lands he is now able to take a much greater interest in what we call "quality" in goods than was practicable for him in pre-war times. Then, he was obliged to buy cheap goods; now, he is able to buy goods of a much better quality. In former years the cheaply produced, low-grade articles manufactured in Germany possessed a distinct advantage over the more expensive, better American article, because it more nearly harmonized with the financial condition of the South American, or Far Eastern, or Scandinavian purchaser, than did the American article.

Another advantage which has come to us through the war is to be found in the lessons we have learned. Our point of view has been broadened; our national commercial horizon extended. We have learned much concerning world business which, before the war, we did not know. Our banking situation has improved wonderfully, both at home and abroad. The processes of foreign exchange no longer are shrouded in deep mystery, but are things with which a great number of American banks have acquired substantial familiarity. The problems of foreign finance, too, have been put on the high road to solution. One cannot read English financial publications or reports issued by important British financial institutions without being struck by the very substantial respect these people have developed for certain qualities we possess in the field of world finance.

And we are learning everywhere, and shall continue to learn. We find ourselves rather effectively emancipated from many of the fictions which in the past tended to confine our study and investigation to things domestic. Our nation is sound, vigorous, possesses practically unlimited wealth and credit, has become definitely established among the nations, not as a youngster seeking for recognition, but as a seasoned veteran, possessing national qualities which demand respect and inspire confidence.

We still have our problems to solve, of course, but who, realizing the miracles of accomplishment to our credit as the result of our part in the war, can have any reasonable doubt as to our ability to solve them? We cannot afford to play with the situation, or to sleep upon our opportunities. The case is altogether too serious for that. Before launching our plans we must take stock carefully; must measure our world assets with reasonable accuracy; must not over-estimate our advantages, or underestimate the advantages possessed by our world competitiors. Gratitude and brotherly love and world citizenship and internationality all must be given their proper place in our plans for the future, but no one of them must be exalted beyond its rightful place in our own United States world plans.

We must avoid mixing things up unnecessarily. Business and sentiment generally must be kept apart. If world gratitude is to be ours we will be that much ahead; if world charity is to be ours to dispense, let us dispense it intelligently, and upon plans of our own, not upon those prepared for us by other nations.

Industrial Co-operation*

By CHARLES P. STEINMETZ

Capital and labor are equally essential to industry. While the interests of employer and employee are opposed at some points they are identical at others. To bring about an ideal condition in industry it is necessary to merge as far as possible the two interests in one. It has taken two generations to bring about the unfortunate situation wherein it seems that fighting is the only way to settle the differences. We can only get back to a saner basis by working along these lines; merely wishing for, or talking about it will accomplish nothing.

THERE is an old saying, "In unity lies strength and a house divided against itself must fall." If that is true of anything it is true in Mother Industry and particularly true today where modern civilization in the world's war has practically become bankrupt and we now, as receivers, have to reorganize the world again. Our industries must have coöperation to be successful and efficient; to be able to take care of the world's work as it has to be done to redeem our civilization from what has occurred in the last few years. But is it possible?

The socialistic radical labor agitator tells us there can be no peace between capital and labor. They are inherently antagonistic and must fight to a finish because the interests of one are against the interests of the other. In industrial depression the employer as well as employee suffer. The old-time corporation president preaches to us that capital and labor interests are identical; that if the individual interests are trusted to his keeping that they will be taken care of. At the same time every child sees and knows that a dollar more paid out in wages means a dollar less profit and that the interests of capital and labor are different—entirely opposite in some respects. We cannot get any further in solving the problem if we take an extreme view one way or the other. Capital and labor interests are not identical but are the same in some respects and opposite in others. In general, in any industry, those interests which have to do with industry on the outside, customers, etc., are usually identical.

Within the industry the interests of employer and employee are often opposite to each other. There are relations in which capital and labor interests are identical and some in which they are not identical, but there are many other relations in our modern civilization where there are common interests and unidentical interests. Take buyer and seller, manufacturer and customer, landowner and renter. Many interests in common, and still we do not have warfare. They are not going to fight merely because there are some features where the interests are opposite. In all those relations where the relations exist as between employer and employee, there is no settlement of the condition by fight and warfare; but on the contrary there are often, usually very often, friendly relations between the manufacturer and customer. It is not the historical relation, as we unfortunately find, in this one feature. Why is it necessary that employer and employees and capital and labor cannot get along in the same manner by coöperation? The reason is historical.

*An address before the Industrial Conference of the New York Business Publishers Association, April 11, 1919.

Originally, the employer and employee bore an equal standing as regarding industrial power, in the days of small manufacture. The organization of employers as represented by the formation of industrial corporations meant an increased power on the side of the employer and a disadvantage to the employee, until labor organizations were formed; but conditions had already become hostile.

How to bring the coöperation about; how to return to such conditions as should have remained operative, is the main problem, because we must bring about coöperation within our industry if we wish to meet the demands of the new world. It has taken two generations of development to bring about the present unfortunate situation where differences are settled by fighting. We cannot expect to secure this coöperation by merely wishing, or talking about it. It is a long, slow, difficult work which will mean many setbacks and we have to remain at it and fight for it.

Each Side Equally Responsible

Adjustment must come first from the employers, but not for any moral reason. The present situation is not the fault of labor more than capital. It is merely historical development of a situation beyond the control of man. The employer must have a broader view than the employee. We must not forget that there are still many imperfections in our civilization. Most serious is that a large majority of men cannot enjoy complete education, as would be desirable for making the most of themselves, and heads of industry as a rule have the benefit of the broader education and must take the broader view of things. We cannot expect the same broad view of the one who left school at fourteen years of age as the one who has enjoyed a more extensive education. That the initiative must come from capital is realized. All through groups of occupations and industries we have talk on coöperation. We must realize it does not mean to spend a few dollars here and there, but the work is probably the most important development in the industrial field which faces us today and men must devote their time and attention to it, and must give high-grade service, the same as those in charge of other administrations. We cannot expect to see any positive results until we are really willing to approach it more seriously in time, interest, quality of men and amounts of money devoted to bringing about industrial coöperation.

Coöperation implies two parties working together, not one settling the matter and telling the other you must do that and that and then we will coöperate. Unfortunately most of the serious efforts made in this direction have been of that character—that the employer has worked out plans and then asked the employees to coöperate on those plans. Very often those plans were good and the whole scheme would have been satisfactory if it could have been worked out jointly, but it came as paternalism and was therefore tainted from the beginning. That is not coöperation.

It is easy to say we must have coöperation; also to find fault. It is not easy to make suggestions how it should be done and how the present strained relations between capital and labor should be overcome. Probably there is no single way to bring about true coöperation. It depends largely on local conditions and social conditions. In short, there is not a broad and single way. Before we try to find out let us discover the relation of Mother Industry. One attitude, the attitude of the old-time employer, is that industry is the private property of the owner, recognizing only capital and not labor. This relation was destroyed forever at the moment when President Roosevelt interfered in the anthracite coal trouble and brought both sides to terms. The other extreme is the socialistic conception that all wealth is created by labor and that all wealth therefore belongs to labor and that capital is a parasite on labor due to having acquired a monopoly of the means of production. At present industrial production requires capital and labor. Both are necessary. Labor unrest is a demand for a share of the profits of industry and a share in the management of industry. This is the final foundation of all our social unrest. Since they are both necessary it is right that they both demand a right in the share of the profits and management of industry. There are several ways—mostly unsuccessful. One way, welfare work, which is important and useful, but offensive and insulting, by being forced on labor in a paternalistic manner, is appreciated only when not done as a welfare work but merely as a matter of corporate self-interest. We must realize that quality of one's work depends on conditions under which work is done. That makes the difference in the self-respect and quality of the man. This will not bring about coöperation. We must not use the name "welfare work." It should be called an industrial relation department or committee, instead of welfare department.

Another attempt which has been made is the attempt of getting closer relation by the bonus system, giving bonuses during times of industrial prosperity and getting the employee interested in the industry. To some extent that is all right. Somewhat of paternalism. It may be all right in Germany where people have been trained to look up to their masters as superiors, but leaves a bad taste among Americans. They are prone to ask, "Why not give us an increase of wages instead of a bonus?" The bonus system has the disadvantage of sharing only in profit and not in management.

Another attempt is the committee system, claimed to have been successful in England. There are several forms. There are the committees elected by employees which take up with employers all relations of mutual importance and interest, arbitrating wages, hours, etc. Another form is joint committee, half of which is elected by employees and half by the corporation. This appears to have very much in its favor. There are, however, some difficulties; the most serious of which is that labor has its own organization and such action is apt to be taken by labor unions as not recognizing them. Labor unions claim that they represent the employees. Facts show in many cases that they are right, because while union men may often have a minority among employees, when serious questions arise, experience very often shows that the majority of non-union workers take the lead of the unions rather than the non-union committees. Shop committees are liable to be considered as eliminating the labor unions by putting up a rival union. While leaders of industry recognize the necessity of coöperation, unions of labor organizations have not yet realized the advisability of coöperation in industry. But there is another side. Do we want the committee system? Let us assume it is successful—a board of directors on one side and a labor committee on the other. Is this not another warfare by organizing two different parties?

The last is wage dividend. Mother Industry requires capital and labor. Therefore both are entitled to share in the profits. Capital is entitled to a fair rate of interest on the money invested and labor is entitled to a fair rate of wages for the work done. All profits beyond that belong to capital and labor. These should be divided as dividends, being dividends on capital stock, the other being divided on labor stock as found by yearly wages. This system is in operation in a number of corporations, in electric-utilities companies and others. It lacks provision for share in the management. But we could carry it further and recognize labor as equivalent to capital and give the labor stockholder the same right as the capital stockholder in the management. This would be revolutionary, but both would share in the profits, getting dividends, one on capital and the other by labor stock. Both share in the management (labor-union officials could hold the proxies). This does not set up rival administration, but brings about joint control by evolution and not by revolution. The question is, How far should employees be recognized as stockholders? Should every one, even if he joined yesterday, vote today? There are many things that show that only those who have been with the organization for a number of years should be recognized as wage stockholders, taking part in dividends and management. We could set the limit at ten years. There would not be many and would not make any radical change in industry, and every year or so we could change the minimum, going down to six or five years. This would eliminiate any opposition except from the extreme socialists.

Finally, leave only the laboring men as stockholders. This revolution could be brought about by evolution if desired. This would be carried to full socialization of society by evolution, as the final outcome of our industrial development. We all believe we want to bring about this change by evolution and not by revolution.

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Manufacturing the 9.2-In. Howitzer Shell—II

By S. A. HAND
Associate Editor *American Machinist*

This installment covers operations on the shell from finish-turning the outside until it is ready for fitting the base plug in place. At this point the operations are interrupted to describe the making of the base plug. This will be considered as an integral part of the shell in the further descriptions which will appear in the next article.

UPON the completion of finish-turning the outside of the shell the next operation is to score, undercut, turn the groove for the copper band and form the base radius. This is done in a 26-in. lathe and the shell is held by the interior on a short expanding mandrel with four wide blades similar to that used for finish-turning. The tools for this operation are held in a square turret on the lathe carriage; three of them are forming tools of high-speed steel and one is a square Stellite tool in a holder. Fig. 16 shows the tool layout. First, the position of the band is marked with the scoring tool, then the Stellite tool is used to turn the band groove to the diameter of the top of the wave lands. The scoring tool is again used to score the ends of the band groove to the diameter of the roots of the wave lands, after which the undercutting tool is fed in to the same depth and moved sidewise in both directions to make the groove the proper width and to undercut or dovetail the sides to an angle of 7½ deg. The last operation is to form the radius on the base. The sinusoidal waves are cut in a 26-in. lathe, the shell being held on an expanding mandrel provided with six buttons, three near the front and three near the back. The buttons (which are equidistantly spaced circumferentially) are normally pressed inwardly by flat springs and are expanded by the longitudinal movement of a tapered plug controlled by a handwheel at the left of the headstock.

The reciprocating motion of the carriage necessary to produce the waves is controlled by the cam *A*, Fig. 17, which revolves with the spindle of the lathe. The roller *B* is fastened to the carriage and is held against the cam face by a heavy spiral spring under the cover at *C*, which pushes the carriage to the left. Thus motion is transmitted to the carriage in one direction by the cam and in the other direction by the spring.

The waves, seven in number, form an included angle of 70 deg. and are 0.05 in. in height. The tool, made of high-speed steel, is formed so as to cut all the waves at once. It is held in the tool block in the manner shown in the illustration and is fed in bodily by the large handwheel, the top of which may be seen in the lower left-hand corner. Afterward five scores are cut across the waves at an angle of about 45 deg. with a broad chisel. These act as air vents and prevent the trapping of air around the waves as the band is being pressed into place. At this stage the shell is subjected to a preliminary Government inspection. This is a visual inspection for cracks and general condition; it also includes gaging the band groove and waves for all operations.

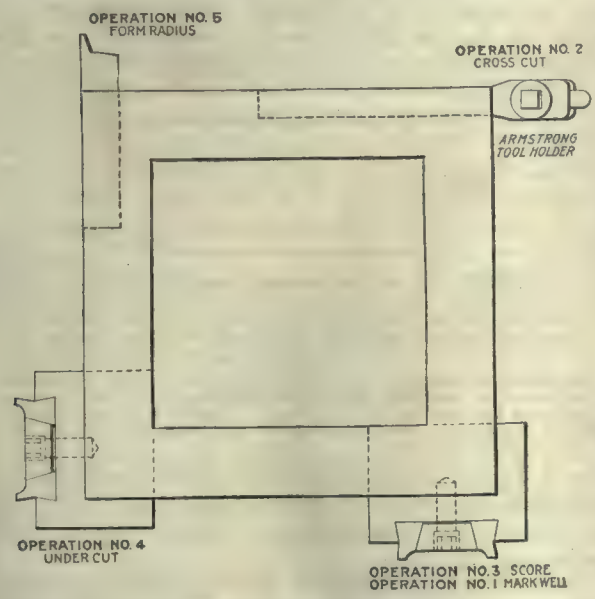


FIG. 16. TOOL SET-UP FOR SCORING, TURNING AND UNDERCUTTING

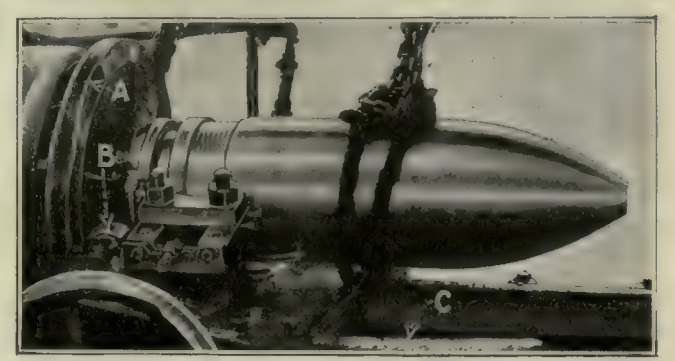


FIG. 17. CUTTING THE WAVES

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Before pressing on the copper band an expanding plug, details of which are shown in Fig. 18, is inserted in the bore at the base and expanded by the use of a long wrench. This is to minimize the collapsing effect of the pressure in banding. All grease is washed from the band groove by dipping in a vat of hot Oakite.

Pressing on the Copper Band

The copper band is brought to a red heat in an oil-fired muffle furnace and the shell is placed with its base in a depressed seat in a Metalwood six-cylinder banding press of the usual construction, Fig. 19. The hot copper band is dropped over the shell and rests on a shoulder of the shell seat which is of the proper

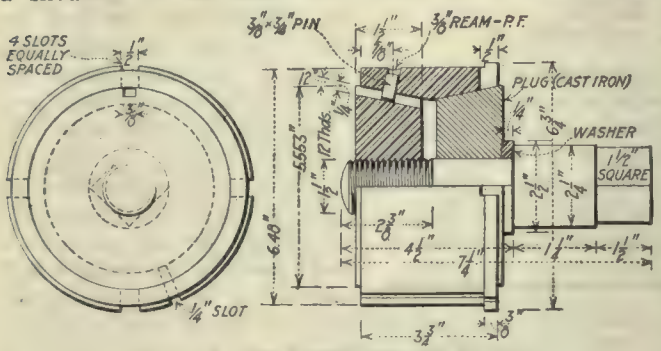


FIG. 18. THE EXPANDING PLUG

height to bring the band fair with the groove into which it is to be pressed.

The ram heads of the banding press are scored circumferentially in such a way that the greatest pressure is exerted directly over the waves and at the edges where the band must be forced into the dovetailed sides of the groove.

The pressure applied to the cylinder in banding is 2500 lb. by the gage, which is equal to about 20,000 lb. per square inch of band surface. In addition to the pressure exerted by the press there is that of shrinkage as the hot band cools.

In banding, the pressure is applied and released several times, and in the interim the shell is partly

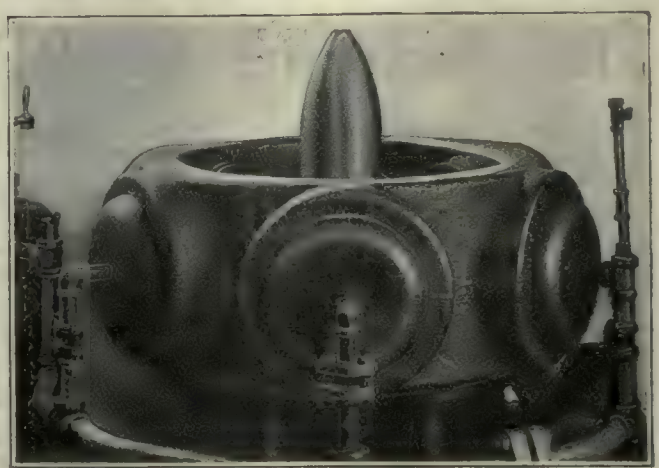


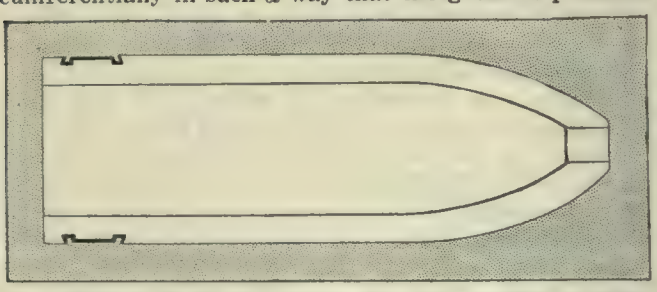
FIG. 19. PRESSING ON THE COPPER BAND

revolved so as to equalize the pressure at all points. The banding operation requires the labor of seven men distributed as follows: Two to put in the expanding plugs, one to wash and put the shell in press, one to heat and put on the bands, one to operate the press, one to remove the shells from the press and one to take out the expanding plugs.

Reboring

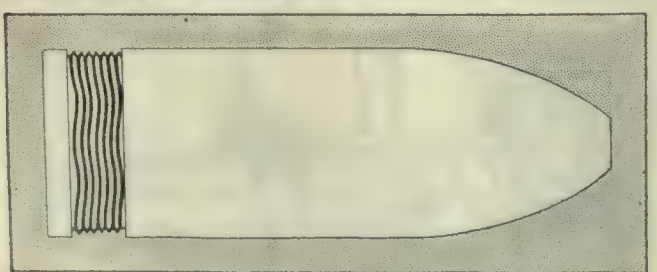
Notwithstanding the use of an expanding plug the banding pressure collapses the shell from 0.015 to 0.020 in. at the location of the band and to a less extent for some distance above and below. This necessitates reboring as far in depth as any reduction has taken place. This is done in a 22-in. lathe, the shell being held in a long draw-in chuck supported at the outer end in a ring steadyrest. A single-pointed Stellite boring tool is used.

Before removing the shell from the lathe the counterbore for the flange of the base plug is roughed out and the base below the copper band is re-turned to a



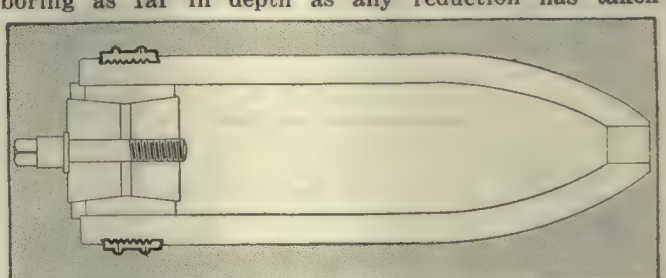
TRANSFORMATION FOR OPERATION 507—SCORE, UNDERCUT AND TURN FOR WAVE

Machine—Fairbanks-Morse 26-in. lathe. Number of Operators—One. Work-holding device—Wrench-operated expanding mandrel with four blades. Tool-holding device—Square turret on carriage. Tools—Stellite for turning; high-speed steel for scoring and undercutting. Number of cuts—One. Cut data—Speed, 52 ft. per minute; feed, 0.046 in. per revolution. Coolant—Soluble oil. Gages—Angle, depth, width, diameter and length from base. Production—65 per machine in eight hours.



TRANSFORMATION FOR OPERATION 508—WAVE

Machine—Fairbanks-Morse 26-in. lathe. Number of operators—One. Work-holding device—Wrench-operated expanding mandrel with six serrated buttons. Cutting tool—High-speed steel. Number of cuts—One. Cut data—Speed, 32 ft. per minute; feed, hand. Coolant—Soluble oil. Special fixtures—Cam on faceplate; roller on carriage held to cam by spring. Gages—Diameter for top of wave lands. Production—225 per machine in eight hours.



TRANSFORMATION FOR OPERATION 509—PRESS ON COPPER BAND

Machine—Metalwood six-cylinder banding press. Number of operators—One and six helpers. Pressure—2500 lb. on gage = 9 long tons per square inch on band. Special fixtures—Expansion plug for shell base. Production—350 per machine in eight hours.

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diameter of 9.05 in., the lower edge of the band faced to a definite distance from the base and the base-corner rounded. The reduced diameter provides clearance for any burrs that may be forced back from the copper band by the rifling when fired from the gun.

The thread for the base plug is a left-hand Whitworth thread, eight per inch. It is made left hand so that the sudden spinning of the shell to the right as it takes the twist of the rifling will tend to tighten the plug in its place. Whitworth thread is used because



TRANSFORMATION FOR OPERATION 510—REBORE, ROUGH COUNTERBORE AND ROUND CORNER AT BASE

Machine—Davis 22-in. lathe. Number of operators—One. Work-holding device—Hand-operated draw-in. collet. Tool-holding device—Turret on carriage. Cutting tools—Stellite. Number of cuts—One. Cut data—Speed, 184 ft. per minute; feed, 0.039 in. per revolution. Coolant—Soluble oil. Gages—For bore diameters, plug, go, 6.490 in., no-go, 6.510 in.; rear of band, snap, go, 9.055 in., no-go, 9.045 in.; length from base to band; radius for corner. Production—55 per machine in eight hours.



TRANSFORMATION FOR OPERATION 511—MILL THREAD AND FINISH COUNTERBORE

Machine—Lees-Bradner thread-milling. Number of operators—One. Work-holding device—Hand-operated draw-in collet. Cutting tools—High-speed steel hob and plain milling cutter. Number of cuts—Two, one for thread and one for counterbore. Cut data—Speed, 84 ft. per minute. Coolant—Mineral lard oil. Gages—Plug, Whitworth left-hand thread, 8 per in.; diameter and depth of counterbore. Production—45 per machine in eight hours.

the plant had been previously making the 9.2-in. British shells which required that type of thread. As the plant was already supplied with hobs and gages for the Whitworth thread there was no objection to its use, as the plug becomes an integral part of the shell and is never removed.

(*This Article Will Be Continued in the May 15 Issue.*)

Abstracts of Recent Office Orders of General Interest

No. 610, Mar. 27. Maj. Parker Dodge is designated a member of the Board of Officers to approve executive salary increases at plants working on a cost plus basis. The present members of the board are as follows: Maj. H. L. Rice, Maj. Arthur Frantzen, Maj. B. T. McCormick, Maj. C. A. Stolberg, Maj. J. S. Black, Maj. Parker Dodge.

No. 611, Mar. 28. Maj. J. L. Crane is designated Chief of the Rochester District Ordnance Office and Chairman of the Rochester District Claims Board, succeeding Mr. Frank S. Noble. Appointment effective Apr. 1.

No. 614, Mar. 31. Col. L. B. Moody is assigned as Chief of the Tank, Tractor and Trailor Division, succeeding Maj. Paul Weeks.

No. 616, Mar. 31. J. H. Scobeel is appointed Ordnance District Chief, Cleveland District Ordnance Office and is designated Chairman of the Cleveland District Claims Board, succeeding Samuel Scovil, effective Mar. 27.

No 617, Apr. 2. George J. Roberts, special assistant to the Chief of Ordnance and Deputy Fixed-Nitrogen Administrator, is placed in charge of all matters concerning the fixed-nitrogen interests of the Ordnance Department, with authority to act for the Chief of Ordnance in all such matters—especially in connection with the administration of the Nitrate Division and the present and future disposition of nitrate plants.

No. 618, Apr. 1. A board to consist of the following, Col. Thomas J. Smith, Lieut.-Col. Dwight K. Shurtleff, Lieut.-Col. Russell L. Maxwell, Lieut.-Col. Patrick J. O'Shaunessy, Maj. Amasa Trowbridge, Maj. Frank J. Stephenson, Maj. Michael T. Carney, Maj. Frederick C. Hosea, Capt. F. H. Keller, and First Lieut. Henry L. Slade, is appointed to investigate and determine proper methods of procedure at ordnance establishments in assuming property and financial responsibility for salvage materials transferred to those establishments. This board will meet at Washington, D. C., at such times as may be called by the senior member.

PERSONALS

Capt. Earle K. Williams, 350 Broadway, New York, who was commissioned First Lieutenant in June, 1917, has been discharged. He attended the University of Pennsylvania and was formerly an executive with S. H. Kress & Co. He has been on duty in the Planning and Control Section of the Engineering Division.

Maj. Frank W. Wood of Cleveland, Ohio, president of the Wood & Spencer Co., machinists and machinery manufacturers, and also president of the Cleveland Castings Pattern Co., has been recently discharged from the service. He served about 11 months in France in the Construction and Maintenance Division.

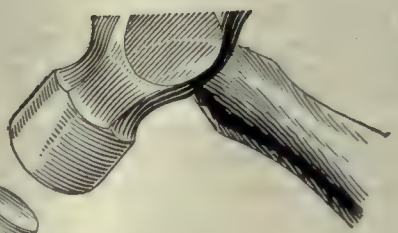
First Lieut. Hudson D. Dravo, whose home is at 4732 Center Ave., Pittsburgh, Penn., was discharged on his return to America after ten months' service with the American Expeditionary Forces. His service overseas was in connection with the construction of railway artillery. Before entering the service he was employed by the Pennsylvania Railroad Company.

Maj. Carlisle Mason has returned from France, and has resigned his commission. He will resume the practice of general engineering in a consulting capacity under the firm name of Carlisle Mason, Inc., 207 Broadway, N. Y., and will be assisted by a staff of experts in the specialized branches. Major Mason has had 30 years' of varied engineering experience covering a wide field of scientific research both at home and abroad.

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas

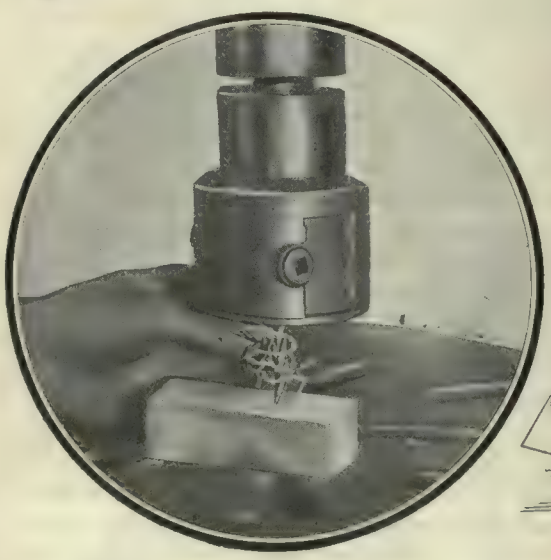




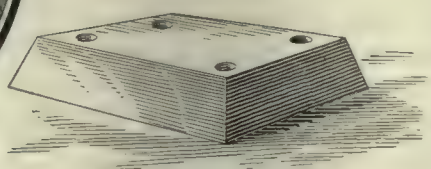


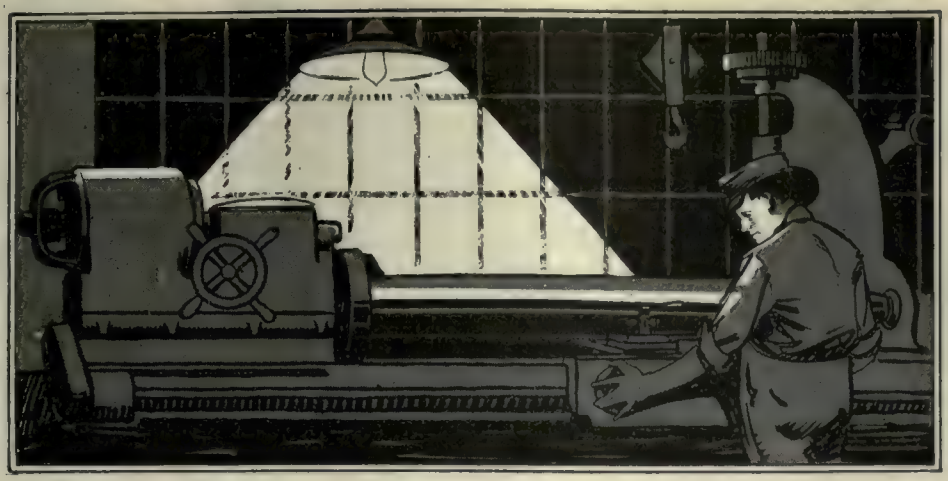












LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Small Motors for Hand Tools and Others Uses

The field of electric motors in capacities of fractions of a horsepower is sometimes overlooked. This article takes up the question of small motors for industrial purposes and emphasizes why their use has increased so rapidly in recent years. Included also are illustrations of some types of hand tools with motor equipment.

THE high efficiency and wide range of usefulness of small electric motors with rated capacities of less than 1 hp. are perhaps not generally recognized, and the object of the following notes is to call attention to a number of their practical uses. The principal reasons advanced for the development of the small electric motors include: (a) The influence of efficiency engineering, which has made the industries realize that time and wages can often be saved by the operation of the smaller appliances by electric power; (b) the fact that it has become possible to use small motor-driven equipment on electric circuits which were originally installed for purposes of lighting only, and (c) the fact that the small motor has proved itself to be a reliable source of mechanical power and has thus led motor manufacturers to make the necessary investments to develop this line of equipment as an important branch of the electric-motor field[1]. Bernard Lester in some of his writings on small motors for power purposes calls attention to what seem to be the principal features that make them so popular for many purposes. First, the small electric motor is a simple device to start and stop; second, its weight is usually so light that together with that of the device driven it is low enough to make them easily portable, and third, small motors can be operated continuously or intermittently over long periods with little or no attention. The average central station from which shops purchase electric current tends to the use of the alternating current for its transmission and distribution circuits. It also often occurs that the lighting and other circuits of the shop, as supplied by the shop power house, are fed by alternating current. It follows therefore that the principal development of the type of motor for these small-power applications has been one that could readily be connected through an ordinary lighting socket or other means to the regular lighting or other circuits, and as the lighting circuit is practically always single phase, when of the alternating-current type, it follows also that most of the attention on the part of the motor designers has been along the lines of a good and reliable single-phase alternating-current motor. In a general way all of the principal single-phase small motors fall under one of the two main classes, in one of which the speed varies widely with the torque which the motor is called upon to deliver, and in the other the speed remains practically constant under all conditions of the load up to the full rated capacity of the motor. The first type, because of its wide speed variation with load changes, has a rather limited field

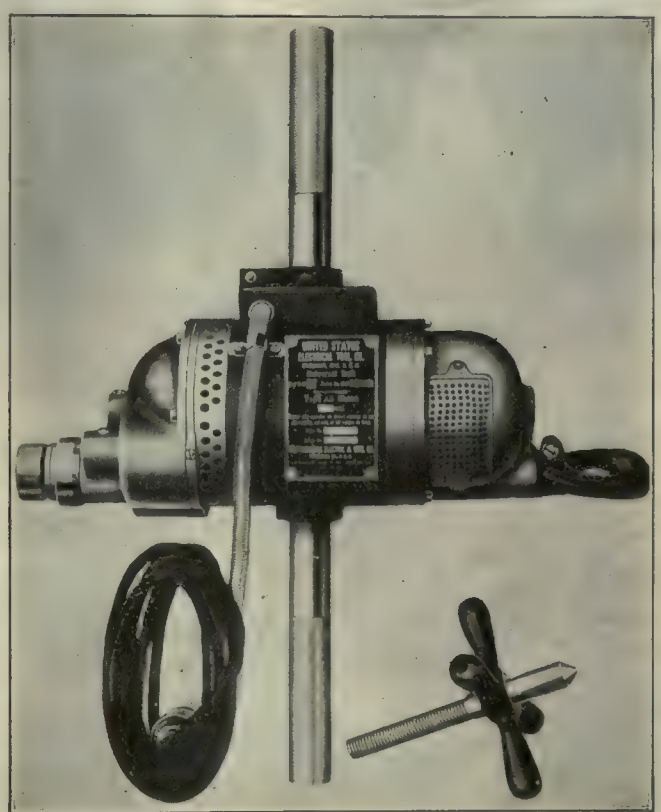


FIG. 1. A MOTOR-DRIVEN DRILL

[1]These causes of development of the small motor field, together with certain points concerning types of small motors, their characteristics and uses are based in part on discussions of Bernard Lester, Trans. Am. Inst. of Elec. Eng., Vol. XXXIV, 1915, p. 681, and "Standard Handbook for Electrical Engineers," p. 1286.

of application, while the second is better suited to the general run of service.

The name given to the first type is the series-wound, single-phase, alternating-current motor, and while its speed characteristics may be a disadvantage in some cases one of its greatest advantages is that it can be used under certain conditions of construction on both direct- and alternating-current circuits having the same voltages, and that when so used the operating characteristics are sufficiently similar, in general, to meet the needs of the driven device. One of the conditions of its use, however, is that it must be mechanically coupled to its load at all times, since motors of this type attain dangerously high speeds if they are operated without load.

The use of the series single-phase motor is largely limited to such industrial cases as fan-type forge blowers, fans for exhaust or supply purposes, and for portable tools where the electric supply is turned off when the tool is not in service, rather than mechanically to disconnect the motor from the tool, thus leaving the motor attached to the supply circuit. In all of these applications, therefore, it is understood that the series motor is permanently connected to its load to avoid the dangerously high speeds above referred to.

The So-Called Repulsion Type

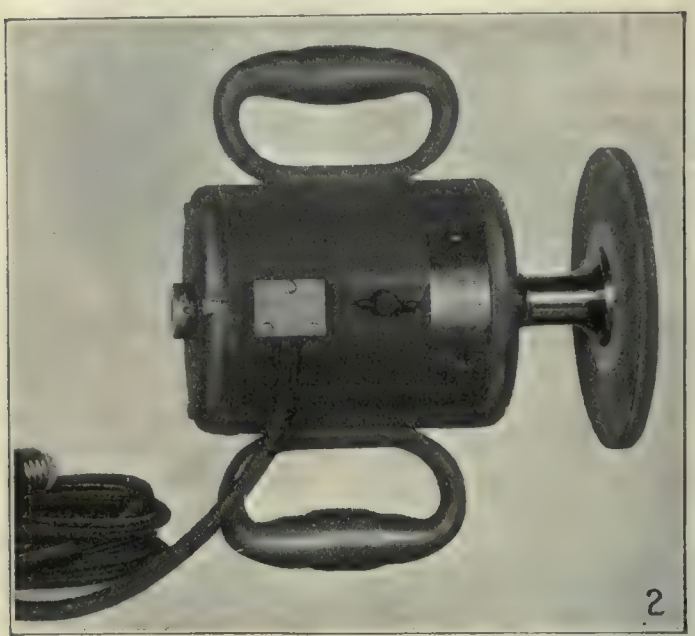
Another alternating-current form of small motor is the so-called repulsion type, which has approximately the same speed-torque characteristics as above outlined for the series alternating-current motor, but which does not reach a dangerously high speed at zero load; that is when the motor is disconnected mechanically from the device with which it is used. While this is an advantage in some cases, this type does not possess the same flexibility of use on both direct- and alternating-current circuits as may be the case with the series-wound type.

The other type of alternating-current motor in common use is that known as the induction type, which is equipped in the smaller sizes with a simple auxiliary device to make it self-starting under load.

Besides the alternating-current motors those of the direct-current type may also be used, and the practice has been standardized by some motor manufacturers to such an extent that the sizes of both alternating- and direct-current small motors, with the same operating characteristics and ratings, are the same so that either may be attached to a device at will.

Small Induction Motors

In small induction motors the starting torque varies approximately as to the square of the circuit voltage. It follows therefore that if the circuit voltage is below normal, due to any cause, the ability of the motors to start under load will suffer more of a reduction than the amount of the reduce voltage. In good practice it is considered desirable to design the motor so that it will start up the machine to which it is connected with a voltage as nuch as 20 per cent. below normal.





FIGS. 2 AND 3. A GRINDER AND A FAN DRIVEN BY MOTORS

With he foregoing notes as a basis it will be possible to turn to some of the practical applications of the small motor in the shop field, and these applications in turn will serve to emphasize some of the preliminary notes regarding the types of small motors available and some of their uses and limitations.

Description of Illustrations

Fig. 1 illustrates the compact appearance of a motor-riven drill[2], in which the extension line for making connections to a lamp socket or other receptacle is seen in the figure. Fig. 2 gives an idea of a portable grinding machine. In Fig. 3 the application of the small notor to a blower is shown. The motor has a rated capacity of $\frac{1}{30}$ hp. only, and is of the series type before referred to.

[2]Figs. 1 and 5 are due to the United States Electrical Tool Co.; Figs. 2, 4, 6 and 7 to Jas. Clark, Jr. & Co., and Fig. 3 to the Crocker-Wheeler Co.

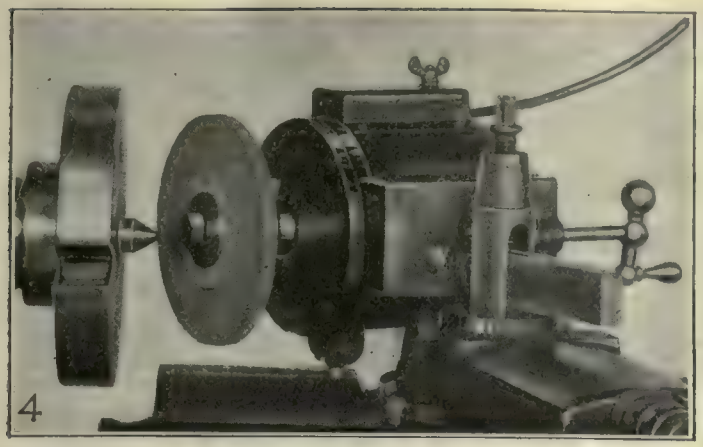


FIG. 4. GRINDING A LATHE CENTER

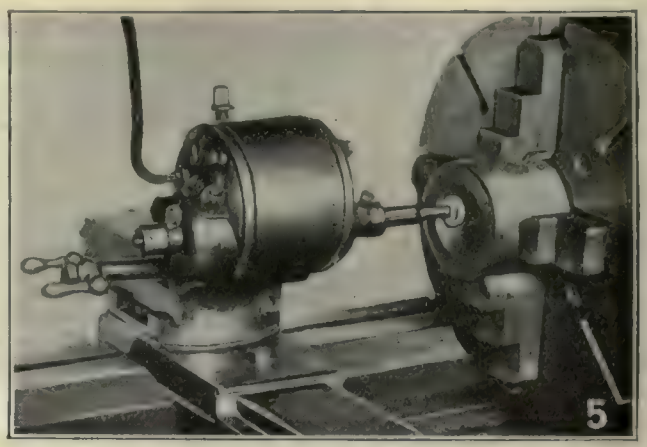


FIG. 5. INTERNAL GRINDING

However, the great convenience of these smaller motor-driven devices is perhaps best illustrated by views which show operating conditions. Thus Fig. 4 shows a small motor-driven grinder arranged for grinding a lathe center. The shank of the grinder is clamped in the toolpost of the lathe and the grinder is then placed in proper position and angle for grinding the center.

Grinding Operations

The practice of one manufacturer is to make toolpost grinders of this general kind in a variety of sizes for taking wheels ranging from 4½ to 14 in. in diameter, split taper bearings being used so that the grinder may be adjustable for wear, and dustproof collars being employed to prevent the emery from reaching the bearings.

Fig. 5 shows a case of internal grinding which is readily accomplished by an extension arbor. Fig. 6 illustrates another adaptation of the toolpost type to grinding operations on lathes. Motor-driven grinders may be employed for light grinding generally and for bench grinding, or for surface grinding in shaping and planing machines. Fig. 7 shows a grinding operation on a planing machine.

It is perhaps evident that the small portable tool is not likely to receive as much care and attention as the larger apparatus in the shop. At the same time it is an advantage to know something of the kinds of items that are most likely to require attention in the operation of such light tools, as in the following notes based on General Instructions, sub-headed care of Electrical Tools, by the United States Electrical Tool Co.

If a portable tool fails to operate, first try out the supply circuit by inserting a good lamp in the socket. If the lamp burns it indicates that the trouble is between the socket and the motor or in the motor. Take off the commutator end of the motor and with the motor attached to the supply circuit note if there are any sparks at or near the brushes. Next note if the brushes are bearing on the commutator. Look at the commutator, and if it looks black or oily wipe it off with a rag and some kerosene. While inspecting and cleaning, the current must be turned off.

Two Important Points to Consider in Operating These Tools

After the commutator is cleaned and the brushes have been found to fit on the commutator turn on the current again and try the tool. If it still refuses to work look at the commutator again and see if there is a burned spot between two of the bars. If a burned spot is noted take out the armature and return it to the factory for repairs.

Two of the most important points to consider in the operation of such tools are that they are oiled from time to time, and where brushes are used that they are replaced with new ones when the old ones are worn down. Where the tools are equipped with their own fuses failure of the tool to operate should be followed up by an inspection of these fuses, and if a burnt place is noted a new fuse should be inserted. Care should also be exercised to see that the brushes do not stick in the brush holder, as this will sooner or later keep the motor from operating.

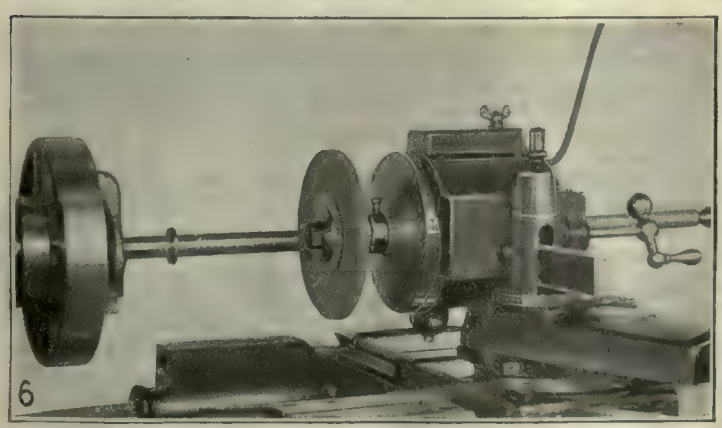


FIG. 6. CYLINDRICAL GRINDING

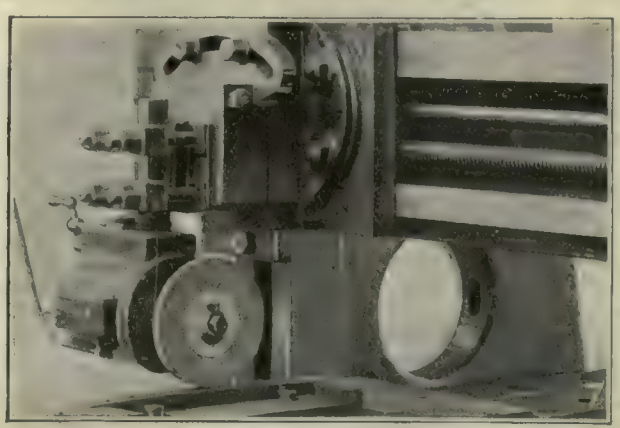


FIG. 7. GRINDING FLAT WORK

Proper Sizes and Materials for Gears for Tractor Construction*

By E. J. Frost
Frost Gear & Forge Co.

THAT the tractor has come to stay and is going to be an important factor in the future development of the world, from an industrial and agricultural standpoint, few will dispute. That its manufacture and sale will add tremendously to the wealth and prosperity of those countries capable of producing and marketing it in any considerable quantities, also needs no debate. That the tractor of today has in any large measure reached its ultimate development and will satisfy the needs or ideals of the future, is very much open to question.

The histories of the pleasure car and the truck both point to development covering a period of years and, judging from the new features brought out each year, the end is not yet. It is therefore unreasonable to suppose that in the short time of experimenting and trying out in actual field service, a mechanism will have been developed that will measure up to the requirements of the future. From an engineering standpoint, the problem seems to have been approached mainly from two different angles, due to the previous training of what might be called separate schools of engineers.

Naturally one of the first to enter this field of endeavor was the man having had training and experience in making agricultural implements, with very little or no training at all in engine, clutch, transmission, differential and radiator design; and it is natural to expect that most of the thinking of this type of eningeer would be strongly biased by the previous experience with horse-drawn agricultural implements.

The other type came, naturally, from the pleasure-car and truck-manufacturing interests, and while he might have had all the experience and ability necessary in connection with the power end of the problem, he naturally was lacking in the lore of the implement man.

It is natural that the implement man should be biased toward the use of cast gears and unprotected internal gears and chain drives, and that to many such, strength and ability to resist wear should be represented only by cast-iron, malleable, or possibly steel castings, in most instances large to the point of being cumbersome, and frequently incapable of being properly housed to retain lubrication and keep out dirt.

The subject of upkeep, cost of repairs and accessibility of the parts is going to be given increasing attention by future buyers, and it behooves designers to spend any amount of thought and time necessary to attain the desired ends. A careful analysis of the physical properties of the cheaper materials sometimes used, as compared with even medium-priced alloy steels, will disclose the fact that smaller gears and shafts can be used, giving equal resistance to wear and shock and permitting assembling in much smaller housings, greatly facilitating protection from dirt and making it much easier to apply proper lubrication. I assume too, that frequently these substitutions can be made with little or no increased expense, due to the decreased size lessening the machine work, and the decreased weight offsetting the increase in cost per pound.

In a paper of this character, time will not permit of an extended discussion of the varied requirements to cover the entire gamut of tractor design as, in all probability, each case would have to be analyzed by itself, taking into account the power, speed, drawbar pull, weight and any other items affecting the required strength; and possibly considerable experimenting and field trials would be necessary to determine proper sizes.

It is apparent, even to the casual observer that both extremes have been reached. It is evidently unfair to ask a successful manufacturer of gears, on the one hand, to put his trade-mark on and guarantee the durability of another man's design, known to be wrong, because too light, and on the other hand compel him to equip his shop with machinery for cutting teeth of a size so large and overpowered as to make it only a question of a season or two before a decided alteration must take place.

It would seem, therefore, that the best interests of the tractor manufacturers would be conserved by conferences of their engineering staffs looking, as far as possibl . toward standardizing design and materials of construction, in an effort to improve the general average and increase the confidence of prospective buyers. It also might not be amiss to call for such help as the American Gear Manufacturers' Association can give and I am sure that I voice the sentiment of those here when I say that we would give nothing short of the best we have.

A carefully made 3½-deg. nickel, low-carbon steel suitable for case-hardening may safely be used for tooth pressures away in excess of common open-hearth steel. The same is true of chrome nickel and chrome vanadium; the latter, however, in the hands of those inexperienced in its heat-treatment to secure machineability, may find considerable difficulty in maintaining uniformly good results, and will have to slow down so much in making and cutting the blanks that the work becomes unprofitable.

Higher carbon (40-45) chrome nickel may also be used in many instances, with good results, as such material can be heat-treated to give the required physical properties so far as tooth strength is concerned, and when properly made by the mill will give good wearing service although soft enough so that a new file will bite the teeth.

The only trouble I have found with a steel of this analysis was destruction of the contact surfaces of the teeth due to what is termed "pitting" and the only explanation we could find for our difficulties was that something had gone wrong in its manufacture at the mill. The chemical analysis showed material up to specifications and the microscope revealed nothing that we could assume pointed to trouble. However, the trouble existed and in our efforts to eliminate the difficulty we experimented with steel of the same analysis but with the carbon content increased from 0.37 to 0.45.

This did not remedy the pitting, and I went so far as to take out a set of gears from an automobile transmission after having been driven 20,000 miles and showing no appreciable wear, and substituted a set made from the chrome-nickel steel of 0.45 carbon and with the scleroscopic hardness (checked by the Brinnell machine) considerably raised, and these failed, showing considerable pitting in 500 miles.

It is therefore evident that where steels are to be used in service that will approach the destructive limits, great care must be taken to see that they not only check up as to chemical analysis and physical properties as ordinarily determined, but that experiments should be made to satisfy us that the individual batch of steel under consideration will stand up under the proposed load, speed and other conditions.

My criticism of what I saw at the Kansas City tractor show is along two lines: First, such a multiplicity of levers, reach rods, valve tappets, links, chain drives and in too many instances gears unprotected from dust and grit, so that unless an owner spent most of his time wiping up, the tractor never would be cleaned; secondly, and to my mind a serious matter, the bull gears and main drive pinions, and frequently other gears, were left unprotected, I imagined, due to excessive size, which can be corrected only by using better materials of construction which will tolerate adequate protection without making the housings too cumbersome.

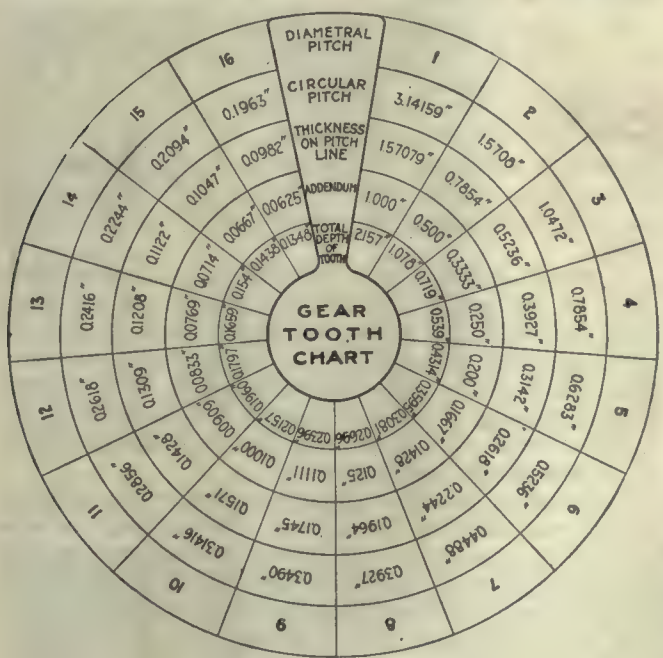
*Presented at the annual convention of American Gear Manufacturers' Association, Cleveland, April 15, 1919.



Gear-Tooth Chart

By J. H. Moore

I had considerable gear work to do, so I constructed the chart shown in the illustration, which operates as foliows: Bearing in mind that the various figures around the chart represent the values of the different



GEAR-TOOTH CHART

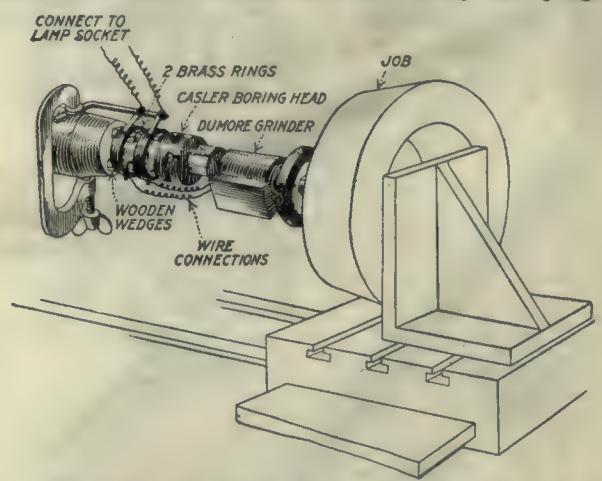
diametral pitches the key-shaped piece is moved over to the pitch desired and all the necessary dimensions can then be read at a glance. This scheme has proved a time saver of no mean proportion and is well worth the work spent on its construction.

Grinding Large Ring in a Boring Mill

By James Mitton

The sketch shows the manner in which I ground a ring in place on a fixture in a Lucas precision boring mill. Having no lathe large enough to swing the work it was clamped on an angle plate on the platen of the boring mill and set up as if for boring. A Dumore tool-post grinding machine was mounted in a Casler offset boring head. To carry the electric current to the motor I took two brass rings (scrap ends of bushings) with a 4-in. hole in them and secured them in place on the spindle of the machine with hardwood wedges, this method enabling me to true up the rings and at the same time insulate them electrically from the spindle. The leads from the motor were then soldered to their respective rings.

Two brass strips or brushes were then fastened by screws to a board which was secured by clamping to



A KINK FOR THE INTERNAL GRINDING OF LARGE DIAMETERS

the spindle handwheel bracket in position to bring the brushes to bear upon the rings. Wires from a convenient lamp socket to the brushes completed the circuit allowing the grinding wheel to run continuously while feeding the platen forward and backward to grind through the ring.

The job was finished as well as could be done in a regular grinding machine and in a very reasonable time. The sketch shows how the connections were made.

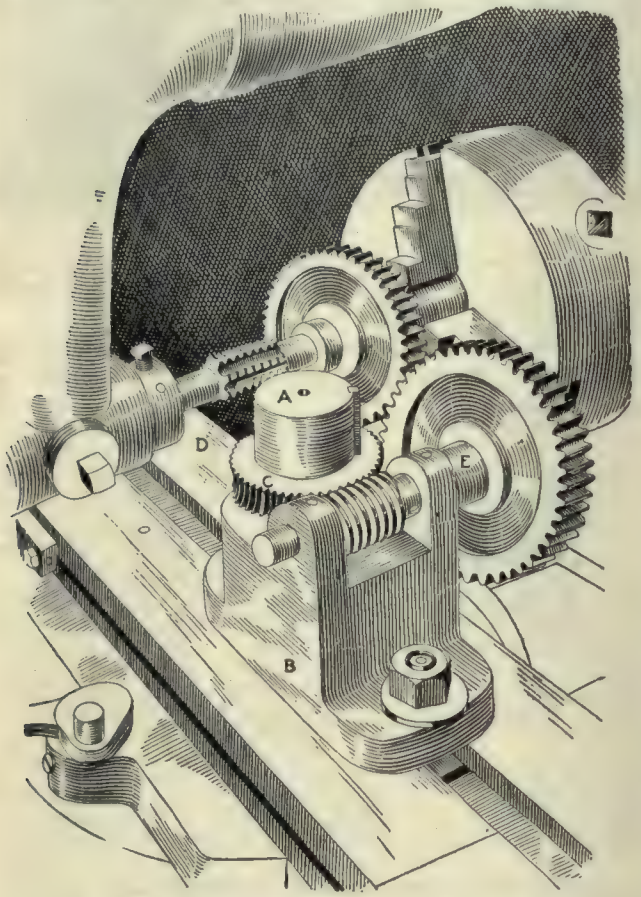
Hobbing Wormwheels Without Gashing the Blanks

By Bernie Soule

Oscar Craft describes on page 41 of the *American Machinist* how he rigged up the dividing head of his milling machine to hob some wormwheels without the usual preliminary of gashing the blanks. This seems to me to require considerable rigging up and to be not particularly good exercise for the dividing head. The fixture I am showing in the accompanying cut, while it has no advantage in the way of preliminary rigging, is still very simple to make, is very sturdy and efficient, and does not involve the dividing head at all.

The short stud *A* turns freely in a bronze bearing sleeve forced into the casting *B*. The wormwheel *C*, a duplicate of the wheels to be cut, is keyed to this stud, the key extending to the top of the stud. The latter

is made a light drive, or hard push fit for the bore of the wheels. The hob *D* is held in the chuck of the milling machine and is geared, even, to the worm shaft *E*. In operation, a wormwheel blank is tapped onto the shaft with a mallet or piece of lead, and the table of the milling machine is fed straight toward the hob until



DEVICE FOR HOBBING WORMWHEELS

it reaches a set stop, at which point the work, after making a revolution or two to cut clear, is finished. The table is then withdrawn and the completed wormwheel lifted off the stud with two small specially made pinchbars.

The gears on this device would ordinarily constitute a considerable item of construction, but in most machine shops a suitable pair of gears may be found close enough to requirement to allow the device to be adapted to them. No leeway can be had in respect to the diameters of hob, wormwheel and worm, but the center distances of the gears may be accommodated within reasonable limits by a spacing collar of the required thickness between the driving wormwheel and the blank being cut. This separates the planes of the hob and worm shafts in a vertical direction and compensates for slight variation in this respect. No such compensation was necessary in the case illustrated.

When starting a blank toward the cut, the gears are of course out of mesh and must be entered carefully, but if gears of sufficiently coarse pitch are chosen, they will connect before the hob touches the work, will work toward the proper position as the cutting proceeds, and will be running on their pitch circles when the work is completed.

This device has seen long service and has turned out wormwheels at the rate of four per hour continuously.

Form-Milling a Wire to a Peculiar Cross-Section

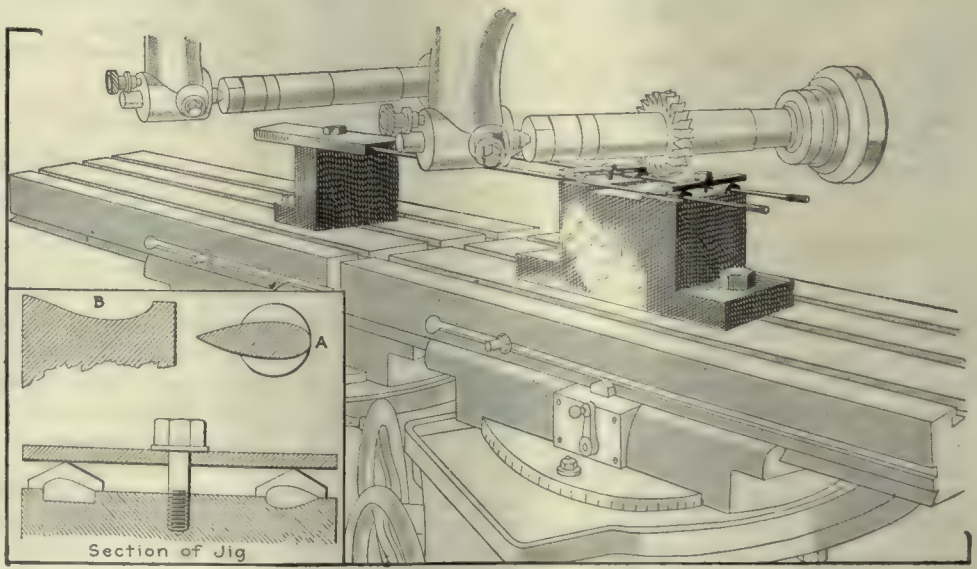
By Adolph Moses

Some time ago I was called upon to make the wires shown at *A* in the sketch. Originally it had been intended to draw this wire to form and then upset and thread the ends, but this method did not work out, and as only a few wires were needed at the time and the stock available was ½ in. in diameter and rough, I proceeded as follows:

The ends of the rods were turned and threaded in a lathe. Then by holding in an ordinary milling-machine vise and shifting and resetting after each cut a flat was milled on one side to the proper depth. Next the rod was turned over and another flat milled, bringing the wire to the correct width, leaving a few thousandths for finishing. After the other two sides were milled the wire was rectangular in shape except for the round ends.

A formed cutter, shown in section at *B*, was made from an old milling cutter by dressing a grinding wheel to the proper shape and then feeding it radially into the cutter, using a stop on the grinding-machine table to get all the teeth the same height. The contour of the grinding wheel was tested by cutting a piece of sheet metal with it and testing the profile by means of an accurately filed templet.

Two milling machines which happened to be properly located were used for the milling. The rectangular wire was lightly clamped in the jig as sketched and the jig bolted to the table of the first milling machine, this table being rigidly held against end movement. The feed was obtained by means of a tie rod running from



AN UNUSUAL MILLING JOB

the wire end to the table of the second milling machine. In this way the full travel of the second table could be used before it was necessary to return, get a new grip on the tie rod and start the machines again without disturbing the wire in the fixture. When one side was milled to form the wire was turned end for end and inserted in the other side of the fixture in which was a slot formed to fit the recently milled contour. The other side of the wire was then milled to form in the same manner.

Each end where the cross-section changed from the fish shape to the circular was shaped by filing. Had not this method been used it would have been necessary to hold the wire in a vise and reset it after each cut, and this would have been very difficult to do with this peculiar shape.

Perhaps the wire might have been laid in a long groove and fed in the same direction as the cutting teeth of the milling cutter. At any rate the method used produced the wires with remarkable accuracy as some of them did not vary a thousandth of an inch in 7 ft. of length.

Electric Annunciator Applied to Group Machine-Tool Operation

By A. Des Angelis

An example of group-machine running is shown by the illustrations, Fig. 1 showing the arrangement which includes gear-cutting and generating machines, milling machines, etc.

Each machine is provided with an electrical contact so arranged that when the machine completes its cycle it rings a bell and releases the corresponding indicator needle on the annunciator. The operator determines by a glance at the latter which of the various machines needs attention, makes the necessary adjustments and resets the needle.

One of the contacts is shown at *A*, Fig. 3. It is very simply made, being but a piece of spring wire wrapped around the hub of the indexing wheel of a Gleason gear generator and a contact finger attached to the gear guard. The guard is insulated from the machine, and guard and machine are connected to opposite legs of an electric circuit which passes through the annunciator. In Fig. 2, is the annunciator, which by means of bell and indicator needle warns the operator which machine has completed its cycle. This device has been in service for a considerable period and has saved its cost many times by eliminating the necessity for the operator to watch all machines at once.

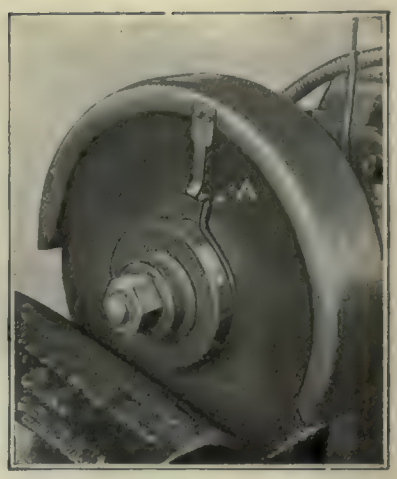


FIG. 3. DETAILS OF ELECTRIC CONTACT

A Cheap Adjustable Die

By J. J. Voelcker

A die needed for cutting a 1-in. outside diameter thread, eight threads per inch, on bronze cleaning rods was made in the following manner. The body was a 4-in. piece cut from a bar of $\frac{3}{4}$-in. x 4-in. cold-rolled stock and was bored centrally to $1\frac{5}{16}$ in. diameter. The six dovetail slots shown in the figure were then cut and carbon-steel chasers inserted. The hole for the No. 3 taper pin was drilled and reamed and the slot cut which bisects the hole. The hole for the $\frac{3}{8}$-16 fillister head capscrew, which clamps the die on the taper pin, was next drilled and tapped, and the taper pin inserted and locked with the clamp screw. The die was then bored to the proper size and the chasers threaded, hardened and ground. Two corners were cut

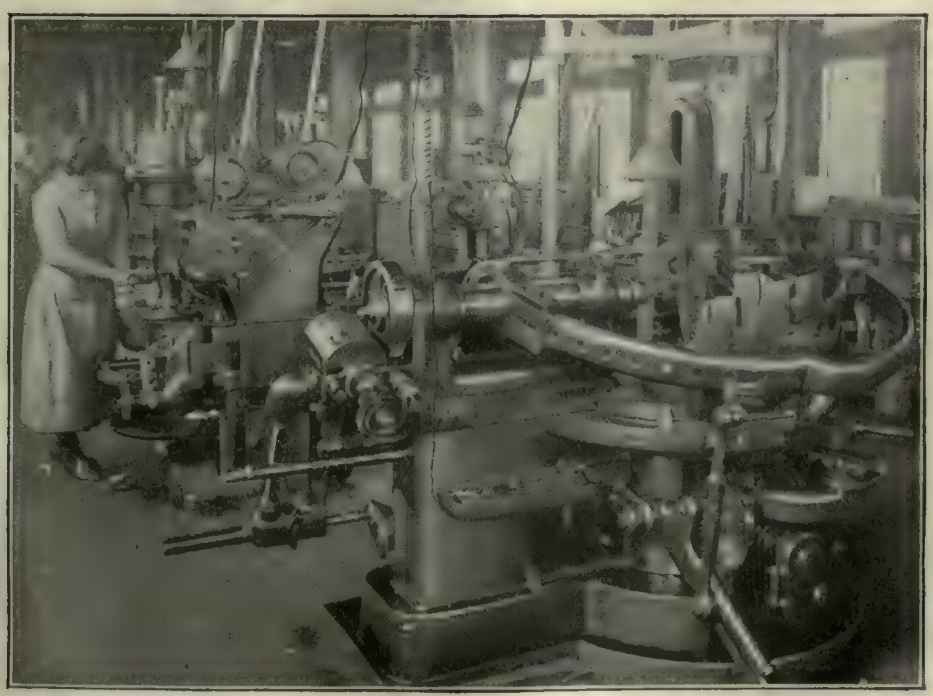
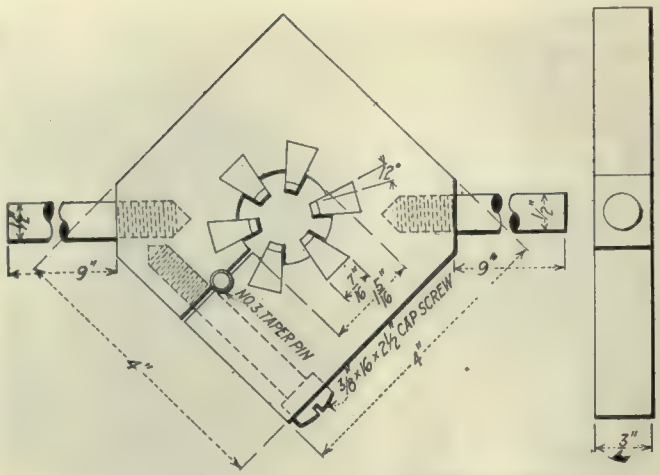


FIG. 1. MACHINES EQUIPPED WITH ELECTRIC TELL-TALE



FIG. 2. THE ANNUNCIATOR



ADJUSTABLE DIE FOR BRONZE RODS

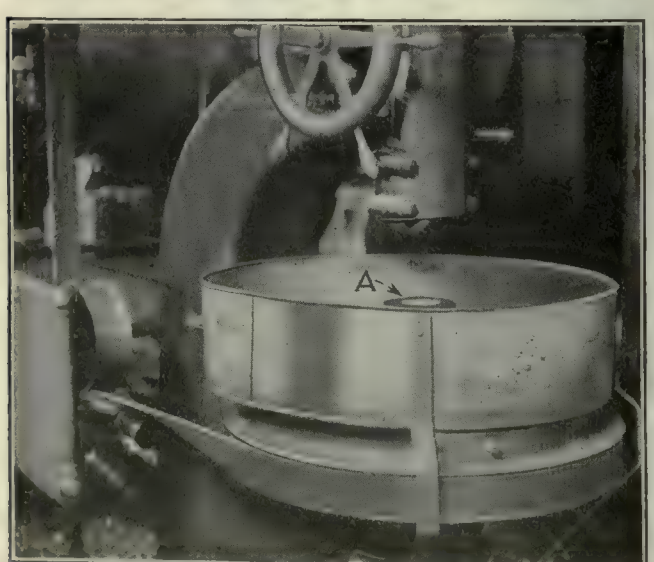
off, and the resulting flats were drilled and tapped for handles made of ½-in. round cold-rolled steel. The die was used on 5000 pieces without the need for regrinding and was apparently good for many more when production ceased.

Direct Drive on Table of Boring Mill

BY J. WRIGHT

A special drive has been used to speed up the table of an old vertical boring mill in the shops of the Chicago Surface Lines in order that it may be used for boring the babbitt lining of motor bearings. The bearings are held in a three-jawed chuck as shown at *A*. It was found impractical to secure a sufficiently high speed with the regular geared drive of the machine because of the vibration and chattering which resulted. The drive is by belt from an overhead counter and is brought down over idler pulleys and around the rim of the table. Flanges were put on top and bottom sides of the table to prevent the belt from slipping off.

The table now runs at a speed of 150 r.p.m., and to overcome its momentum when power is shut off it is provided with a leather-faced wood block for a brake. The result of this arrangement has proved satisfactory and the operator is able to attain rapid production.

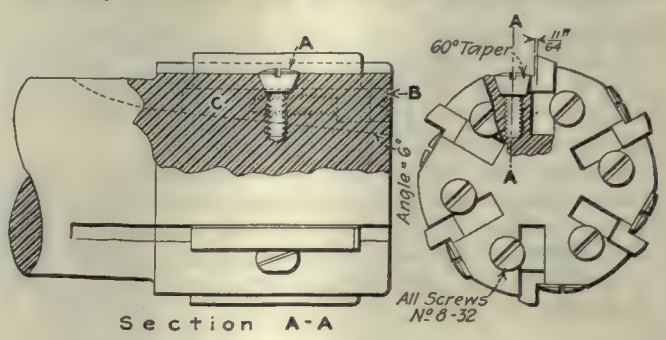


DIRECT BELT DRIVE ON TABLE OF VERTICAL BORING MILL

Special Reamer with Adjustable Blades

BY C. H. DENGLER

The accompanying illustration represents a type of adjustable reamer in which the blades are adjusted by means of a taper wedge in place of the customary shims. The principle is readily adaptable to any size or design where inserted blades are used. The soft steel body is milled with six $\frac{3}{16}$-in. slots the bottom of which are at an angle of 6 deg. from the axial line. The body is drilled and tapped for the special screws



ADJUSTABLE BLADE REAMER

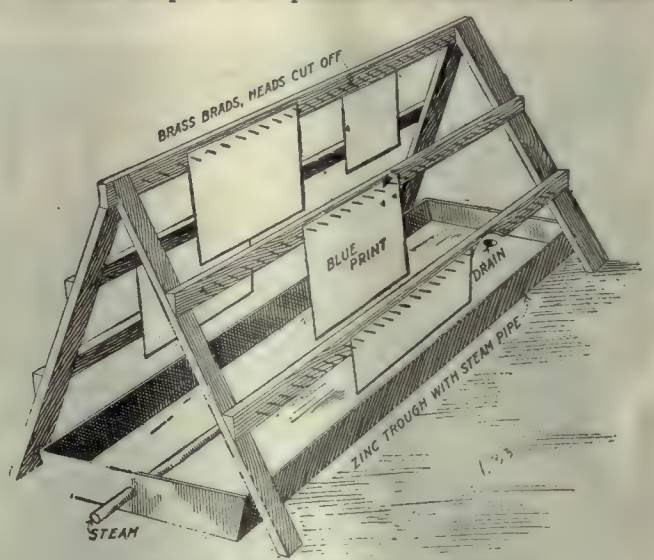
A and *B*, there being six of each. The tapped holes for screws *A* are countersunk 60 deg., while the holes for screws *B* are counterbored. The wedges *C*, which snugly fit the slots, are actuated by the screws *B*. Turning a screw moves the corresponding wedge in, and thus tends to raise the blade. A $\frac{1}{16}$-in. movement of the wedges increases the diameter of the reamer 0.013 in. This design gives a good dependable finishing reamer.

Frame for Drying Blueprints

BY A. P. M. WILKING

The sketch shows a device for drying blueprints in the small shop. The A-shaped frame has horizontal bars which are provided with headless brass brads projecting about $\frac{3}{16}$ in. and spaced 3 or 4 in. apart.

The wet blueprints are pushed over these brads, which



DRYING RACK FOR BLUEPRINTS

make it very easy for one person to handle the prints, even if they are of large size.

The water drips into a zinc trough provided with a drain. A steam pipe furnishes the heat for quick drying.

The Security Chucking Grinding Machine

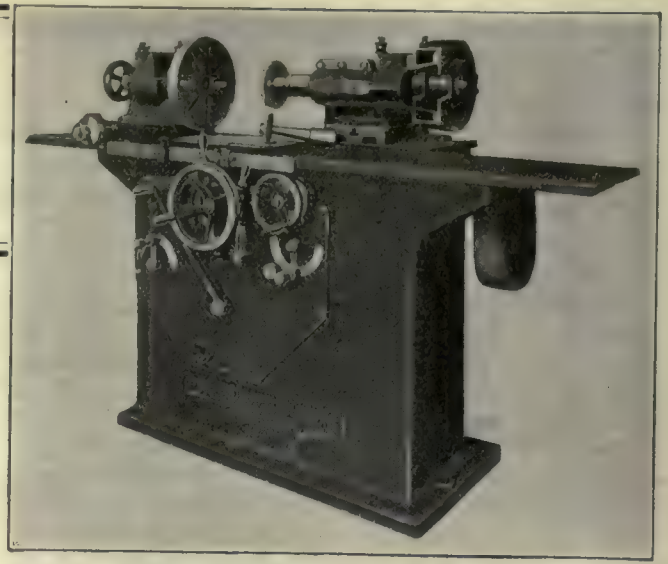


FIG. 1. THE SECURITY CHUCKING GRINDING MACHINE

TO MEET the increasing demand for a heavy-duty internal grinding machine the Security Tool Works, Chicago, Ill., has brought out a new machine of the type shown. This will be marketed by the Security Mechanical and Engineering Sales Co., 115 South Clinton St., Chicago. This machine is intended for manufacturing purposes as well as for the toolroom.

The maximum capacity of the machine is 14-in. swing with lengths of work up to 12 in. It is provided with a base inclosing all of the feed and speed change gears which are operated by levers on the apron. The chrome-nickel steel grinding spindles are hardened, ground and lapped, and run in alloy-bronze bearings. These bearings are mounted in a cylindrical sleeve, which in turn is held in the bore of the support bracket by three clamp screws. The wheel end of the spindle is tapered, and has a threaded portion on the extreme end, thus allowing different diameters and lengths of extensions to be screwed on, and eliminating the use of long spindles on short holes. One of these extensions can be seen lying on the table of the machine, Fig. 1. The bearings are dustproof and provided with adjustment for wear. The interchangeable grinding spindles are made in three sizes, the two large-size spindles have each a range of four speeds, 3500, 4500, 7000 and 12,000 r.p.m.; while the small spindle has one speed only, 25,000 r.p.m. The three spindles are identical in construction and differ only as to size. They are driven by a belt from a pulley mounted on an intermediate shaft, and by changing this pulley the different wheel speeds are attained.

The intermediate shaft runs on SKF ball bearings mounted in a dustproof housing bolted to the swivel base, which also holds the grinding-spindle support bracket. The graduated swivel base will swing 45 deg.

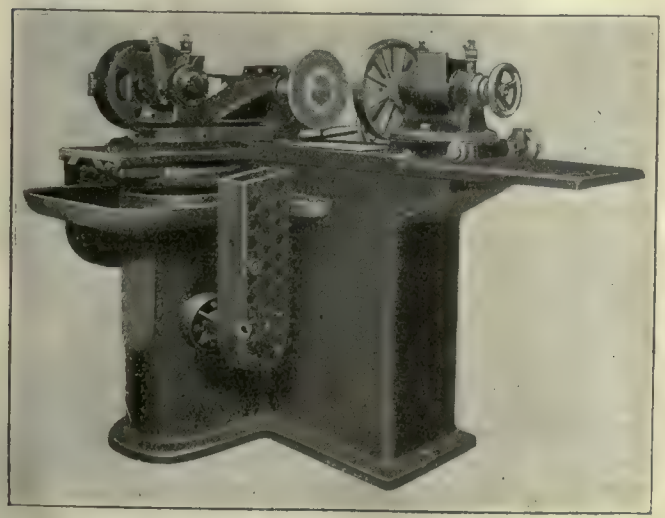


FIG. 2. REAR VIEW CHUCKING GRINDING MACHINE

Floor space: Length, 80 in.; width, 32 in.; height, 52 in.; weight, 3500 lb. Countershaft pulley: Speed, 500 r.p.m.; diameter, 12 in.; belt face, 3 in.

on each side of center, and is mounted to a taper gibbed dove-tail slide, which is operated by a handwheel with graduated dial located at the front of the machine.

The headstock of rigid design swivels, and is graduated for 45 deg. It is provided with a worm and sector arrangement with a dial mounted on the worm-shaft and graduated to read taper per foot and also angular measure. This device is provided with adjustments for wear in all directions.

The headstock spindle is of chrome-nickel steel, hardened, ground and lapped, and has a hole through the center to receive a draw spindle. The front bearing is of tool steel, hardened and ground, and is of a taper-cone construction. The rear bearing is of bronze, and both bearings are dustproof and provided with ample compensation for wear.

The draw spindle is tubular, permitting the wheel lubricant to be fed through the center. The faceplate and chuck are mounted on hardened and ground collets. Split collets are carried in stock up to and including 2½ in. in diameter, and special over-size collets can be furnished up to 6 in. in diameter.

The work spindle has six different speeds, 40, 60, 126, 160, 240 and 500 r.p.m., and all different changes of speed, as well as the stopping and starting, are done by levers in front of the machine, which connect with the gear-chain mechanism inside of the base. A 2½-in. belt connects this gear box to the countershaft by a jackshaft on the right side of the machine, and this shaft is connected to the gear box by a silent-chain drive.

After undergoing the various changes of speed, the gear box is again connected by a silent chain to a jackshaft on the left side of the machine, Fig. 2. This shaft is connected by a belt to a double idler pulley on the countershaft, which drives the cylinder with a short over-head belt. All spindles, clutches and pinions in this gear box are made of chrome-nickel steel, hardened and ground; and all bearings are bronze. The gear box is filled with oil, and a glass in front indicates the proper oil level. This gear-box arrangement permits speed changes while the machine is in full operation or at rest.

The table is 55½ in. long by 14¾ in. wide; it slides on two 2¼-in. V-ways which are 19 in. between centers, these being provided with oil pockets with rollers on

spring supports for delivering the oil to the slides. By a special arrangement all oiling may be done from outside of the machine. The table has three feeds of 20, 35 and 55 in. per min.

A cam-and-roller construction is used for the reverse mechanism. The cam is so designed as not to move the clutch fork, leaving the clutch teeth engaged until the clutch lever has traveled slightly over center, insuring instantaneous reverse movement without the slightest jar. The table reverses on a ⅜-in. stroke.

The wheel lubricating pump is located in the rear inside of the base, and is driven by spiral gears. The pump is connected to the draw-in spindle of the headstock by flexible tubing, and the lubricant is regulated by a handwheel on the apron in front of the machine. All bearings not immersed in oil are provided with glass oil cups, and the loose pulleys as well as the hangers on the countershaft have SKF ball bearings.

Acknowledgment to M. Schneider et Cie.

In the series of articles recently published in the *American Machinist*, describing the manufacture of the 155-mm. howitzer at the plant of the American Brake Shoe and Foundry Co., mention was omitted of the fact that Schneider et Cie., of France, are the originators of this type of howitzer as well as of the 240-mm. model 1918. The American Ordnance Department adopted these two sizes of French howitzers, and Schneider et Cie. has furnished to the Ordnance Department assistance such as is outlined below:

M. Schneider et Cie. provided us with the complete plans of this material; the specifications of metals for different parts, also the treatment of these metals in order to obtain the necessary characteristics; the complete plans of all the fixtures employed in their establishment for the execution of this material, and the complete plans of all the shop gages for the final examination of the gages and their instruments.

For the 155-mm. howitzer they supplied two sets of principal gages and instruments, also the complete data of manufacture regarding each piece; the series of operations; their duration and kind of machine used. They gave us the complete lists of the machines necessary to complete five of the 155-mm. type each day, together with photographs and films showing the different operations of machining; the securing of the pieces upon the machines; the construction of the equipment employed; the kind of tools; the inspection; gages; etc.

Messrs. M. Schneider et Cie. permitted American officers, engineers, foremen and mechanics to take a course of instruction in their workshops in France in order to enable them to employ their processes of manufacture, material, etc., in the production of artillery. These officers, etc., were either representatives of the Ordnance Department or representatives of private manufacturers delegated by the Ordnance Department. Messrs. Schneider et Cie. sent to the Ordnance Department a contingent of eight engineers, a foreman, and specialists to give information in all of the branches needed. Members of this contingent were either assigned to fixed places in factories or moved about in various workshops following the manufacture of this material.

Factories in the United States manufacturing the 155-mm. Schneider howitzer model 1918, were as follows: American Brake Shoe and Foundry Co., Erie, Penn., cannons and breeches; Osgood-Bradley Car Co., Worcester, Mass, gun carriages and cradles or saddles for heavy guns; Mosler Safe Co., Hamilton, Ohio, gun carriages and cradles for heavy guns; Dodge Bros., Detroit, Mich., sledges for transportation of heavy guns; Maxwell Motor Co., Detroit, Mich., limbers; Accurate Engineering Co., Chicago, Ill., wheels.

Factories in the United States building the 240-mm. Schneider howitzer, model 1918, were as follows: Arsenal at Watervliet, Watervliet, N. Y., cannons and breeches; Watertown Arsenal, Watertown, Mass., complete gun carriages; Cambria Steel Co., Johnstown, Penn., gun carriages; Knox Motors Co., Springfield, Mass., limbers and hind carriages; Pressed Steel Car Co., Pittsburgh, Penn., platforms; Standard Steel Car Co., Hammond, Ind., complete gun carriages; Otis Elevator Co., Chicago, Ill., sledges for transportation of heavy guns; Davenport Wagon Co., Davenport, Iowa, limbers and hind carriages; Kelsey Wheel Co., Detroit, Mich., wheels.

That these companies deviated in many cases from French methods of manufacturing and installed methods of their own does not in the least detract from the credit which Messrs Schneider et Cie. deserve for their wholehearted coöperation and able assistance.

The Value of Written Instructions To Draftsman

By John S. Carpenter
Associate Member American Society of Civil Engineers

The chief engineer came into the drawing room looking as pleasant as if he had a mouthful of castor oil. Throwing down a pile of blueprints in front of his assistant, he exclaimed, "Look here, Bill, I told you very distinctly that this Brown order was to have all wearing surfaces bronze lined. It's been sent through just as if I hadn't said a thing! I caught it in time, before it got into the shop. Darn this forgetting things!"

"I'm sure that I told the draftsman about it! The checker passed it, too!" Bill returned, and took the drawings out to the draftsman and started to give him a piece of his mind.

The draftsman took out a little book where he had jotted down Bill's instructions and showed the assistant just what he had said. The checker supported the draftsman's statements when questioned by the chief, and Bill certainly felt uncomfortable.

The chief picked up a scale and laid down the law. "After this," he stipulated to Bill, "you make an abstract of the essential points on each order, dictate it to the stenographer, give the original to the draftsman and a copy to me. I want it all in black and white; no more guessing or relying on memory. There's more time wasted and hard feeling created in fixing up these blunders to more than pay us to keep an extra girl for that work."

The above is not fiction. It is true and every chief draftsman knows it. Verbal instructions are unreliable unless they be of the simplest and briefest kind. Even then, other matters may intervene, sickness may delay the work, etc., so that when the job is taken up again all the instructions and impressions are cold. To regain these, it is necessary to go over the entire work again and the chances are that something will be forgotten.

EDITORIALS

Let's Go!

SOME of the buyers of machinery are taking a little snooze while waiting for prices to drop. If they do not wake up pretty soon they are going to find that a few of the live wires have gotten a start that will keep them ahead for the next ten years. For prices are not going to drop.

Price level can be pictured as a level of a great ocean. If this level were to rise three or four feet, some of the boat houses and piers on the shore would be so low that people on them would get their feet wet. If under these conditions a convention were called to consider what was to be done to remedy conditions, we imagine that it would be decided to be more feasible to raise the level of the piers and boat houses than to lower the level of the ocean.

This rising tide of price averages has carried the majority of wages with it. There are some instances (and these are making most of the trouble) in which individuals are getting their feet wet because the wages that support them have not risen to the new level of the price ocean.

Prices are not going to drop. If anything they are going to rise, except the few that are inflated beyond a reasonable margin of profit. Prices that are honestly based on cost are bound to rise for the simple reason that cost is based on labor and we face an inevitable labor shortage within the next ten months. The rate of emigration of labor assures us of this fact without the shadow of a doubt. Everybody believes that six or ten months from today, after the adjustments have been made, business is going to increase. How much drop in the cost of labor do you expect *then* with increased demand, when you find it extremely difficult to get skilled help *now?*

The bright boys who are getting the jump on the other fellows are the ones who have thought out these facts and who are taking advantage of them. They know that there is going to be a pretty stiff race during the coming ten years and that the wheels must turn with a minimum amount of friction and the maximum of speed. They know that the man who gets his car oiled up and adjusted and running perfectly the day before an automobile race has more chance to win than the fellow who begins to oil up and adjust and replace parts after the starting shot has been fired.

For the past four years there has been less maintenance of machinery and machine shops than during any other like period in our history. There hasn't been time, nor has there been men enough to maintain our machinery in first-class condition. It has been a case of making every tool work as nearly twenty-four hours as possible. The machine shops of America are on the average, therefore, decidedly *not* in first-class order for the coming race.

These live wires who are getting the jump on the other fellows are going about their business quietly but very effectively. They are putting their plants in prime condition for the big race. They are rearranging, repairing, altering; making use of every bit of valuable and costly experience gained during the war. They are searching the market for machinery which will produce at a more economical rate than that which they already have; appreciating the fact that, with labor costs rising, the man who succeeds must utilize improved machinery. They are installing lunchrooms, cafeterias, better heating and ventilating systems, better lighting arrangements; knowing that if they are to attract labor in a competitive market they must offer inducements of this kind. They are making use of the present comparative abundance of labor to do the things that *you*, if you do not do them now, will find it impossible to do ten months from now.

These fellows are shrewd enough to know that when the rush begins the fellows who have been holding off will find themselves permanently handicapped. The man who knows that his shop should be rearranged and reëquipped, but who is waiting for the price of day labor to drop so that he can rearrange those machines at less cost than he can now, and who is waiting for the prices of machine tools to drop so that he can reëquip his shop at less cost than he can now, will find that this policy of procrastination has cost him his chances of winning the race, and that he will have to make ten times the effort to keep abreast that he would have found necessary, had he read the times right.

How is your shop? Is there a department that needs rearranging? *Do it now!* Are there new motors to install to get more power or flexibility? *Do it now!* Are there machines on the market superior in production to the ones that you are using? *Install them now!* Do the line shafts need relining, boxes need rebabbitting, and general equipment need repairing? *Do it now!*

Paste this in your hat: Unless you're a dead one you've got a considerable distance to go and the sooner you get started the sooner you'll get there. Perhaps you are one of the live wires who have already made a start but, if not, take our advice and *do it now!*

Let's go!

They're At It Again

THE baccalaureate Bolsheviki who believe that the sun, moon and stars operate exclusively on the metric system, are making another attempt to upset America's industrial digestion by forcing us to take a dose of their dangerous concoction. Their slogan is "You need a meter-liter-gram." This time the propaganda is fathered by the "World Trade Club, San Francisco, U. S. America." By means of a circular and stamped envelopes they are beseeching that we petition His Excellency David Lloyd George, and His Excellency Woodrow Wilson, that they pause a moment from their trivial duties of rearranging world boundaries and national relations, to take up the really important work of abolishing the yard and the inch.

These ardent reformers apparently find in the prohi-

bition act and in the proposal to eliminate the curse of tobacco by force, an indication that the time is ripe to do away forever with the curse of the inch, pound and foot.

To those of us who have to do with machinery and the mechanical arts in which the establishment of standards has built up an invested value of many billion dollars' worth of equipment, tools, jigs, fixtures, etc., all made to English measurements, this proposal appears in its true light; namely, the childish prattle of the "anti-izzers"—who believe that because things *are* they must be wrong.

Engineers, manufacturers and mechanics, perhaps unfortunately, see so clearly the futility of permanently removing the foundation from under American industry by philosophical fiat that they do not regard these attempts of the "I want things my way-ers" very seriously. We say "unfortunately" because those whose experience does not put them in a position to measure this propagandic twaddle at its true value are likely to be influenced by the specious attractiveness of the theory proposed, although as far as this spasm offered by the World Trade Club is concerned, there is little danger of any educated man reading their pamphlet without getting the impression that the mental processes of these metric mentors is as disjointed as their expressions of facts.

For example, quoting from page 4 under the heading of "It is all very simple. . . . U. S. American Bureau of Standards, Director S. W. Stratton, tells, in an admirable article in Americana, the Scientific American Encyclopedia, in sense 1 per cent.—read the other 99 per cent. in Americana—metric system—the world's one system."

This may be futurist or cubist talk or perhaps an imitation of Irwin's Japanese school boy, but it would surely take the ability of a corkscrew mind to follow the logic of this sentence.

A map is reproduced in this 16-page effusion, showing the "well-nigh world-wide use of metric units." The United States and Canada on this map are described as, "Countries using coins of metric weight and measure decimally divided," (nothing said about the half-dollar or quarter of course); "exclusively metric postal union," (nothing said about the ounce under which all of our postage is carried); "metric units in electric industry, in science, liberty motor airplanes, Brit.-Am. helium Zeps (science's wonder of the world war); indorsed by organized manufacturers, steel, tanners, furriers, canners, packers, growers, miners, grocers, fishers, recorders, writers, draftsmen, labor, cooks, waiters, shippers, traders, furriers, world advertisers and women, so on, so on."

What a pathetic picture! Think of the poor fishermen who are now deprived of their catches because they have no metric worms, of the canners and growers who see golden opportunities withheld them because this Government does not compel by law the asparagus and tomato plant to grow to metric measure, the cooks who find that a "pinch of salt and a cup of flour" are an aggravation to their culinary art, the poor waiters who are compelled by heartless Congress to face the insult of a 25-cent tip where there should be but dimes, dollars and pennies. But most pathetic of all is the thought of the poor women at the end of the list sewing on buttons to the hated English system of measurement.

The usual hackneyed arguments, expressed rather less cleverly than usual, however, are found in this World Trade Club's circular. Great capital is made of the fact that the simplification of arithmetic would save many hours of trial and tribulation to the suffering school child, overlooking the fact perhaps that the best way to save a school child from trial and tribulation is not to make him study at all.

Secretary Redfield is quoted as follows: "The fact, of course, is that the metric system, adopted exclusively by 34 nations is simpler, easier, more effective, and more widely used than any other. It has made its way by its merits. There is no argument for the retention of our present weights and measures that is not an argument against our decimal metric dollar system. No reason supports our decimal-dollar system of currency that does not support decimal system of measure. This handicap we must throw off, get out of the darkness—out of foolishness toward reason." Perhaps the honorable Secretary in his close association with the Bureau of Standards, which appears to be the self-constituted hotbed of metric propaganda in America, had been getting a whiff or two of the famous six-cent per gallon Liberty fuel.

It is difficult to become angry at a comedian and herein lies the danger, for the sort of talk put out by the World Trade Club contains so much that is laughable and side-splitting to the man of sense that laughter leaves him weak.

We strongly advise you as a precaution against a paralyzing industrial calamity which would follow the abandonment of our standard tools, gages, jigs and fixtures, and more serious than that, the abandonment of our instinctive familiarity with our own measures—to tell your Congressman what the loss of the inch and the foot would mean to *your* business.

How's Your Imagination?

HAVE you ever stopped to consider the effect of *imagination* on present-day mechanical creation? Necessity provides the itch, it is true, but necessity without imagination is like an armless man afflicted with the "cooties."

War has brought necessity to our doors by destroying a vast amount of manufacturing man-power. As normal conditions return, the war-engendered itch for more efficient production must be satisfied by improved machinery. This crippled world must be fitted with mechanical limbs. Herein lies a task for the machinery builder and for imagination. Users feel the necessity but are helpless without the trained machine designer.

Webster says that imagination is the power of having mental images. Did you ever examine one of yours or try to draw a picture of it? Two to one it was as foggy as an artistic photograph and just as useless. After you have tried to pick the details out of one or two of these smoke-screens, you begin to realize the value of an imagination like the chief clerk's card index for details and as good at assembling as Henry Ford's factory. Such imaginations only come from hard training and are scarce enough to be valuable.

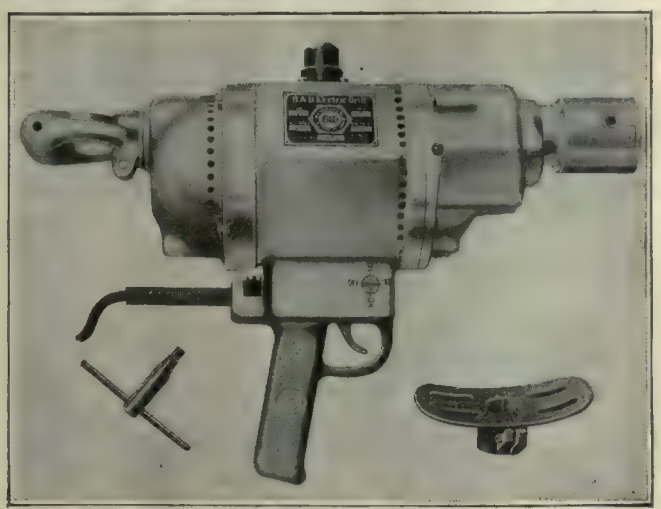
New tools are coming in at a rate which shows that something is stimulating the designer's wits. It is a good sign and leads us to believe that when the manufacturers hear the howl raised by necessity they will be there with the machines to relieve the itch. The howl has already started and is increasing daily in volume. Listen and answer.



SHOP EQUIPMENT NEWS

Black & Decker ½-Inch Electric Drill

The Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md., is now marketing a ½-hp. electric portable drill for holes up to ½ in. in diameter. The full-load current consumption is about 700 watts, and the no-load speed, 600 r.p.m. The housing is of aluminum alloy completely inclosing the motor



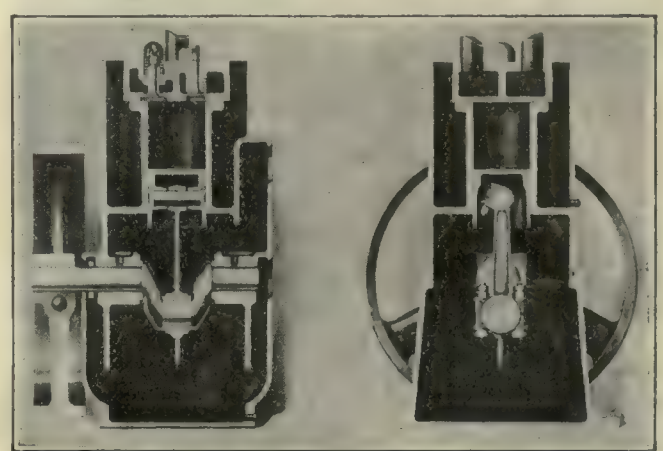
BLACK & DECKER PORTABLE ELECTRIC DRILL

Horsepower of motor, ½; capacity, holes up to ½ in. in diameter; current consumption, 700 watts; no-load speed, 600 r.p.m.; weight, 21½ lb.; current used, either direct or alternating of 25, 40 or 60 cycles.

and gears, and the total weight is 21½ lb. It is equipped with the Black & Decker pistol grip and trigger switch, the arrangement enabling the operator to control the drill without changing the position of his hands. An indicator is provided showing when the switch is on or off. The motor is of the series-compensated wound interpolar type, and uses direct current or alternating current of 25, 40 or 60 cycles. The machine will operate from any two wires of a three-phase circuit. The motor is air cooled by a fan mounted on the armature shaft which draws in air at one end of the motor and expels it at the other. The gears are of high-carbon steel mounted on ground shafts and operate in grease in a separate grease-tight compartment. The drill spindle runs in a bronze bushing, thrust being taken by a ball-thrust bearing. The commutator end cover is entirely separate from the armature shaft bearing and can be easily removed for inspection or adjustment of the brushes, this also eliminating the possibility of the armature shaft binding in its bearings in case the end cover is accidentally distorted by dropping the drill.

Ingersoll-Rand Air Compressor

The Ingersoll-Rand Co., 11 Broadway, New York, has recently placed on the market a line of four new air compressors, ranging in sizes and capacity from 3 to 45 cu.ft. of air per min. at a pressure of 100 lb. per sq.in. The small-size compressor can be used for pressure



CROSS-SECTION VIEWS OF THE INGERSOLL-RAND AIR COMPRESSOR

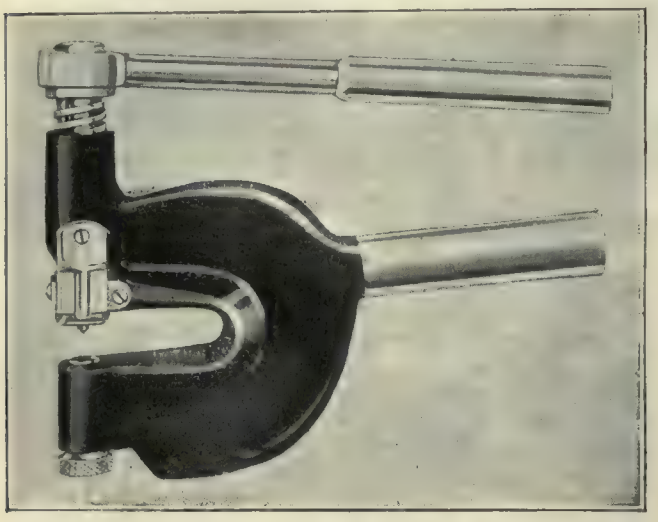
Sizes, 2½ x 3 in., 3½ x 4 in., 4½ x 5 in., and 6 x 6 in., the smallest size being made either air or water cooled, the other three sizes being made in water-cooled styles only. Capacities, 3 to 45 cu.ft. of air per min.

requirements up to 200 lb. per sq.in. if desired. The machines are single-acting, vertical type, belt driven or motor driven as desired. They are said to be so balanced as to operate satisfactorily if bolted to any solid flooring. The smallest size is built for either air or water cooling, the former being for intermittent service, while the larger machines are built for water cooling only, employing a reservoir-jacket system. The

largest machine is also built with a closed jacket for the pressure circulation of water. The crankshafts and connecting-rods are drop-forged while the bearings are die cast and removable in case of wear. Lubrication is by the automatic splash system.

"Jiffy" Hand Punch

The "Jiffy" metal punch shown in the illustration is for use on sheet metal and will punch holes $\frac{5}{32}$, $\frac{3}{16}$, $\frac{7}{32}$ or $\frac{1}{4}$ in. in diameter in metal up to 10 gage thick. The weight is 5 lb. and the over-all length is $9\frac{1}{2}$ in. The throat is deep, allowing holes to be punched at a

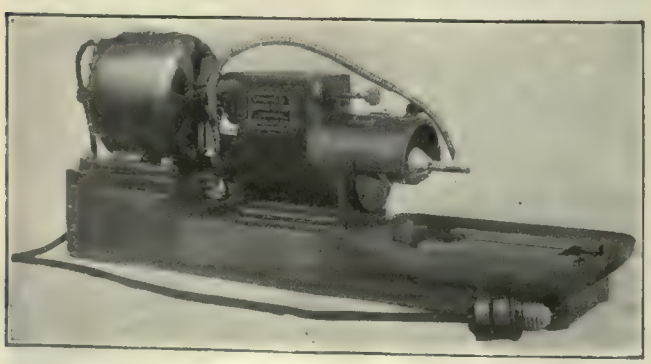


"JIFFY" HAND PUNCH

considerable distance from the edge of the sheet of metal, and a one-piece automatic disappearing stripper is used, giving a clear view of the punch mark, as well as permitting a number of sheets to be punched at one operation. The punches are of the crowned floating type, a feature that is said to greatly reduce punch breakage. The punch is driven through the metal by one-half a turn of the lever handle. Paul W. Koch & Co., 19 South Wells St., Chicago, Ill., is the manufacturer.

Bicknell-Thomas Tapping Machine

The Bicknell-Thomas Co., Greenfield, Mass., has just placed on the market a new bench type tapping machine that is rather a distinct departure in tapping-machine design. It is compact, and there are no protruding parts to catch the fingers or clothing. It has a cone friction driving mechanism which, it is said, enables the operator to tap to the bottom of a hole without



BICKNELL-THOMAS MOTOR-DRIVEN TAPPING MACHINE

danger of breaking the tap, and also enables the operator to tap a larger number of holes than are generally completed. The device has a two-speed geared transmission that is said to be noiseless. This runs in grease which serves to lubricate all parts of the machine except the motor. All spindles are hardened and ground and the main spindle runs on ball bearings. The table slide, which is made to hold suitable work-holding fixtures, has ball bearings, making it sensitive in operation, and has an adjustable stop for the table. The machine is furnished either with or without oil pump and piping. It is stated that the machine has tapped as many as twenty-four $\frac{3}{16}$-in. holes per minute.

Milburn Oxyacetylene Cutting and Welding Tips

The illustration shows cutting and welding tips that are now being marketed by the Alexander Milburn Co., Baltimore, Md., the advantages of which are that the same torch with a change of tip can be used for both cutting and welding. The tip at the left is the cut-



MILBURN WELDING TIPS FOR WELDING AND CUTTING

ting tip while that at the right is the welding. Another feature is that the cutting tip can be burned back considerably without destroying the cutting qualities of the flame. To prove the foregoing statement, the tip in the center was purposely burned back in cutting an 8-in. piece of steel, after which the tip at the right was put in place and the piece again welded without cooling off. It is also claimed that it is impossible for these tips to backfire.

Newton Duplex Locomotive Connecting-Rod Boring Machine

The machine shown in the illustrations is primarily intended for the boring of locomotive connecting-rods, but it is also applicable for the production of many other parts that require heavy drilling, such as cross-heads, etc. The machine is the product of the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn., and its particular advantages are summarized as follows: (1) The machine utilizes newly developed cup cutters which dispense with the necessity of drilling pilot holes for boring bars, this feature being said to conserve drills, material, time and power; (2) the kerf by the cup cutters in no case exceeds $\frac{5}{8}$ in.; (3) the cores are removed solid and have an

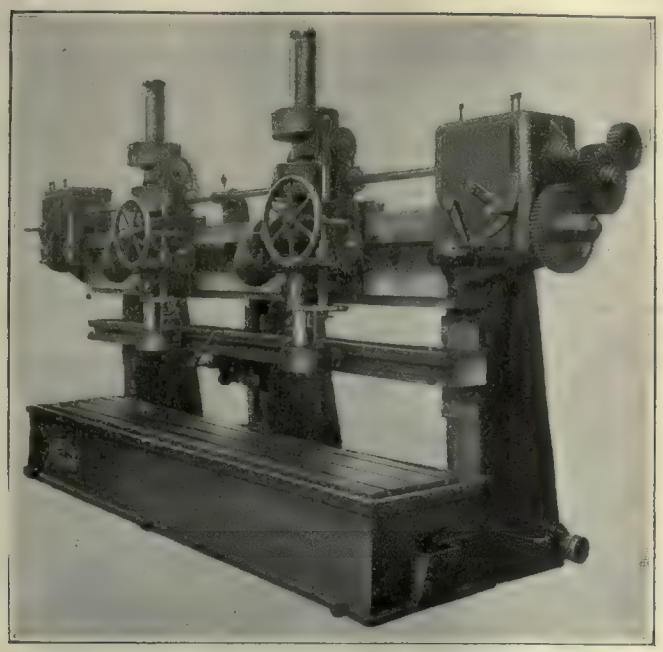


FIG. 1. NEWTON DUPLEX LOCOMOTIVE CONNECTING-ROD BORING MACHINE WITH SPEED BOXES

Diameter of spindle, 4 in.; diameter of spindle nose, 5½ in.; length of automatic feed for spindle, 16 in.; minimum distance between spindle centers, 30 in.; maximum distance between spindle centers, 11 ft. 4 in.; maximum distance from top of table to end of spindle, 25½ in.; distance from center of spindle to upright, 17½ in.; work table, 24 in. x 13 ft. 6 in.; Morse taper in spindle, No. 7; distance between spindle centers with auxiliary table, 14 ft. 5 in.; distance from spindle to surface of auxiliary table, 50 in. maximum, 34 in. minimum.

increased salvage value; (4) a lower support that makes the above economies possible; (5) two ends of one, or one end of two rods may be bored at the same time; (6) the two spindles allow the duplication of center distances in like rods; (7) cross-heads can be reamed advantageously; (8) a new speed box, by means of which speeds may be controlled by levers without a change of gears, and (9) adaptability for odd jobs of heavy drilling.

Fig. 1 shows the machine with the speed box in place, while Fig. 2 shows one end of the machine and the auxiliary table. The base consists of a large casting, the top surface of which, after being finished and slotted, is used for the working surface. This surface is surrounded by an oil pan cast integral with the base. The box-type rail, which is ribbed internally, is attached to the base by means of three uprights. The spindle saddles have angular bearings on the bottom section of the rail to give close contact under heavy pressure, while the top bearing is square, adjustment being made by a bronze taper shoe on the top and rear by a gib bolted to the saddle. The saddles may be held at any position on the rail and are adjusted by a pinion, the solid end of which is squared to fit a removable ratchet handle.

The spindle turns in the sleeve in bushed bearings and has a Morse taper and drift and retaining key slots. The drive is through worm gearing, the wheels having bronze rings with teeth of steep lead, while the worms are hardened steel fitted with roller thrust bearings. The spindles are incased for lubrication purposes and the section fitting the rack sleeve revolves in bronze bushings. The upper ends of the spindles and rack sleeves are protected from dirt by covers serving as a support for the counterweights. A feature of the design is that the thrust of the driving worm is carried on a bearing cast integral with the saddle.

The feed is through spiral gears, one of which is mounted on the spindle sleeve while the other is keyed to the horizontal pull-pin shank on which are also mounted four pull-pin gears, giving four changes of feed which are transmitted to the rack sleeve through a worm and worm wheel. This motion is clutched by means of a cone friction permitting both power and hand elevation. The saddles have hand adjustment on the rail. The auxiliary or lower support for the spindles has a bearing on each upright and also hand elevation by means of a worm and wormwheel. This bearing supports the spindle at the lowest possible point and prevents distortion.

The auxiliary side table shown in Fig. 2 is used for reaming cross-heads. The in-and-out adjustment of this table is supplemented by the longitudinal adjustment of the spindle over the table, thus permitting the clamping of work without having to locate to the actual center. These adjustments also permit the drilling and boring of a series of holes on varied centers at one setting. T-slots are incorporated in both the vertical and horizontal faces, to permit clamping as most convenient. The rail is extended to carry the spindle center 18 in. beyond the vertical face of the auxiliary table, giving a maximum distance between centers of the spindles of 14 ft. 5 in. The side table is placed low to allow for the extra height of work, the distance from the top of the table to the spindle end being 50 in. maximum and 34 in. minimum.

The speed boxes shown in Fig. 1 are for use with constant-speed motors and single-pulley drive, allowing for changes of speed by means of sliding sleeves without the removal of gears. Each spindle is under the control of its own speed box, permitting suitable speeds when the spindles are boring holes of different sizes.

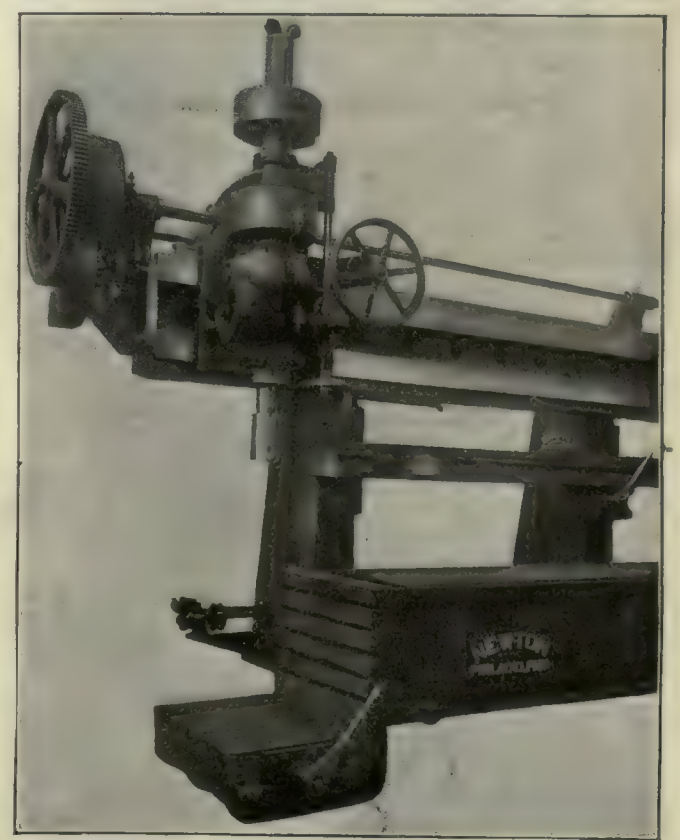
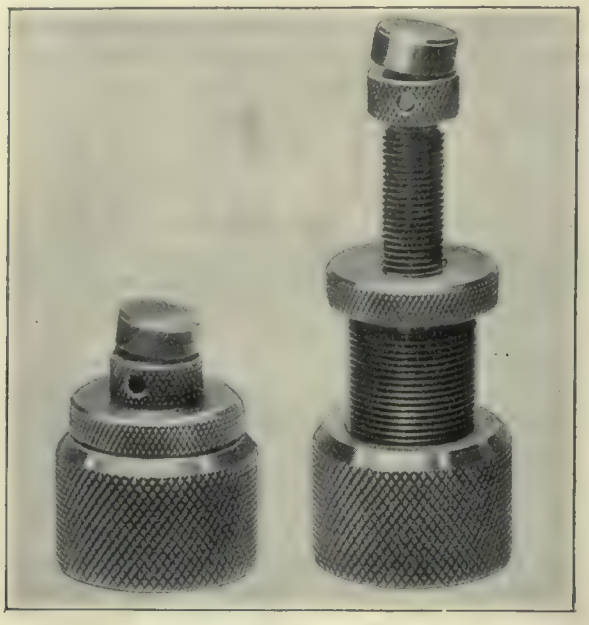


FIG. 2. THE END OF THE CONNECTING-ROD BORING MACHINE SHOWING THE AUXILIARY TABLE FOR CROSS-HEAD WORK

"Hi-Lo" Jack

The Harvard Machine Co., Harvard Square, Cambridge, Mass., has recently placed on the market the "Hi-Lo" jack shown in the illustration. This has a range of adjustment from 2 to 4 in. and requires very

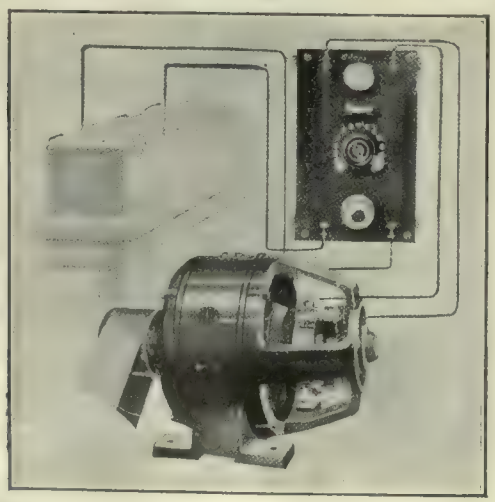


"HI-LO" ADJUSTABLE JACK

little space in the tool case. By removing the top screw it is said to be useful in drilling parts requiring a support directly beneath the drill, as it allows the drill to go through. The top piece is secured in place but is free to adjust itself to uneven surfaces. All parts are made of steel and hardened.

Hobart Battery-Charging Outfit

The illustration shows a new battery-charging outfit that has been recently placed on the market by Hobart Brothers Co., Troy, Ohio. This is made for charging the storage batteries of industrial tractors, or the storage batteries of automobiles, and can also be used for regular electric-lighting work, if desired. The generator is wound for the desired voltage, direct current, and runs at a speed of 1800 r.p.m. The weight is

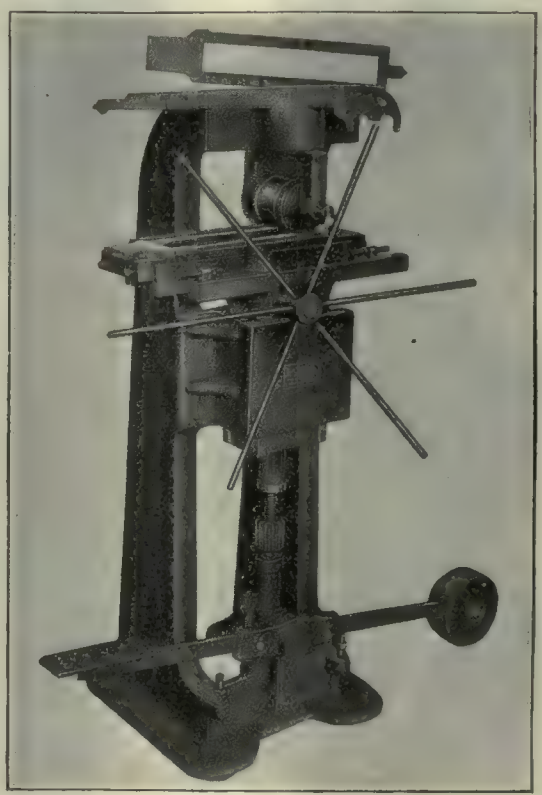


HOBART STORAGE-BATTERY-CHARGING OUTFIT

300 lb. It is intended to be operated from a lineshaft or engine and requires approximately 4 hp. at full load. The outfit includes generator, base tracks, field rheostat, charging panel and pulley with 6-in. diameter and 4-in. face, no switchboard being necessary.

Noble & Westbrook Marking Machine

This machine is for impressing the graduations and figures on scale beams or other long work of similar character, and is a recent product of the Noble & Westbrook Manufacturing Co., Hartford, Conn. It is claimed that the machine is simple, accurate, easy to



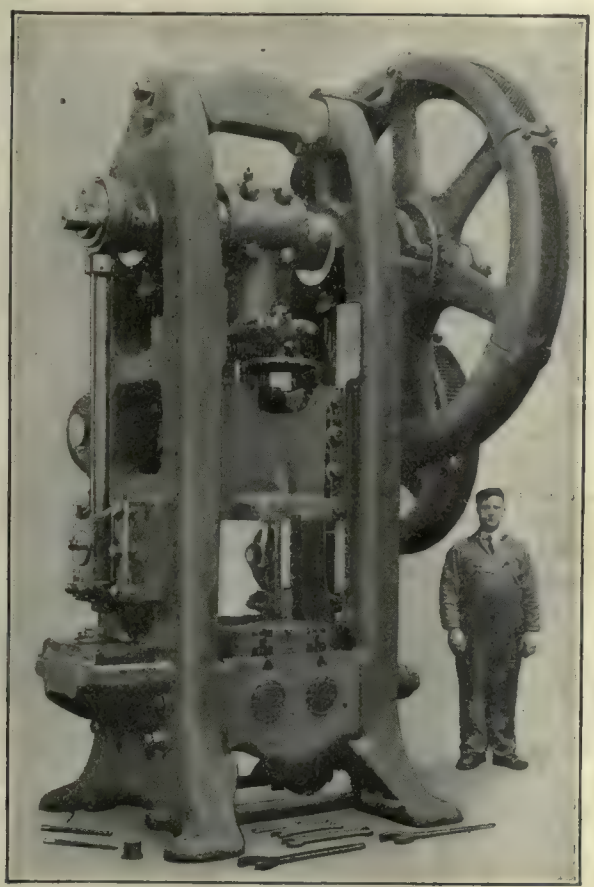
NOBLE & WESTBROOK MARKING MACHINE

operate and that it is a great saving to the manufacturer over other methods of graduating this class of work. The work to be marked is held on the table by a suitable fixture, the die being cylindrical. The die is carried in a yoke or holder, and is connected to a cut gear meshing with a rack. The marking is performed by pressure applied to the foot lever, and an adjustable cam regulates the depth of the impression, so as to make this uniform on the various pieces of work.

Ferracute Trimming Press

The press shown in the illustration is a recent product of the Ferracute Machine Co., Bridgeton, N. J., and is said to contain a number of new features. It exerts a pressure of 200 tons and is provided with a side punch exerting a pressure of 50 tons. A pair of shearing dies is shown set in the side press, which has a stroke of 3 in., the stroke of the ram of the main press being 6 in. Motor drive is furnished, the motor being mounted on a shelf and the drive being through a rawhide pinion engaging teeth on the rim of the flywheel, which weighs one ton and has a speed of 183 r.p.m., producing 20 strokes per min. of the press.

Steel gearing is used, the larger gear being 78 in. in diameter with 9-in. face. The flywheel and gears are guarded, the guards being made in sections composed of woven wire, the edges of which are cast into an iron frame. The diameter of the steel shaft at the journals



FERRACUTE TRIMMING PRESS

is 7½ in. and at the crank 9 in. The adjustment of the main ram downward from top position is 5 in., and of the side-punch ram, 3 in. The total height of the machine is 13 ft., and the weight, 39,500 lb. The machine is started and stopped by means of a pin clutch, pressure on the treadle causing the press to make one stroke, at the completion of which the ram automatically stops at its highest position.

"Seminole" Chisel Steel

The Ludlum Steel Co., Watervliet, N. Y., has recently developed and placed on the market a new chisel steel known as "Seminole." It is stated that this new alloy chisel steel can be made so hard that it will cut glass, yet may be bent by being hammered over the edge of an anvil. It is claimed that the steel is almost foolproof in hardening and has a very wide temperature range, this being from 1650 to 1950 deg. F. The steel is quenched in oil and slightly drawn. The drawing does not seem to affect the hardness but assists in producing toughness.

Fig. 1 shows a spike made of this steel that has been driven through a piece of low-carbon steel and has curved slightly as it passed through the bar, yet the spike was not broken. Fig. 2 shows a chisel that has been driven through a slab of steel and still remains unbroken and with the edge undamaged. It is also

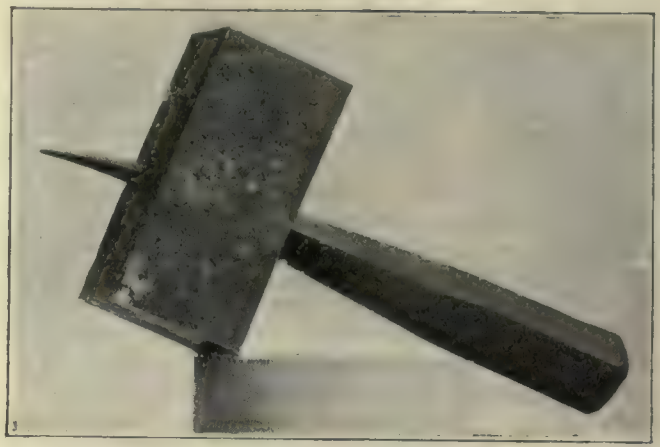


FIG. 1. A SPIKE OF "SEMINOLE" CHISEL STEEL DRIVEN THROUGH A LOW-CARBON STEEL BLOCK

stated that in the case of chisels made of this steel the head will mushroom somewhat but will not chip off. It is said the steel is very peculiar metallographically and that it seems to have a very fine structure that is quite difficult to define in the usual nomenclature of the metallographist.



FIG. 2. A CHISEL DRIVEN THROUGH CARBON STEEL AND SHOWING NO SIGNS OF BENDING OR BREAKING

American Radial Drilling Machines

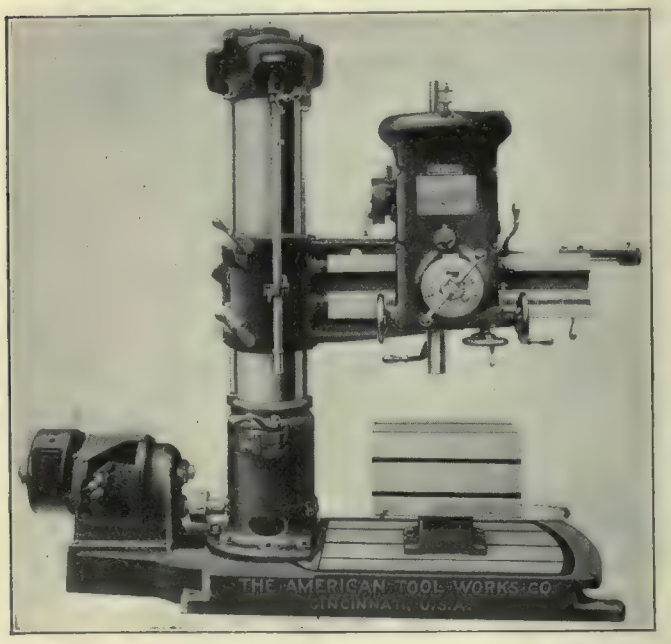
The radial drilling machine shown in the illustration is made in two sizes, 3 and 3½ ft., and is a recent product of the American Tool Works Co., Cincinnati, Ohio. It is known as the company's "Triple-Purpose Radial," it being stated that features have been added that make it not only useful in drilling and tapping, but also in boring. The machine is intended for heavy work, and it is recommended that at least 9 hp. be delivered to the speed box through the belt on a belt-driven machine, while a motor not less than 7½ hp. is recommended for motor drive.

The head is quadruple geared, these four distinct speeds being in turn divided into two separate ranges of speed, one for heavy tapping and boring, while the other is for high-speed drilling and light tapping. The boring and tapping range in conjunction with the six-speed gear box gives 12 speeds from 30 to 134 r.p.m.

obtained through an internal gear drive on the spindle, while the high-speed drilling range consists of 12 speeds from 155 to 700 r.p.m. obtained through an external gear drive, the internal and external gear drives being non-interfering. These 24 spindle speeds are in geometrical progression. The head mechanism is fully inclosed in a casting or housing. A feature of the double-spindle drive is that it allows a range of speed from 30 to 700 r.p.m. without encountering excessive gear velocities. No gear in the machine has a speed greater than 875 ft. per min., which is said to be considerably lower than the gear speed on most machines of similar type.

The entire tapping attachment is inclosed and runs in oil. Gears are semi-steel, bronze-bushed, the friction bands being 4¾ in. in diameter and adjusted from the outside.

It is stated that the machine is very simple and convenient, and that it does not contain a multiplicity of parts in consequence of the added speeds. Only 14 gears are used in the speed-changing mechanism to obtain the 24 spindle speeds. The controlling levers on the heads



AMERICAN 3- AND 3½-FT. TRIPLE-PURPOSE RADIALS

Specifications for 3-ft. machine: Maximum distance from spindle to base, 53 in.; spindle speeds, 24, 30 to 700 r.p.m.; range of feeds, 0.004 to 0.026 per spindle revolution; taper in spindle, Morse No. 4; drills to center of circle outside of column, 72 in.; traverse of spindle, 12 in.; traverse of head on arm, 28 in.; traverse of arm on column, 28 in. Specifications for 3½-ft. machine: Maximum distance from spindle to base, 53 in.; spindle speeds, 24, 30 to 700 r.p.m.; range of feeds, 0.004 to 0.026 per spindle revolution; taper in spindle, Morse No. 4; drills to center of circle outside of column, 84 in.; traverse of spindle, 12 in.; traverse of head on arm, 34 in.; traverse of arm on column, 28 in.

are located within reach of the operator, and two head-moving wheels are provided, one on each side, so that the operator can use either as most convenient. In order to allow the arm to be swung easily a conical roller bearing is placed between the column and sleeve at the bottom, while at the top a ball bearing is interposed to take the radial thrust.

All gears in the machine are made of steel with the exception of the gears on the cap, tapping attachment, arm miter gears and main spindle gear which are of semi-steel, and a few feed gears which are of manganese bronze. The pinions and clashing gears in the speed-changing mechanism except for the large internal gear are heat-treated and hardened. All shafts in the head and gear box are of crucible steel, while the long vertical and horizontal shafts are made of 45-point carbon steel ground to size. Every cylindrical bearing is renewable and bushed with phosphor bronze.

Another feature of the machine is the centralized lubrication system. The oil ducts are brought to centralized locations on the head and cap, this method insuring an oil supply to all bearings. The oil is led to annular chambers formed in the bronze bushings, these chambers containing a large supply of lubricant, which is in turn fed to the bearings by strips of felt in slots cut lengthwise in the bushings, this construction being said to insure uniform supply without flooding.

Another feature is the counterweight construction which is completely inclosed by the head casting. It is stated that the movement of the head along the arm is facilitated by the counterweight being built close in to the spindle, bringing the center of gravity close to the head support on the arm.

The feeding mechanism gives six feeds in geometrical progression from 0.004 to 0.026 in. per spindle revolution. The indicating mechanism of the feeds is direct reading, only one dial being required, on the face of which the respective feeds are indicated. The mechanism is protected against shocks or excessive stress by a friction which forms the connection between the mechanism and the spindle. This is of the improved expanding-band type, quickly adjustable to the desired tension, and is operated by two levers known as quick-return levers. Another important point is that the feed wormwheel runs in an oil bath to insure a minimum amount of wear.

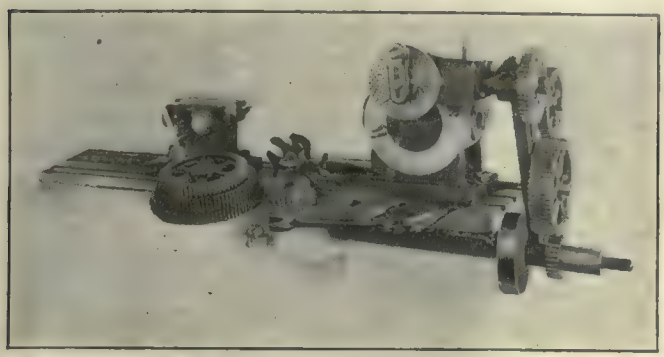
The arm is said to have been greatly increased in size and has a rib or web at the bottom. The bearing area of the arm girdle is said to be unusually great, and the improved arm binders permit the use of a solid girdle instead of a split girdle. A safety friction incorporated in the elevating gear prevents the arm from being elevated until the binders are loosened. It is also impossible to raise the arm above or below fixed points. The friction also eliminates the shock that generally takes place when the elevating gears are engaged. The elevating mechanism is controlled by a lever which is inoperative until a safety knob is released, thereby guarding against breakage caused by careless handling.

The speed box which furnishes six changes of speed is of the cone and tumbler type and has an automatic silent clutch auxiliary drive that keeps the shafts and gears running while the changes are being made, this system eliminating the shock caused by the engaging of the gears. This drive is used during speed changing only, and never for a working speed. The gears of the tumbler mechanism are cut with 20-deg. cutters, and later carbonized and hardened, the pointed teeth facilitating the engagement of the gears. A spring shock absorber is located between the speed box and column driving gears to lessen the wear and tear on the mechanism.

A ledge is regularly provided on the base to accommodate the auxiliary support which swings as the arm is moved. The machine is furnished with a separate, plain, box table as shown in the illustration, but if desired can be equipped with a swinging box table or a worm swiveling and round table, it being possible to rotate this latter in a complete circle by means of an inclosed worm and wormwheel, a mechanism also being provided to tilt the table at any desired angle.

Simmons Universal Index Heads

The Simmons Machine Co., Inc., Albany, N. Y., has recently placed on the market the universal index heads shown in the illustration, which are designed to swing work up to 10 in. in diameter. The swivel block is graduated and can be adjusted to any angle from 10 deg. below horizontal to 10 deg. beyond perpendicular,



SIMMONS UNIVERSAL INDEX HEADS

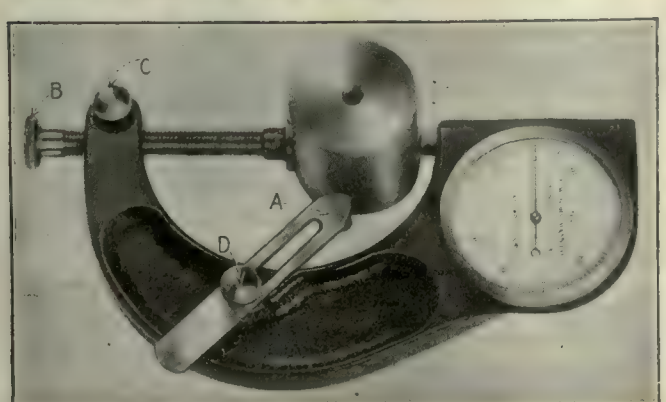
Taper in spindle, No. 10 B. & S.; hole through spindle, 1 1/8 in.; threads on spindle, 2 7/8 in. in diameter, threaded, 6-pitch right hand; swivel, from 10 deg. below horizontal to 10 deg. beyond perpendicular; diameter of wormwheels, 5 in.; gears, 3/4 in. thick, 1 1/4 in. bore; weight, 150 lb.

and by removing the extension arm the head can be swung 90 deg. The index crank is adjustable and all bushings are hardened. Equipment includes three index plates, gears, four 5/8-in. bolts, driving dog, wrenches, index chart showing every division obtainable up to 360 deg., and also a spiral chart.

Horstmam Indicating Clippers

The F. W. Horstmann Co., of 210 Coit St., Irvington, N. J., has placed on the market an indicating caliper or dial comparator which is designed to take the place of the snap gage to some extent. It is claimed for this tool that work can be more quickly gaged, and that inexperienced operators may use it as readily and rapidly as the more experienced ones.

Where it is desired to gage quickly a number of round pieces as in regular production of turned parts from the lathe or screw machine, the stop *A* is set to allow a standard plug gage of corresponding size to enter the proper distance between the measuring points to gage the maximum diameter; that is, to bring the gaging points diametrically opposite in relation to the center of the plug. The screw *B* is then turned until the pointer indicates 0 on the dial.



HORTSMANN INDICATING CALIPER

Clamping screws *C* and *D* are now tightened and the tool used in the same manner as a snap gage except that the work will enter the gage readily if it is within 1/32 in. of correct size, and a glance at the pointer will show immediately not only whether the work is too large or too small, but will indicate in thousandths of an inch the amount of the variation.

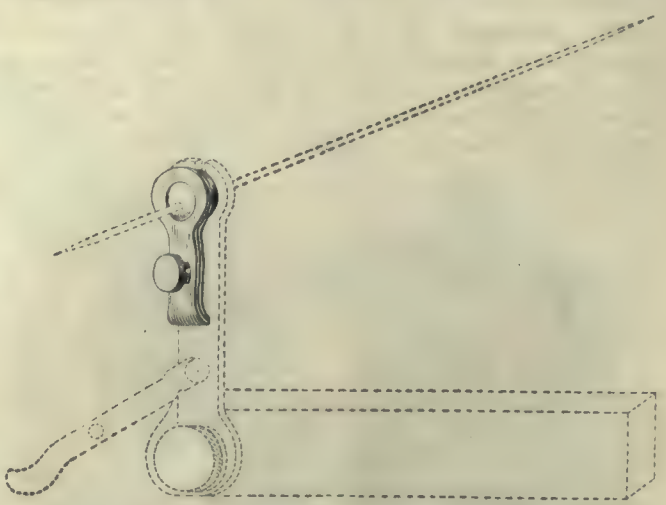
Positive stops are provided on the gaging spindle so that the indicating mechanism cannot be injured by forcing the gage onto a piece that is too much over size. There is no possibility of variable readings by different individuals because of difference in the sense of touch as the measuring pressure is always applied by the tension of the indicator spring.

The indicator movement is through a compound lever, segment and pinion, the spiral spring tending at all times to hold the parts in contact in one direction so that there is no liability to error through backlash or lost motion.

The tool is made in all sizes from 1 to 12 in. and weighs very little more than a micrometer of corresponding size.

Horstmann Indicating Clippers

T. Daniel Bush, 119 South Center St., South Allentown, Penn., has just placed on the market an attachment to be used in connection with the universal

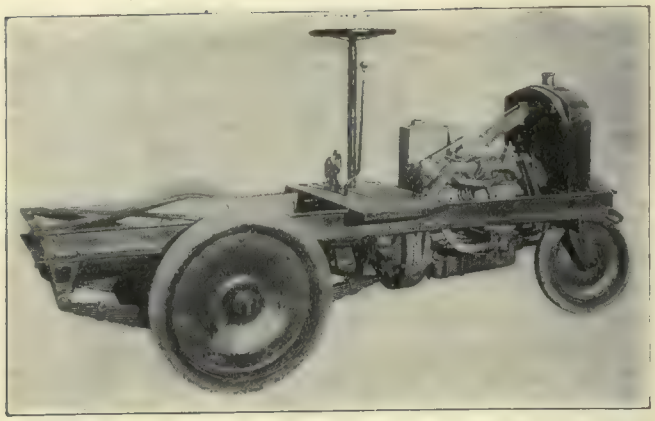


NEW ATTACHMENT FOR BUSH UNIVERSAL INDICATOR

indicator described on page 419. This attachment allows the ball-headed needle to be reversed and is said to be very convenient for some classes of work.

Clark "Tructractor"

The "Tructractor" shown is a recent product of the Clark Tructractor Co., 80 East Jackson Blvd., Chicago, Ill., and is intended for use where the combined features of a truck and tractor are desired. As a truck it will carry a load of 1½ tons and as a tractor will haul a number of loaded trailers. It turns in a radius of 6 ft. and is mounted on three single-piece metal disk wheels with roller bearings on the front wheel and annular ball bearings on the two rear wheels, the tires being of the solid pressed-on type. The motor is a four-cylinder with internal gear-driven axle; dry plate, multiple disk, non-adjustable clutch; selective type transmission, three speeds forward and one reverse;



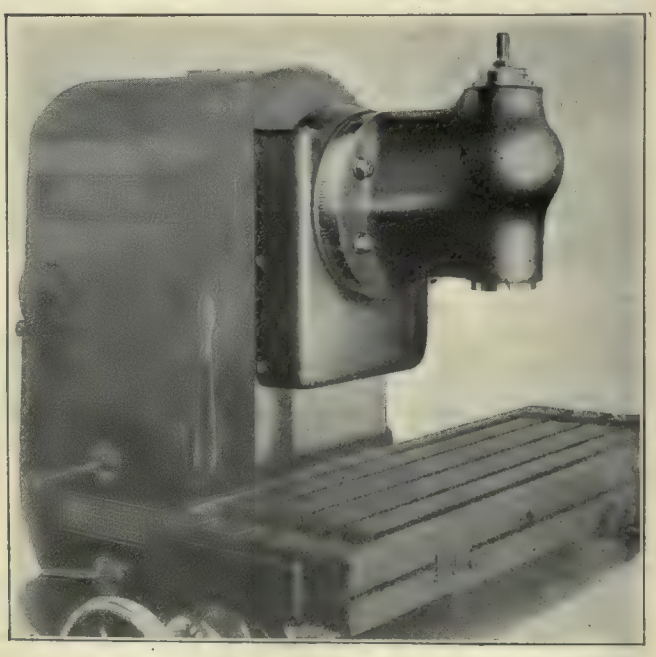
CLARK "TRUCTRACTOR"

Load carried, 1½ tons; turning radius, 6 ft.; motor, four-cylinder, 3⅛ x 4½; drive, internal gear; clutch, dry plate, multiple disk; transmission, selective, three speeds forward, one reverse; gasoline feed, gravity; steering gear, worm and sector type; weight, with standard body, 2050 lb.; wheel base, 72 in.; tread, 35½ in.; over-all length, 112 in.; over-all width, 42 in.; height of platform above ground, 28 in.; speeds, 1 to 15 m.p.h.

and standard automobile control. The gasoline is fed by gravity. The steering gear is of the worm and sector type. Speeds obtained on these trucks are from 1 to 15 miles per hour.

Cleveland Vertical Milling Attachment

The Cleveland Milling Machine Co., 18511-18517 Euclid Ave., Cleveland, Ohio, has recently placed on the market the vertical-spindle milling attachment shown in the illustration. This attachment is made for the Nos. 1, 2 and 3 machines made by this company.



VERTICAL SPINDLE MILLING ATTACHMENT

Specifications for a No. 1 machine: Distance from face of column to center of vertical spindle, 10¾ in.; distance from nose of spindle to table, 1¼ to 16½ in.; cross range of machine, 8 in.; longitudinal range of machine, 22 in.; taper hole in spindle, No. 10 B. & S.; weight, 200 lb.

Specifications for No. 2 machine: Distance from face of column to center of vertical spindle, 12¾ in.; distance from nose of spindle to table, 1½ to 16½ in.; cross range of machine, 10 in.; longitudinal range of machine, 28 in.; taper hole in spindle, No. 11 B. & S.; net weight, 245 lb.

Specifications for No. 3 machine: Distance from face of column to center of vertical spindle, 15 in.; distance from nose of spindle to table, 2 to 18½ in.; cross range of machine, 12 in.; longitudinal range of machine, 34 in.; taper in spindle, No. 12 B. & S.; weight, 350 lb.

The drive is taken from a gear fastened to the nose of the spindle, which in turn drives the spur gear on the horizontal shaft, and the spindle is in turn driven by miter gears. All gears and shafts are made of steel, are inclosed and run in bronze bearings throughout. The bearings on the spindle form two taper cones in opposite directions, and are adjusted by a nut outside of the spindle. The base of the head is graduated so that it may be set to any angle in a vertical plane parallel to the elevating screw, and the distance from the face of the column to the vertical spindle and the distance from the nose of the spindle to the top of the table in its highest and lowest positions, covers the range of the ordinary vertical-spindle milling machine. The attachment is clamped in position on the dovetail slide of the column and is said to be as rigid as if it were a part of the machine.

Cone Worm-Gear Hobbing Machine for Production Work

The Cone Automatic Machine Co., Inc., Windsor, Vt., has recently placed on the market the machine illustrated, which is for hobbing worm gears on a production basis. The machine is primarily intended for use on gears up to 18 in. in diameter, but can cut gears up to 24 in. in diameter in an emergency. The blank to be cut is attached to the upper end of the vertical spindle at the right, while a master gear is mounted on the lower end of the spindle, this being driven from a master worm mounted on the horizontal shaft which is in turn driven through a system of gearing from



CONE WORM-GEAR HOBBING MACHINE

the cutter spindle. The cutter is fed into the blank, suitable stops being provided for limiting its motion. It is stated that the machine is very simple in construction, that it is a good producer, and that there is little chance to go wrong in setting up the work.

War Factors Affecting Mechanics

By C. E. Shaffner

That the transition from war to peace production in the factory and the shop is characterized by a changed attitude on the part of mechanics generally toward modern production methods seems quite apparent and is largely due to a broader sense of correlation to which several factors engendered wholly by the circumstances of the war have especially contributed.

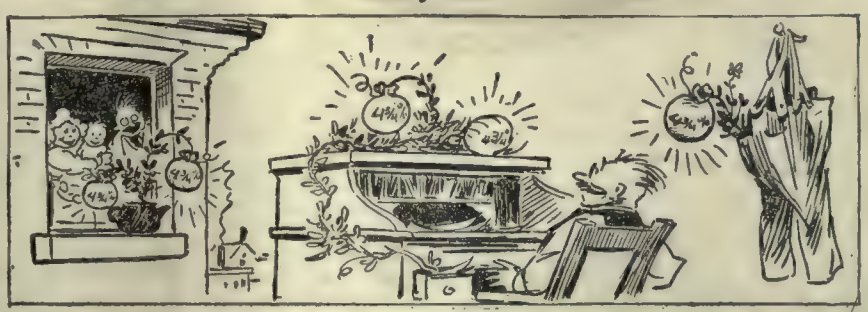
When there was a good deal of hurrying and scurrying about in our war preparations, the writer heard an efficiency engineer in a middle western factory engaged in making cannons say to his associates: "Pay no attention to what any one tells you. Simply go ahead and get the results we want and the information we need." At the time foremen throughout the plant were openly disregarding any attempt to maintain production records and an adequate system of routing. Here was a situation whereby two departments of vital importance to each other were setting up tangles and difficulties rather than the proper coöperation. As a matter of fact the hindrance of production was the last thing in their minds but because of petty differences they were accomplishing the same results as if they had purposely planned to hold up the work. At the same time it is undoubtedly safe to say that for some months before the armistice was signed there was little evidence of any such attitude on the part of the mechanics. Aside from motives and feelings prompted by patriotism there were other considerations which brought the man engaged in production work in closer contact with the other departments of the plant and to measure of understanding as to their actual needs and purposes never before attained.

From observations at first hand which the writer was in a position to make it seems that two factors were chiefly responsible for this more complete understanding on the part of the man in the shop and these were: The induction into the shop and factory of men from other walks of life; and the increased capacities and vision of foremen in particular and of all mechanics to a considerable extent. In several ways at least these two factors are so closely related that their effect is best described briefly by general illustrations showing how they operated as complementary forces. In this connection I recall that one day last winter a bench foreman in an ordnance plant seized a box of small parts for cannons and carelessly emptied them into a larger receptacle even though each lot was carefully marked with a shop tag. "What's the difference?" he shouted. "All of them are operating slide liners and why shouldn't we have them together?" At the end of that particular shift he was no longer foreman in charge of that work; not only because he had openly disobeyed instructions but also on account of the feeling he had stirred up among the men in his charge who understood thoroughly why these gun parts should be separated and therefore had a particular interest in seeing that no unnecessary tangle should be introduced into the process of production which could be charged to carelessness of some of them.

Plant 'em Now. There Are a Few Packages of Seeds Left



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Grow Just as Well in a Cracked Teapot, a Desk Drawer, or the Pocket of an Old Pair of Pants!



Absolutely Unaffected by Frost, Flood, Drouth or Grasshoppers or Neighbors' Chickens



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Ding in New York Tribune.



Sparks from the

Can Export Metal Goods to England

Restrictions Placed on Machine Tools and Metal Goods by the British Government Are Reported Removed

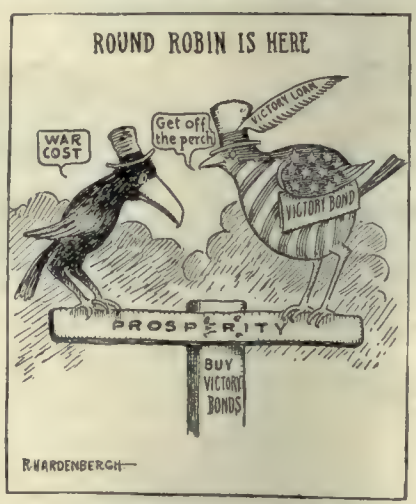
According to a cable received in Washington from Consul General Skinner, the British Government has removed the embargo against imports from the following important items: Belt hooks for machinery and sewing machines, bolts and nuts, enameled steel tanks with glass linings, heddle steel strip iron, hook strip, tube strip, and ground flat steel stock; machine tools and parts, tools and appliances and parts, namely, abrasive wheels, adjustable clamps, anvils, auger bits, bench drills, bolt clippers, boring heads, calipers, carpenters' tools, chasers, chucks, cooper tools, cutting nippers, dial gages, dies and die stocks, die heads, drills, drill presses, drill sleeves and sockets, emery-wheel dressers, engineers' hammers, expanding mandrels, expansion bits, farriers' tools, furniture and dovetail bits, gaged glass cutters, hacksaw blades, hand and breast drills, hand grinders, hand screwing machines, hide hammers, iron hammer heads, joiners' tools, lathe carriers, lathe dogs, lead hammers, machine vises, masons' tools, measuring tapes and rules (except wooden rules) and including verniers, micrometers, milling cutters, miter blocks and scrapers, blocks and scrapers for metal miter boxes, nail pullers, pipe cutters, pipe vises, pipe wrenches, pliers, polishing heads, punches, reamers; saws—band, circular, crosscut, kitchen and others; screwing tackle (i.e. chasers, dies and stocks, taps, and threadmilling cutters); shipwrights' tools, slide rules of metal, smiths' tools, spanners, swage shapers, tailors' shears and trimmers, 6 in. or more in length, tapping attachments, taps, tap wrenches, tool holders, trench struts, tube expanders, upholsterers' or household hammers, welt plows, deacon's wood-boring bits, woodscrapers, treadle lathes of 3-in. centers and over, wire hooks (other than coat and hat hooks), woodworking machinery and parts thereof. Solid drawn weldless tubing is to be admitted only in very special circumstances.

* * *

Gives Post-Graduate Course to Tractor Demonstrators

A tractor-demonstration school was held at the Hart-Parr factory, Charles City, Iowa, on Apr. 23 and 24, for the purpose of affording a post-graduate course for salesmen and demonstrators who are already skilled in the operation of tractors. A special feature of the instruction was in giving plowing and general performance demonstrations for the benefit of the men in their respective sections of the country who will handle the tractor in competitive demonstrations.

The school also brought out points leading to economy of operation such as the saving of fuel and lubricating oils. Another feature largely brought



out was coöperation between the factory and the field, and the possibilities of greater service all along the line from the factory, to salesmen and dealers, to the farmers and the buyers. About 50 salesmen from the field were in attendance.

This school differed greatly from the tractor schools held for the farmers and other buyers of tractors in that this was much more technical and broader in its scope. Some of the men in attendance came from considerable distance. A. W. Fitzpatrick, service manager of the Hart-Parr works, was the manager of the school and chief instructor.

* * *

Consolidation of Sales Organizations of Ball-Bearing Companies

The products of the S K F Ball Bearing Co., Hartford, Conn., and New York; the Hess-Bright Manufacturing Co., Philadelphia; the Atlas Ball Co., Philadelphia, and the Hubbard Machine Co., Worcester, Mass., will be sold through one central organization, under the name of the S K F Industries, Inc., effective May 1. The officers of this new organization are as follows: B. G. Prytz, president; W. L. Batt, vice president; J. P. Walsh, comptroller, and S. B. Taylor, sales manager. The principal office will be at 165 Broadway, New York, with branches in Boston, Philadelphia, Atlanta, Buffalo, Cleveland, Detroit, Cincinnati, Chicago and San Francisco.

Glenn B. Harris With Bureau of Standards

Glenn B. Harris, who for the past 15 months has been engaged in war work as mechanical engineer of the Ordnance Department, has resigned his position to accept an appointment with the Bureau of Standards of which bureau he has been made special representative with an office in the Engineering Societies Building, 29 West 39th St., New York.

During the time of Mr. Harris' service with the Ordnance Department he was in entire charge of master and inspection gages, having selection of design, supervision of procurement, inspection and distribution, and in this capacity handled more than $32,000,000 worth of this material.

Mr. Harris was responsible for the initiation of a gage shop at the Bureau of Standards, which salvaged gages rendered obsolete by revision in component drawings, and also for the manufacture of gages to meet emergency demands. This shop proved extremely valuable in expediting inspection of material for shipment overseas. He is a member of the American Society of Mechanical Engineers and was formerly of the editorial staff of the *American Machinist*.

* * *

Hildreth in Charge of Machine-Tool Sales

Charles E. Hildreth has been appointed to take charge of the machine-tool section of the division of surplus property in the War Department. He served as a dollar-a-year man in the finished-products division of the War Industries Board and is intimately acquainted with the machine-tool business, being president of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., and general manager of the National Machine-Tool Builders' Association. His appointment is the first step in the reorganization of the War Department machinery for the disposition of surplus machine tools.

* * *

The "Flivver" Airplane

"Flivver" airplanes that will carry two passengers and have a wing spread sufficiently narrow to make possible a landing on a county road are to be manufactured at the Maryland Pressed Steel Co.'s plant at Hagerstown, Md., according to reports.

The first plane of this type was witnessed by the July 4 gathering at Towson and is the invention of an Italian. It was the idea of the War Department to use the planes in France, but after the signing of the armistice the inventor was induced to work on a peace plane.

World's Industrial Forge

By E. C. Porter, News Editor

Fellows Gear Shaper Company Enlarges Plant

The Fellows Gear Shaper Co. of Springfield, Vt., has found it necessary to make further extensions to its plant, which was considerably enlarged during 1918 to take care of increasing business. The new plant which is to be built will consist of a shop of steel and brick construction, two stories high, the dimensions of which are 144 x 147 ft. This will increase the manufacturing capacity of the plant about 60 per cent. This company now employs approximately 450 men, and when the additional plant is in full operation the force will be increased to approximately 750 men.

In addition to the extension to the shop a new office of steel and brick construction will be built, the dimensions of which will be 42 x 102 ft. The entire top floor of the new office building will be occupied by the engineering and drafting departments, whereas the general offices will be located on the second floor.

The contract for this extension has been let to the New England Structural Co. of Boston, and it is estimated that it will cost between $200,000 and $250,000, not including equipment.

* * *

The Basic Industry on Which All Else Depends

The editorial supplement inclosed with this week's *American Machinist* presents very graphically the relation of the machine tool to modern industry. Industry depends primarily upon the machine tool, and the development, improvement and distribution of the machine tool must be encouraged by industry as a whole, as a step toward general prosperity.

* * *

Executive Secretary Appointed for American Chamber of Commerce in London

George P. Toby, long connected with banking and industrial corporations in this country, has been appointed executive secretary of the American Chamber of Commerce in London and will sail for his new post about May 12, meanwhile conferring with American merchants as to the service which the American Chamber in London can render them.

Mr. Toby spent over a year in Washington during the war on work for the Treasury Department and on plans for coöperation between the various Government departments and the business world.

G. M. Cassatt, president of the American Chamber of Commerce in London, says: "The London Chamber wants to be used. What we most desire is that the individual American manufacturer, merchant, exporter, from one end of the country to the other, should learn to look upon us as an overseas service bureau of his own—on the spot and on the job, ready to work for him, to protect his hand and to look out for his interests. We are there to promote American business."

Besides Mr. Cassatt, who represents the Remington Typewriter Co., some of the other officers and directors are: J. Grant Forbes, American International Corp.; Frank Wyman Libby, Willys-Overland, Ltd.; H. H. Lukens, E. I. du Pont de Nemours & Co.; George A. Mower, Sturtevant Engineering Co., Ltd.; Walter Phillips, Westinghouse Air Brake Co.; R. P. C. Sanderson, Baldwin Locomotive Works.

* * *

A Letter from Chicago

By Owen M. Fox
Business News Department

Business during the month of April has been such, among machine-tool dealers in the Chicago district, as to cause a well-founded spirit of optimism to prevail, an optimism based not on theories or on a study of apparent conditions, but on the good solid basis of actual sales.

Dealers, without exception, report last month as being the best since the signing of the armistice, and several say that if each month in the year is as good as April has been they would consider it a very successful year. Sales have not been as numerous in point of number of pieces sold, but the aggregate in dollars and cents approximates good pre-war business.

Distribution is not being confined to any particular class of machinery, which is being taken as an indication of a healthy condition. Sales of lathes and of sheet-metal handling machinery seem to predominate, with all other types also being represented. No further reductions are anticipated by dealers and customers do not seem to be looking for any, as the manufacturers' expressed opinion, that cuts already made are as radical as conditions will permit, is being accepted as correct.

* * *

Steel Treaters' Society Holds Monthly Meeting

The regular monthly meeting of the Chicago Chapter of the American Steel Treaters' Society was held at the City Club, Chicago, on Tuesday evening, April 22. W. S. Bidle, of the W. S. Bidle Co., Cleveland, chairman of the Cleveland Chapter of the society, addressed the membership of the Chicago Chapter.

The Spring Meeting of Mechanical Engineers

The American Society of Mechanical Engineers Will Open Its Spring Meeting in Detroit June 16

The spring meeting of the American Society of Mechanical Engineers will open at the Hotel Statler, Detroit, on Monday, June 16, and close on Thursday, June 19. The professional program comprises the following features:

Aims and Organization to be Discussed

Monday, June 16—Business meeting in the afternoon, followed by a general meeting at which the Society's Committee on Aims and Organization will make a preliminary report. There are representatives on this committee from the various sections of the society and seven members at large, constituting a committee of over thirty members. Several meetings have been held by this representative group in order to bring out the sentiment of engineers from different parts of the country as to what should be the controlling elements in an engineer's work under present conditions, what constitutes engineering as a profession and what are the really important functions of an engineering society in its service to engineers and the public.

Papers on Industrial Research

Tuesday, June 17—Morning session on the subject of Research under the auspices of the Research Committee of the A. S. M. E. Several papers and reports will be presented. This is to be made a leading subject of the meeting because of the great impetus which has been given to industrial research as a result of the conditions resulting from the war.

What Conditions Are Necessary for Industrial Peace?

The afternoon session on Tuesday will be on the subject of Industrial Relations, with several addresses by men of national reputation. This session will constitute a symposium by leading organizers on the factors dominant in the labor situation, with an interchange of views as to what must be done to assure industrial peace.

Papers to Be Contributed by Local Sections

Wednesday, June 18—There will be a session in charge of the Detroit local committee and of several of the other sections of the society, with technical papers contributed by members of these various sections; also Gas Power Session with papers on Oil Engines.

Thursday, June 19—Miscellaneous

technical sessions, one of which will be for the discussion of fuels, including powdered fuel and oil fuel.

The Detroit local committee is arranging many events for the entertainment of the members of the society and others who may attend. Among these will be an afternoon and evening devoted to a boat ride on the lake during which dinner will be served.

* * *

Engineers' Club Organized in Youngstown

An Engineers' Club has been organized at Youngstown, Ohio, with nearly 550 charter members, made up largely of mechanical and civil engineers and others connected in official capacities with the various blast furnaces and steel companies in the Mahoning and Shenango Valleys. The new club is planning the erection of a building to contain the usual club facilities.

* * *

Electric Hoist Association Elects Officers

The Electric Hoist Manufacturers' Association has elected the following officers: Chairman, C. W. Beaver, Yale & Towne Manufacturing Co., New York; vice chairman, J. B. Adams, Franklin Moore Co., Winsted, Conn.; secretary-treasurer, W. C. Briggs, Shepard Electric Crane and Hoist Co., New York; executive committee, the above officers and S. H. Libby, Sprague Electric Works, Bloomfield, N. J., and A. J. Barnes, Shepard Electric Crane and Hoist Co., Montour Falls, N. Y.

* * *

New York Engineers Hold Meeting

A meeting of the New York Chapter of the American Association of Engineers was held at the United Societies Building, Wednesday, Apr. 23. The principal speaker was Robert M. MacBride, a publisher and journalist, who went to Europe with the party of journalists who accompanied President Wilson, and visited the battlefields of of France and occupied Germany.

The next meeting of the chapter will be held at the United Societies Building on May 14, at which time the newly elected officers for the ensuing year will take office.

* * *

Ford Street Car Coming Next

Henry Ford and the engineers of his tractor organization, it is reported, are working on plans for a street car driven by an internal combustion engine, which will be demonstrated in Detroit this summer, according to Charles E. Sorensen, general manager of the Henry Ford & Son tractor plant.

Lieut.-Col. E. J. Hall, one of the designers of the Liberty engine, will go to Detroit to assist in the demonstration of the new car. He has already successfully worked out engine-driven street cars, but will coöperate with Mr. Ford in perfecting the latter's new idea.

New Restaurant Opened for Employees

The firm of Henry Disston & Sons, Inc., Philadelphia, Penn., has opened an employees' restaurant, in which it will sell food at cost price. This restaurant is known as the "Disston Cafeteria," and was designed with the view of accommodating 900 people and having kitchen facilities to prepare 1500 meals at one time.

Business Items

Sleeper & Hartley, Inc., Worcester, Mass., has secured through its French agent, Edgar Bloxham, an order from the French High Commission for a considerable quantity of wire-nail machinery amounting to more than 100 machines, which in addition to its regular orders will make it necessary to double its staff and operate two shifts. This equipment will be used in reconstruction work in France.

Rivett Lathe and Grinder Co. has recently made arrangements with the following concerns to represent it exclusively as selling agents in the following territories: Metropolitan New York, western part of Connecticut, northern part of New Jersey, Patterson, Gottfried & Hunter, Inc., 211 Center St., New York; all of New York except that part in the southeastern corner which is accessible from New York City, Homer Strong, 301-309 State St., Rochester, N. Y.; the eastern half of Pennsylvania, the southern half of New Jersey, Delaware and Maryland, D. Nast Machinery Co., Bourse Building, Philadelphia, Penn.; that part of Michigan known as the lower peninsula, J. R. Stone Tool and Supply Co., 997 Woodward Ave., Detroit, Mich.; the entire Dominion of Canada, H. W. Petrie, Ltd., corner Niagara and Bathurst Sts., Toronto, Canada.

C. W. Rice, secretary of the American Society of Mechanical Engineers, was the speaker at a joint meeting of the Omaha Technical Club and the Nebraska Association of Civil and Mechanical Engineers, Apr. 14. Howard J. Webster, president of the Uniflow Boiler Co., Philadelphia, Penn., was another speaker, taking as his topic, "Combustion Engineering." J. A. Bruce, city engineer of Omaha, was the presiding officer.

The Engineers' Club of St. Louis discussed the McCullough-Martin road bill, relating to state roads, at the meeting held Apr. 16. Louis J. Brooks, John W. Woermann, A. P. Greensfelder, J. C. Trevilla, W. W. Horner, Walter Heimbucher, J. M. Slater, C. W. Roehrig, William Elbring, and William Stocker were the speakers.

The Nilson Die and Tool Co., Chicago, Ill., announces that it has taken over the Strand Machinery Co., and is now furnishing the Strand pneumatic die cushions to the trade.

The Chicago Pneumatic Tool Co. announces the election of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Co., Ltd., whose offices are at 170 Piccadilly, London, and whose plant is in Fraserburg, Scotland. Mr. Goodhue will also be in charge of European sales for the Chicago Pneumatic Tool Co.

The executive office of Slocum, Avram & Slocum moved on May 1 to the 40th floor of the Woolworth Building, New York City.

Norman Hatton, Wm. J. Klein and S. E. Holmes of Cedar Rapids, Iowa, announce the formation of a partnership under the name of Hatton, Klein & Holmes.

The Thermal Appliance Co., Inc., has moved into its new manufacturing plant and headquarters which are located at Port Ave. and Third St., Elizabethport, N. J.

Booth & Stewart, consulting engineers, have recently established offices at 410 Press Building, Kalamazoo, Mich. K. W. Booth was formerly assistant engineer for Fuller & Son and H. M. Stewart was chief engineer for the Lane Motor Truck Co., both of the same city.

Personals

M. M. GRUBER, formerly assistant chief draftsman of the Hill Publishing Co., and for the past two years president and mechanical engineer of the Presto Machine Works, Inc., Brooklyn, N. Y., has been elected secretary of the Presto Phono Parts Corporation, an allied interest to the machine corporation. Mr. Gruber, who is a member of the American Society of Mechanical Engineers, will act as mechanical engineer to both corporations.

LIEUT.-COM. H. J. ELSON, U. S. Naval Reserve Force, has been released and has resumed his civilian work as secretary and treasurer of the Walter A. Zelnicker Supply Co., St. Louis. He was formerly with this company in charge of internal management and manufacturing operations. Lieutenant Elson will have the general internal management of operations and manufacturing of the Zelnicker Co., and its various allied subsidiaries.

CAPT. THOS. F. GITHENS has been discharged from the U. S. Army and is now employed by the Cleveland Twist Drill Co., Cleveland, Ohio.

HERMAN A. HOLZ, has moved his office and laboratories from 1 Madison Ave. to the Pullman Building, 17 Madison Ave., New York.

ENSIGN FRED D. RICE, U. S. Naval Reserve Forces, has been released from active service and is now representing the Hess Steel Corporation, Baltimore, Md., in Western New York and Western Pennsylvania.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Toolholder, Spring

The Federal Products Corporation, 393 Harris Ave., Providence, R. I.

"American Machinist," April 10, 1919



A flexible goose-neck is put in this tool to give flexibility to the cutter with the idea of eliminating chatter and tearing of the stock. A setscrew is provided to brace the goose-neck against springing when it is desired to use the holder as an ordinary lathe tool. Three cutters are furnished one for right-angle cutting and the others for offset cutting to a shoulder—one right and the other left. The cutters are ground with one end for roughing and the other for finishing and with parallel sides so that they can be removed and reground or reversed without changing the holder setting.

Drilling Machine, 20-Inch

Richards Machine Co., 3417-3419 Vliet St., Milwaukee, Wis.

"American Machinist," April 10, 1919

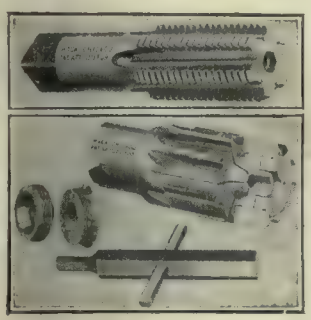


Equipped with back gears, power feed, automatic stop and geared tapping attachment. Speeds, eight; four with back gears and four with open belts; holes drilled, up to 1½ in.; holes tapped, up to ¾ in.; belt used, 2 in.; feeds, three, 0.002, 0.005 and 0.010 per spindle diameter of column, 5 $\frac{3}{16}$ in.; diameter of revolution; ratio of back gears, four to one; spindle, 1¼ in.; diameter of sleeve, 2⅜ in.

Reamers and Taps, Hack Solid Adjustable

American Machine Tool Engineering Works, 4854 W. Kinzie St., Chicago, Ill.

"American Machinist," April 10, 1919

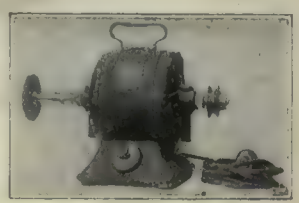


These taps and reamers are adjusted by means of two threaded cones, one for contracting and the other for expanding them. The one not in use is screwed against the other to act as a locknut. These tools can be adjusted for over or undersize work and can be reground and still be adjusted to the original size. They are adjusted by a solid, double-end, plug wrench.

Motors, Grinding, Polishing and Power

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," April 10, 1919



Intended especially for light-grinding, polishing or power requirements. The machine is portable and is furnished with an attaching cord and snap switch, as well as a handle at the top by which it can be conveniently carried. A single-speed wholly inclosed motor is used, with long dust-proof bearings. Rubber cushions or bumpers on the base allow the motor to be set on any surface without danger of marring and holes are also provided for fastening down if desired. The illustration shows the alternating-current motor with the grinding wheel and pulley, but buffing wheels are also furnished. The machine is also furnished for direct current.

Drilling Machine, Heavy-Duty No. 3 Compound Table

Defiance Machine Works, Defiance, Ohio

"American Machinist," April 10, 1919

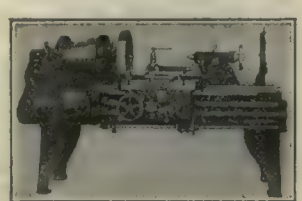


Capacity with high-speed drills in solid steel, 3 in.; length of power feed, 16 in.; diameter of spindle nose, 3½ in.; diameter of spindle drive, 3½ in.; Morse taper in spindle, No. 5; diameter of spindle sleeve, 3½ in.; width of steel rack in sleeve, 2 in.; pitch of steel rack in sleeve, 6; diameter of feed pinion shaft, 3 in.; pitch of feed pinion, 6; width of helical-drive spindle gear, 2½ in.; center of spindle to face of column, 12 in. maximum distance from nose of spindle to top of table, 32 in.; working surface of compound table, 17½ x 35 in.; vertical adjustment of table, 15 in.; feed changes, four, 0.007, 0.012, 0.018, 0.046 in. per spindle revolution; spindle speeds, eight, 51 to 408 r.p.m.; height of machine with compound table, 9 ft. 8¾ in.; horsepower, 10; floor space, 42 x 67 in.; domestic shipping weight, 5300 lb.

Lathe, 14-Inch

Greaves-Klusman Tool Co., Cincinnati, Ohio

"American Machinist," April 10, 1919

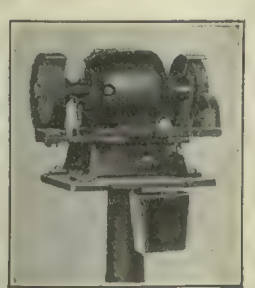


Length of bed, 6 ft. 4⅜ in.; swing over ways, 16½ in.; swing over carriage, 10⅝ in.; distance between centers, 37⅜ in.; front spindle bearing, 2⅜ x 3½ in.; rear spindle bearing, 1 $\frac{15}{16}$ x 2⅜ in.; hole through spindle, 1½ in.; taper centers, Morse No. 3; spindle nose, 2½ in. in diameter and 1⅛ in. long; threads on spindle nose, U. S. S. 6; width of belt with single back gears, 2½ in.; width of belt with double back gears, 2⅜ in.; range of threads cut, 2 to 56; range of feeds, 0.0066 to 0.188 in. per spindle revolution; travel of compound rest, 2½ in.; weight crated, 1700 lb.; weight per extra ft. of bed length, 80 lb.

Grinding Stand, Electric

Janette Manufacturing Co., 617-625 W. Jackson Blvd., Chicago, Ill.

"American Machinist," April 17, 1919



Furnished in either bench or floor type as desired. The machines are identical except for the pedestal and can be furnished for either 110 or 220 volts, d.c., or for 30, 50 or 60 cycles, 110 or 220 volts, a.c. The d.c. motors are of the compound-wound type, of 3500 r.p.m. and ¼ hp. The spindles are made from 90-point carbon steel, hardened and ground to size, and the bearings are of hard-drawn phosphorus bronze or SKF ball bearings. The inner flanges are keyed to the spindle and can be removed if desired. The wheel guards protect the grinding wheels for two-thirds of their circumference. Adjustable grinding rests are furnished and held in position by means of a clamping bolt and a wing nut in a T-slot. They may be removed if desired. The water pot at the front of the machine is detachable. Floor type: Height, 46 in.; width, 14 in.; weight, 105 lb.; wheels, ¾ in. x 5 in. Bench type: Height, 10 in.; width, 14 in.; weight, 55 lb.; wheels, ¾ in. x 5 in.

Welding Apparatus for Alternating Current

Arcwell Corporation, 42 Broadway, New York City

"American Machinist," April 17, 1919



Built for operation on alternating current of any specified voltage or frequency. It differs from the company's standard machine in that it is being put out expressly for the use of smaller machine shops and garages. It will do any work that can be done by the larger machines, but the work cannot be performed as rapidly, the machines being intended expressly for use by concerns who have only occasional welding jobs to perform. The machine weighs approximately 200 lb., and being mounted on casters, it can be moved from one job to another.

Trade Catalogs

Lava for Mechanical and Electrical Purposes. American Lava Co., Chattanooga, Tenn. Booklet; pp. 16; 6 x 9 in.; giving its physical, mechanical and electrical properties together with its use and cost.

The "Ideal" Automatic Governor. Ideal Automatic Governor Co., Inc., Newark, N. J. An 8-page bulletin describing the various styles of automatic governors and control valves put out by this company.

Non-Pulsating Pressure Blower. Eclipse Fuel Engineering Co., Rockford, Ill. Circular describes and illustrates non-pulsating pressure blowers giving tables of various pressures and dimension data on blowers.

The Strong Arm of Industry. A 12-page booklet published by the Electric Hoist Manufacturers' Association, 9 W. 40th St., New York City, giving the types of electric hoists, their capacities and some suggestions for their application. It is illustrated throughout.

Simonds Saw Steel Products in the War. Simonds Manufacturing Co., Fitchburg, Mass. Booklet; Pp. 32; 9 x 12 in.; illustrated; showing how the company closely coöperated with the Government in the production of war materials, such as armor plate, saws, machine knives, etc. The last four pages contain illustrations of some of the company's products.

Introducing the Makers of Diamond Chain. Diamond Chain Manufacturing Co., Indianapolis, Ind., have issued a booklet describing their products which is entitled "Introducing the Makers of Diamond Chains." This booklet has been especially prepared for use for their export trade with a view to give this American product a wider acquaintance among foreign buyers.

"Logan" Air-Operated Labor-Saving Devices. The Logansport Machine Co., Logansport, Ind. General sales agents, Frank G. Payson Co., 9 South Clinton St., Chicago, Ill. Bulletin R-10; pp. 8; 8½ x 11 in. A bulletin which describes and illustrates the "Logan" air-operated two- and three-jaw chuck, also the "Logan" double-acting air cylinder and the "Logan" compensating collet chuck.

New Publications

Industrial Goodwill—By John R. Commons, of the University of Wisconsin. Two hundred and thirteen 5¼ x 8-in. pages; bound in dark-green cloth boards. Published by the McGraw-Hill Book Co., 239 W. 39th St., New York. Price, $2.

This is a review of shop and factory conditions and the relation of employer and employee, as they exist today. It is a book of constructive criticism and upbuilding. Its statements are clear and the whole book will be of interest to those who are watching the trend of events in the industrial field. The various chapter headings, which, by the way, do not adequately convey the subject matter, are: Commodity; Machinery; Goodwill; The Public; Democracy; Solidarity; Theory and Practice; Security; Labor Market; Insurance; Health; The Shop; Education; Loyalty; Personality; Depression; The World. References and index.

Model Making, Including Workshop Practice, Design and Construction of Models. Edited by Raymond F. Yates. Three hundred and ninety 5¼ x 8¼-in. pages. 300 illustrations. Bound in cloth boards. Published by the Norman W. Henley Publishing Co., New York. Price, $3.

The aim of this book, which is a collection of the best articles on model engineering that have appeared in Everyday Engineering Magazine during the past two years, is to create interest in model making and also to help correct the impression of a misinformed public relative to the science it treats. It might be termed a practical treatise for the amateur and professional mechanic, giving instructions on the various processes and operations involved in model making and the actual construction of numerous working models including steam engines, speed boats, guns, locomotives, cranes, etc. Lathe work, pattern work, electroplating, soft and hard soldering, grinding, drilling, etc., are also included.

Steam Engine Troubles.—By H. Hamkins. Two hundred and eighty-four 5 x 7½-in. pages. Illustrated with detailed engravings. Bound in cloth boards. Published by the Norman W. Henley Publishing Co., New York. Price, $2.50.

For a number of years the author has been in the closest touch with steam engines of all sizes, and he has felt that the troubles which an engineer encounters form a large and not unimportant part of his professional life. This consideration has led the author to write this book, a practical treatise for the engineer, telling how to locate and remedy troubles with a steam engine. The book is divided into twenty chapters, the headings of which are as follows: Cylinders, valves, piping and separators, throttle and emergency valves, pistons, frames, bearings, connecting-rods, hook rods, dashpots, governors, releasing gears, wristplates and valve motions, rod ends and bonnets, oilers, receivers, foundations, erecting, valve setting for Corliss engines, and operation.

Catalogs Wanted

The Abbott Engineering Co., New York Mills, N. Y., designers of special machines, tools, jigs, fixtures, dies and gages, wishes to bring its catalog files up to date and in order to do so, would like to receive catalogs from all machine-tool manufacturers.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A firm in Spain desires to purchase turbine for high-pressure turbines, and electrical machinery of all sorts for developing waterfall power in that district. Quotations should be given f.o.b. New York. Payment, cash against documents. Correspondence may be in English. Reference. No. 29179.

A company in France wishes to secure an agency for the sale of metallurgical products, agricultural implements, and machine tools. Correspondence may be in English. References. No. 29182.

The proprietor of a firm in Norway wishes to purchase and secure an agency for the sale of plumbing, ventilating, gas, and steam fitting supplies, asbestos, and magnesia products, iron and steel, metals, heavy hardware, machinery, and electrical apparatus and supplies. Payment to be made through a New York bank. References. No. 29191.

An agency is desired by a man in Italy for the sale of machinery for working metal and wood. Correspondence should be in Italian or French. Reference. No. 29217.

A company in Switzerland desires to purchase and secure an agency for the sale of all kinds of metal products. Correspondence should be in French. References. No. 29201.

An engineering firm in Italy wishes to purchase monophase and triphase motors; direct current motors and dynamos; electric machinery for ships and mines; automatic safety signal devices; electrical measuring and recording instruments; metallic filament light bulbs, for one-half watt; and Diesel motors for industrial and marine use. An agency is also desired for the sale of pig iron; argentina wire or other materials for electrical resistance; special small plates for the construction of motors and transformers; copper wire, diameter 3 to 8 mm. for electrical transmission lines; and copper braid, 6 to 10 mm. in diameter. It is stated that if advisable one of the members of the firm will visit this country in order to furnish additional information. Correspondence should be in Italian or French. References. No. 29205.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago. C. E. Drayer, national secretary, 29 S. La Salle St., Chicago, Ill.

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

The American Supply and Machinery Manufacturers' Association and the National Supply and Machinery Dealers' Association will hold a joint convention at Pittsburgh, Penn.; headquarters, William Penn Hotel.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Association of Manufacturers will hold its convention at the Waldorf Astoria Hotel, New York City, on May 19, 20, 21.

New England Foundrymen's Association will hold its May meeting at Hartford, Conn., on Wednesday, May 21. Fred S. Stockwell, 205 Broadway, Cambridgeport, Mass., is the secretary.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13 with headquarters at Hotel Traymore. C. Wood Walter, secretary, Cincinnati, Ohio. C. E. Hildreth, manager, Worcester, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

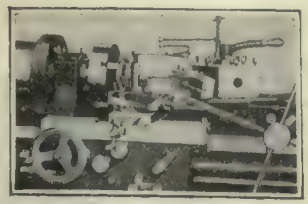
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Turret Attachment for Lathes

Cincinnati Lathe and Tool Co., 3207-3211 North St., Oakley, Cincinnati, Ohio

"American Machinist," April 17, 1919

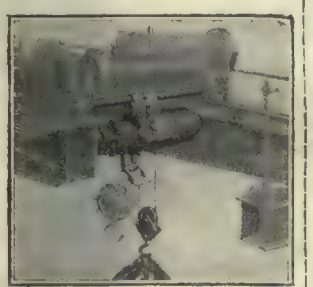


The illustration shows a new attachment that has just been placed on the market for use in connection with this company's regular line of engine lathes. This hexagonal turret is designed for various types of work and is shown machining a bevel gear 5½ in. in diameter, 1¼ in. wide, having a 1⅜-in. x 1½-in. hub, through which a ⅝-in. hole is bored. The lathe shown is supplied with a pan, a pump, a turret toolholder in compound rest, double back gears and hexagonal turret on the bed, together with power-feed.

Hoist, Auxiliary Electric

N. B. Payne Co., 25 Church St., New York City

"American Machinist," April 17, 1919



An auxiliary electric hoist that is intended to be installed on the regular traveling crane for handling light loads. The hoist is made up to suit the requirements of the customer in sizes up to five tons, special hoists of larger size furnished if desired. The hoist does not take any more headroom than the regular crane, does not require an extra trolley, and does not shorten the travel of the trolley on the bridge, nor does it interfere with the accessibility of the main hoist. The advantages claimed are, saving in power over the use of the main hoist and the saving in time required in handling of light loads. The hoist is hung from an axle on the hoist carriage and is equipped with oilless bearings.

Vise, Woodworkers'

Victor Tool Co., Waynesboro, Penn.

"American Machinist," April 17, 1919

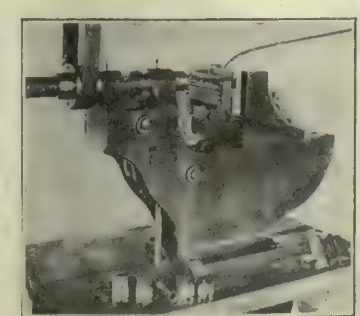


This vise is intended to be a universal woodworkers' and patternmakers' vise. It has smoothly finished jaws, 7 in. x 18 in. with a 15-in. opening. Only 15 parts are used in the vise which weighs 75 lb. The figures show some of the many uses and the arrangements of parts. Fig. 1 shows vise in position for work above bench level; Fig. 2, an inclined position for irregularly shaped work; Fig. 3, holding-dogs for thin wood; Fig. 4, metal-holding jaws; Fig. 5, setting for wedge-shaped work; Fig. 6, tilt or angle jaw in position.

Tube-End Spinning Machine

Grant Manufacturing and Machine Co., Bridgeport, Conn.

"American Machinist," April 17, 1919

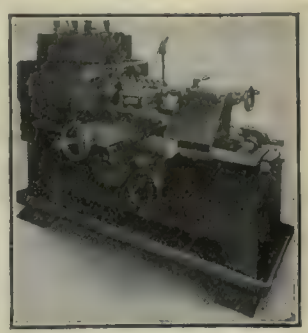


For flanging the ends of brass and copper tubing, such as used for connecting brass or copper pipes to carbureters and oilers for automobiles, aircraft engines, motor boats, or copper coils for hot-water heaters. A quick hand-clamping arrangement is attached to the table or knee of the machine for holding the tubing. Will flange tubing up to and including 1 in. in diameter, and the output from the machine will depend entirely upon the operator, as it requires only a second's time to form a perfect flange on the end of the tubing.

Relieving Machine, Universal "Hack"

American Machine Tool Engineering Works, Chicago, Ill.

"American Machinist," April 17, 1919

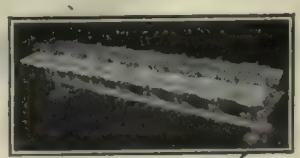


The machine is made with capacities of 6, 10 and 16 in., and is said to be of very massive and rigid construction. There are two sets of ways, one upon which the head and tailstocks are aligned, while the second set is used in connection with the first set to carry the carriage. The second set of ways is also used for aligning the side-relieving attachment. The lead screw is located in the center of the rear set of ways. Speed changes are obtained by sliding gears controlled by five levers, the gearing running in a bath of oil to insure proper lubrication. Specifications for 16-in. machine: Weight, 8000 lb.; capacity, cutters 14 in. in diameter up to 16 in. long; speeds, 9; diametral pitch of teeth in bull gears, 4.

Washbowls

Manufacturing Equipment and Engineering Co., Framingham, Mass.

"American Machinist," April 17, 1919



These washbowl sets have a common water-supply, common waste, and common vent, each bowl being trapped and vented. The bowls are furnished in either single or double batteries as the user may desire. The illustration shows a double battery, there being a row on each side of the middle line of the structure. Each pair of bowls is trapped into an upright pipe which in turn connects vertically with the common vent that is formed by the large pipe at the top of the apparatus, this being supported by hollow cast-iron pipes extending from the top to the bottom flanged feet of the apparatus. There is a hollow upright casting for each set of two bowls, each casting being one piece with two traps, one on each side, extending below the waste or bottom pipe in the apparatus. The bowls shown are piped for hot and cold water but can be furnished for water of one temperature if desired. They are made with plain cast-iron, galvanized-iron or vitrified porcelain enameled bowls, and are shipped completely assembled.

Drilling Machine, Single- and Multiple-Spindle, Sensitive

Edlund Machinery Co., Inc., Cortland, N. Y.

"American Machinist," April 17, 1919

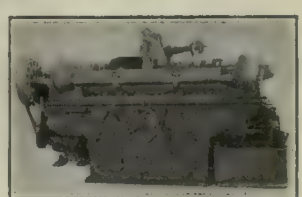


Maximum distance from spindle nose to table, 32½ in.; diameter of spindle, ¾ in.; diameter of spindle nose, 1⅝ in.; taper in spindle, Morse No. 2; vertical traverse of spindle, 6½ in.; vertical traverse of arm, 9½ in.; vertical traverse of table, 16½ in.; diameter of drive pulley, 9 in.; width of drive belt, 1⅝ in.; width of spindle belt, 1¼ in.; face of column to center of spindle, 8 in.; distance between spindles on multiple machine, 9½ in.; working surface of table, 14⅜ in. x 16, 25½, 35, 44½, 54, or 63½ in. in length for one- to six-spindle machines respectively; outside dimensions of table, 19 in. x 21, 30½, 40, 49½, 59, or 68½ in. for one- to six-spindle machines respectively; weight, 825, 1100, 1400, 1850, 2400, or 2750 lb. for one- to six-spindle machines respectively.

Crankshaft Grinding Machine, Self-Contained

Landis Tool Co., Waynesboro, Penn.

"American Machinist," April 24, 1919



For crankpin grinding on airplane, automobile and other gas-engine crankshafts. No offset centers are required, the work being held in adjustable holders located at both ends, driven from both ends, the two crankheads being geared together while the different throws are obtained by means of a sliding adjustment of crank-carrying fixtures which are mounted on the ends of the crankhead spindles. For multiple-throw crankshafts in which two or more pins must be ground in exact relation with one another, one of the carrying fixtures is provided with a gaging block, made to suit the throw-angles of the crankshaft. A special feature of the machine is the method of mounting the counterweights which are fastened to each side of the spindle gear between the spindle bearings. It is claimed that this construction reduces the overhang of the spindle to a minimum and places the counterweights for the work in such a position that they will not influence the end of the spindle.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by the Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$30.75
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	26.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH- INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅛-in. plates the extra is 30c. per 100 lb.
Note—For less than carload lots add 40c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.50	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	6.97	7.25	6.17	7.185	6.27	7.25

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
3/16, 11/32, 1/4, 1/32, 5/16 No. 8, 3/32 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14.00
5/32		1/4 by 19 in. long	12.00
No. 12		5/16 by 19 in. long	10.00
7/32, No. 14 and 1/8		3/8 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		3/16	33.00
		11/32	30.00
Domestic 20c. for 1/16, 15c. for 1/8 to 1/4.		5/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4 c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4, and 3/8	50½%	24%	3/4 to 1½	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	3/4 to 1½	39½%	24½%
1/2	51½%	39%			
3/4 to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
3/8 to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.25	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	4.70	5.25	7.00
Spelter	6.37½	6.55	7.90
ST. LOUIS			
Lead	4.95	5.00	6.80
Spelter	6.02½	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	22.50	22.50–31	50–33	23.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	23.00	34.00	22.00	31.00
Brass sheets	18.75	23.75–28	30.75	23.00	30.00	21.50	30.00
Brass pipe	28.00	34.00–37	36.50	30.00	41.00	31.00	40.00
Solder (half and half) (case lots)	46.50	46.50–41	62.00	43.00	41.25	39.00	55.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

May 15, 1919 American Machinist Vol. 50, No. 20



How the Reed Vise is Made

By J. V. Hunter

The machinist's bench vise is so common an implement that it is often treated with anything but respect, and it must be sturdy enough to withstand such treatment and at the same time be capable of perfect work under the hands of the expert. If careful planning, modern machinery and attractive surroundings are of use in improving a product, the vise described and illustrated should be successful.

THE old bench vise was essentially two heavy cast-iron blocks which were ground, filed and hand fitted until they worked together in a more or less satisfactory manner. In case of breakage neither part could be replaced because standardization was unheard of. The careful machining operations used in the production of the vises made by the Reed Manufacturing Co., Erie, Penn., indicate the development of their manufacture with a view to obtaining interchangeability of parts and at the same time including the idea that the better a piece is made the better care it will receive throughout its life.

Upon delivery to the shop from the foundry the castings are placed in box trucks, Fig. 1, to reduce the amount of handling. The shop has built all its own trucks and their wheel bearings and it uses hundreds of them, but enough are always on hand so that the workman after putting the parts through a machine operation can drop them immediately into a waiting empty truck to be transported to the next process.

The first machine operation on a vise body is that of broaching the hole for the sliding-arm, for which a La Pointe broaching machine is used, which eliminates all of the old hand clipping and filing on this part and insures a true bearing surface at every point. The vise body is laid on blocks before the head of the broaching machine, Fig. 2, and finished in a single operation.

The main nut for the vise-jaw screw which fits in the base of the body is located in a close-fitting dovetailed slot milled out by the special device shown in Fig. 3. This is built on a milling machine and consists of a



FIG. 1. TRUCKS USED FOR HANDLING PARTS

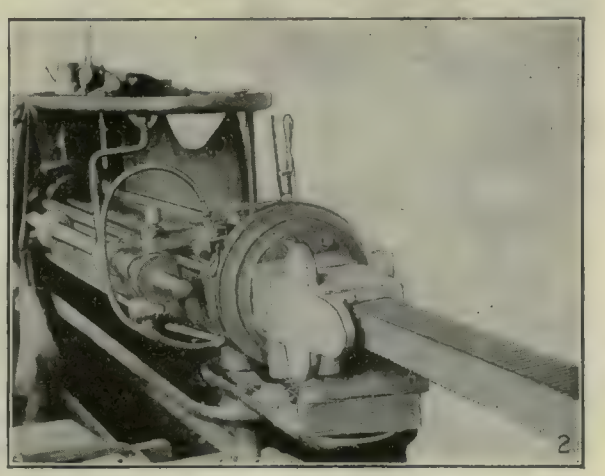


FIG. 2. BROACHING THE VISE BODY

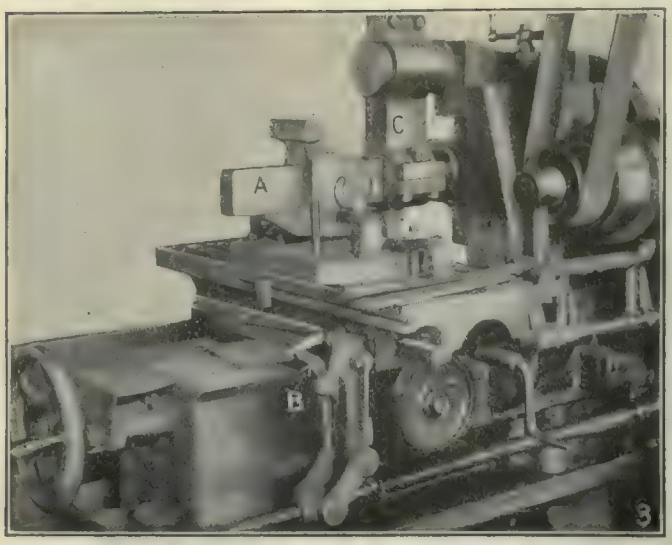


FIG. 3. DEVICE FOR MILLING DOVETAIL SLOT

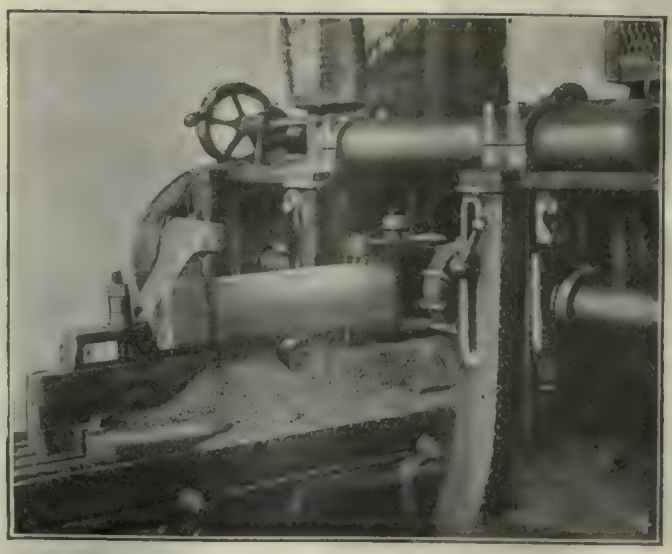


FIG. 4. MILLING SIDES OF THE SLIDING-ARM

large square arbor *A* which fits through the hole in the body of the vise. On the lower face of this arbor is a small milling cutter driven by suitable gearing from the spindle of the milling machine. The cutter is advanced into the work by the feed of the table until it reaches a point where the finger *B* of the automatic tripping device falls into place and stops the cut. It will be seen that the square arbor *A* is supported by a heavy arm *C* which hangs from the overhead arm of the milling machine. This arm carries all of the weight of the arbor, so that none will fall on the spindle which drives the milling cutter.

The square sides of the arm of the sliding-vise jaw are carefully milled to finish in one cut on a double-end milling machine, Fig. 4, fitted with cutters with inserted high-speed steel teeth. The two sides of the arm are finished first, and the arm is then moved to a second machine of similar character where the two edges are milled.

The end of the jaw which holds the head of the clamping screw is milled with a triplex cutter to finish three surfaces simultaneously. For this, Fig. 5, the sliding jaw is mounted in a fixture on a milling-machine table directly in line with the spindle. This cut cleans out the hole for the screw with the cutter *A* and finishes the inside bearing surface *B* by means of an end-mill cutter which is not visible. The large outside cutter *C* finishes the edge of the shield which protects the screw-head bearing from chips and dirt.

A series of drilling processes on the base of the main vise body are conducted on a gang-drilling machine which is handled by a single operator who passes the body successively through the three operations. In the first of these at *A*, Fig. 6, the body is held on a wedge block so that the drill may enter at the required angle; for the second the body is slipped on a square mandrel *B*, a drill-jig plate with aligning lugs serving as a guide while the large bolt holes are drilled in the base, and the third it is held on a square mandrel *C* while the third spindle of the gang drill performs its work.

The preceding methods will practically complete the parts of the plain vise for assembly, and these are now fitted together before the subsequent finishing operations of milling the jaws, the first of which, Fig. 7, is performed on a milling machine carrying on its spindle the two inserted-tooth cutters *A*, which finish the ends of the jaws to length.

Carbon steel is used for the inserts of these milling cutters because the jaws of these vises are formed of tool-steel plates which are cast in place. These plates

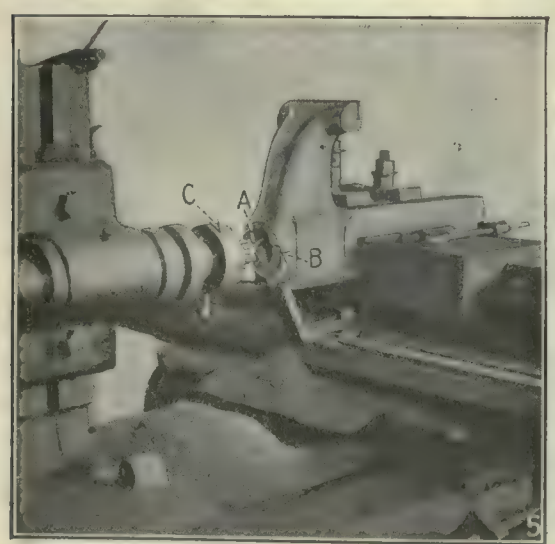


FIG. 5. COUNTERBORING END OF JAW

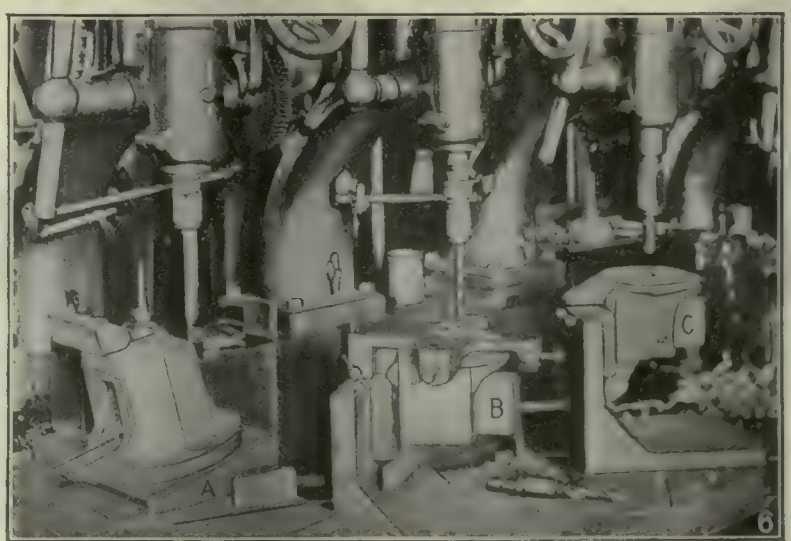


FIG. 6. DRILLING THE BASE

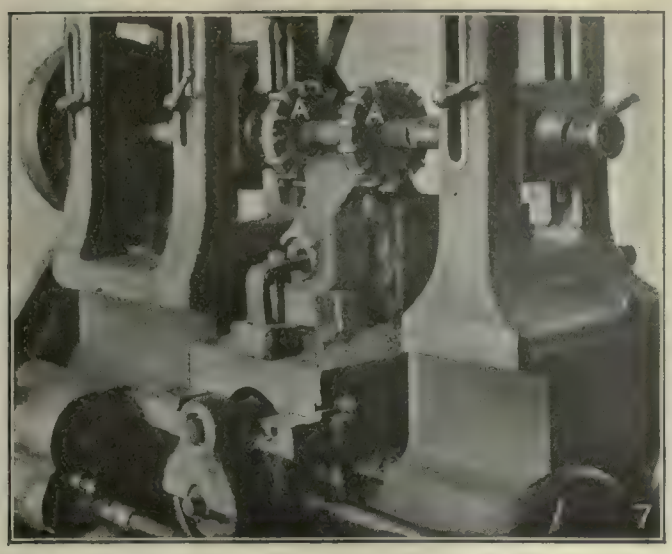


FIG. 7. MILLING THE JAW ENDS

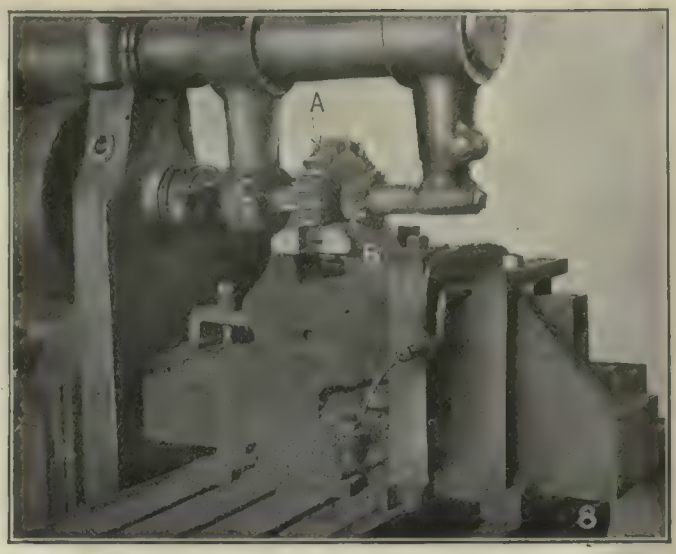


FIG. 8. MILLING THE JAW FACES AND TOPS

may act as chills on this portion of the casting and form hard spots. The result is rather destructive to milling cutters and it has been the experience of the Reed plant that it is better economy to use cheaper carbon-steel inserts and run at a slower speed than to pay for the replacement of high-speed steel inserts, which would be broken by contact with these hard spots.

The inside faces of the jaws are finished true and parallel by the milling cutter *A*, Fig. 8, and at the same time the form mills *B* and *C* finish the top surface of the jaws to a uniform contour. It will be noticed that the blades of the main milling cutter *A* are arranged to cut alternately on the left- and right-hand jaws and thus they are still useful when they have been worn and ground shorter than the thickness of the body of the cutter.

In the production of the swivel-jaw, swivel-base vise the milling-machine fixture, Fig. 9, mounted on the rotating table is used for machining the base to the correct radius to fit that of the swivel jaw. The swivel base *A* previously broached for the sliding-jaw arm is mounted on the rectangular mandrel *B*. The first point milled *C* is cut by the three faces *D*, *E* and *F* of the milling cutter. On the completion of this cut the spindle is raised and the table is moved sufficiently to bring the work in line for the cut shown. When lowering the milling-cutter spindle to the correct depth for making this cut it is gaged for position by means of plugs which are inserted between the finished surfaces of stop lugs that are attached to the spindle head and to the frame of the machine at the point *G*. This arrangement is further detailed in Fig. 10, which shows the moving stop lug *A* on the spindle head and the stationary stop lug *B* which is attached to the frame of the milling machine. By the insertion of different lengths of plugs *C* between these two stops it

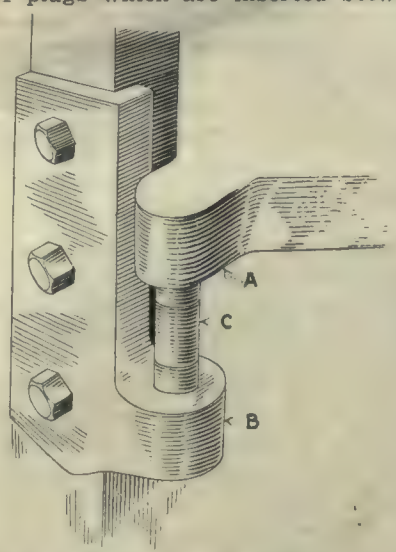


FIG. 10. STOP LUGS AND BLOCKS FOR HEIGHT ADJUSTMENT

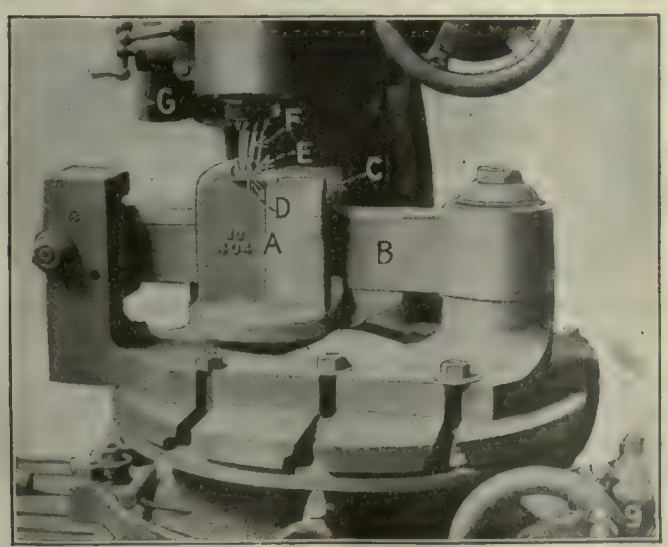


FIG. 9. MILLING THE SEAT FOR A SWIVEL JAW

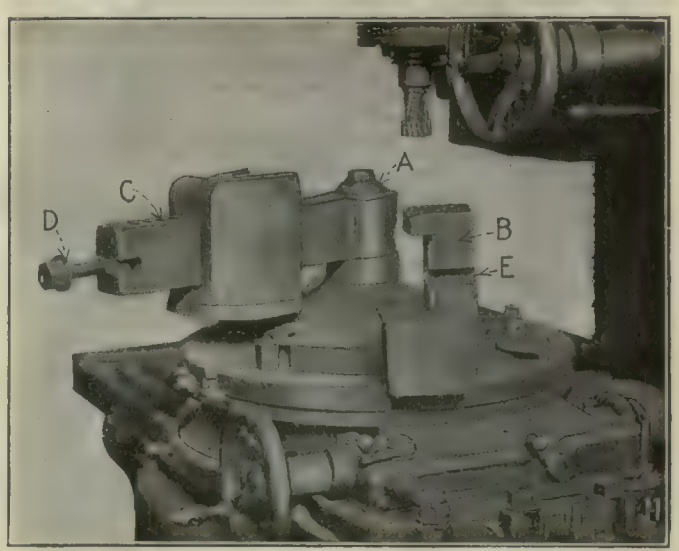


FIG. 11. FIXTURE FOR MILLING BODY OF SWIVEL JAW

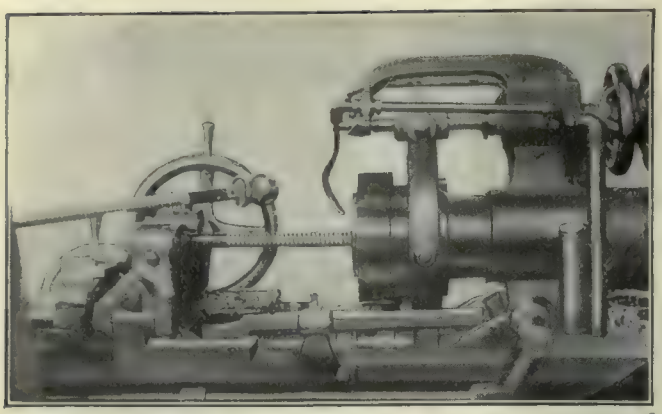


FIG. 12. CUTTING THE SCREWS

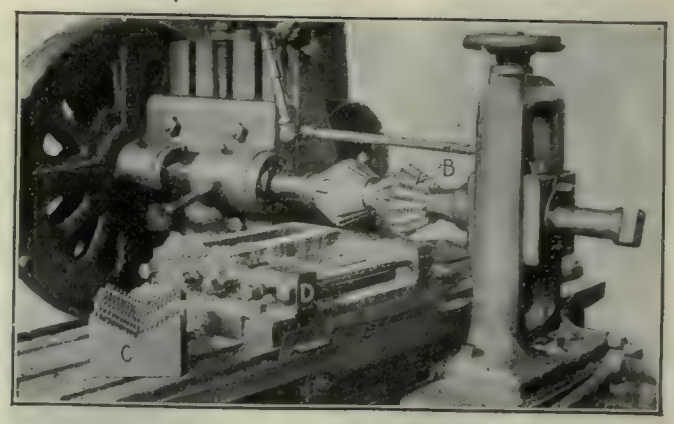


FIG. 14. MILLING PIPE JAWS

is possible to bring the spindle head down repeatedly to any predetermined depth of cut. This arrangement is used both on the spindle head and on the movement of the table when positioning it for making the two cuts.

The arrangement for holding the swivel body on the square mandrel and its quick removal from this fixture is shown in Fig. 11. This arbor, which is swiveled at the end *A*, is swung out from the locking block *B* for placing the vise body, and has a number of holes *C* in its upper face in which plugs may be inserted for stops for different styles for vise bodies. The arbor is swung back under the locking block *B* and clamped into position for the machining by swinging the eyebolt *D* into the slot *E*.

Cutting the Threads

The operation of cutting the modified square thread on the screws for these vises is performed on a standard bolt cutter, Fig. 12, in two cuts, a rough and a finishing cut being used to insure the completion of a satisfactory thread.

Mention has previously been made of the slot milled in the base of the body of the vise for receiving the main nut. The base of this nut is also milled to limits which insure interchangeability in a special fixture, Fig. 13, which holds four nuts at a time. The fixture, as shown, has two nuts in position at the rear, while the front is empty, and one of the nuts is shown at *A*. A combination milling cutter *B* is used, which faces off the bottom of the nut with the large inserted tooth cutter, while the solid bevel section finishes the sloping side. There are two sets of these cutters to cut simultaneously on both sides of the holding fixture. After the nut has been through for the first cut it is turned over and placed on the other side of the fixture for the second cut. It will be observed that a round mandrel *C* is placed through the tapped hole in the nut in order to line it up with the base.

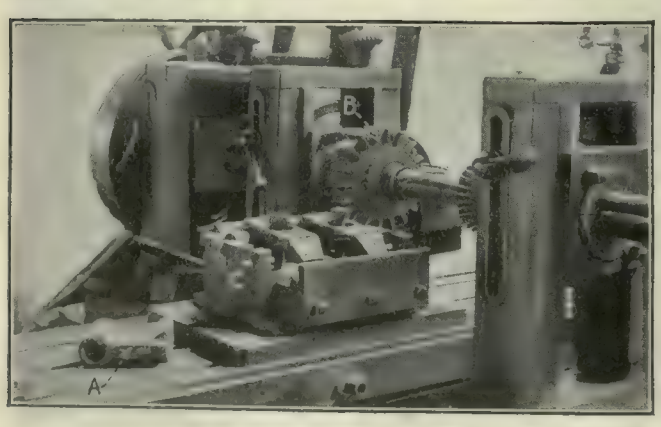


FIG. 13. FINISHING BASES OF THE UNITS

The combination vises are fitted with pipe-holding jaws made of tool steel. These pieces are sheared from the bar, and after being squared up they are put through a milling operation, Fig. 14, for making the V-notch. The milling-machine spindle carries two cutters, the first for roughing out the V-notch, the other cutter *B* for milling the serrations in the blocks. The results are shown at *C*. A plain clamping fixture *D* is used, which is loaded on both sides so that as fast as the pieces are through the first operation they are transferred for finishing by the second operation. The same fixture is used for both the long and short jaws, parallel blocks being put in its base for raising the short blocks the required height to meet the cutter.

Typical Metal Fittings at Aëronautical Exhibition

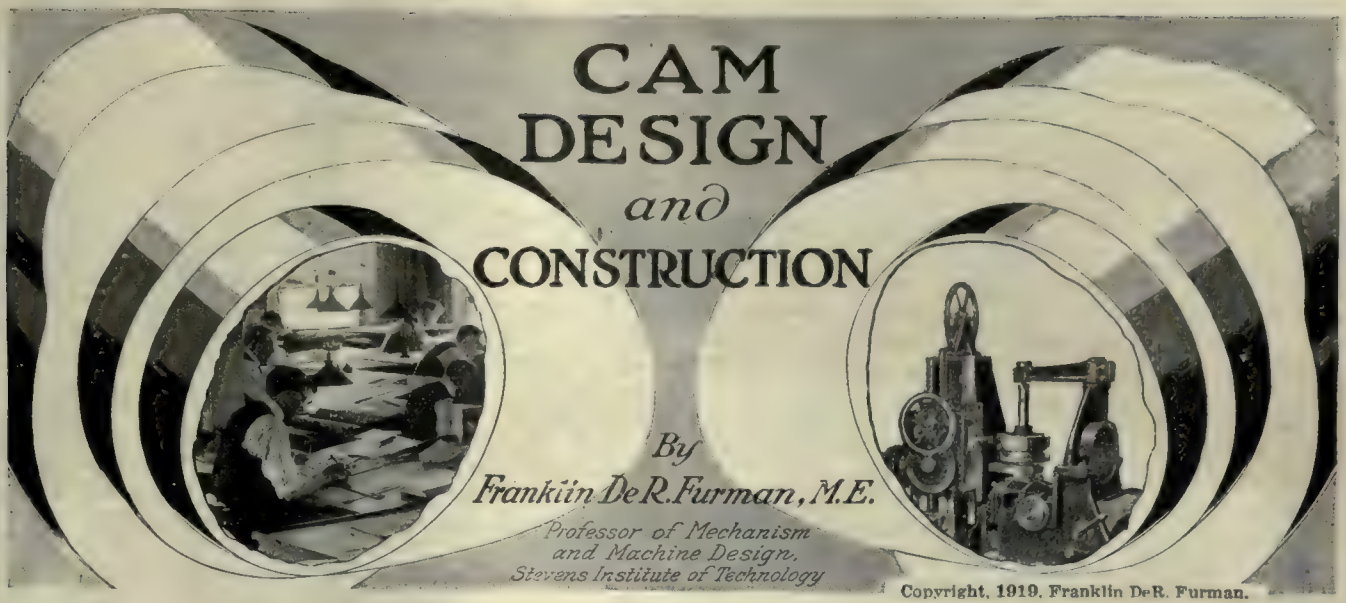
By Arthur H. Morse*

After examining the sketches of "Typical Metal Fittings" on page 712 of the *American Machinist* one is tempted to exclaim *Sutor ne supra crepidam!* or words to that effect, for the artist seems to have misconceived the structure of the parts which he has tried to represent.

In the illustration of the landing gear of the Thomas-Morse scout the label enlightens us as to the presence of a "rubber band." This however could not possibly be of any use because the tube or axle saddle (through which the axle fits after it is assembled) appears to intersect the bent tube which connects the struts and would certainly cut it in two unless all the parts were welded into one. Moreover the slotted bracket, which is intended to act as a guide to the axle saddle when making a landing, is shown with a slot very much less in width than the diameter of the axle saddle, so it could serve no purpose whatever.

But the principal error is in showing the struts with their stream-line sections turned in opposite directions, with their trailing edges toward each other. The sketch of the Thomas-Morse strut socket is also incorrect and misleading.

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IV. Various Types of Cams

The current installment deals, first, with multi-step cams in such a way that the greatest pressure angle on the entire cam and the maximum pressure angle on each step may be known in advance; second, the offset cam-roller follower, in which the pressure angle is largest when the follower is at rest and smallest when the follower is in motion on one of its strokes; third, the radial cam, with offset mushroom follower, in which there is a peculiar combination of sliding and rolling action, a special path of action, a minimum size for the mushroom disk and a characteristic pressure angle.

PROBLEM 5. Required a double-step radial cam in which the center of the follower roller moves in a radial line, the maximum pressure angle to be 30 deg. and the follower to move: (a) Up 4 units in $\frac{1}{8}$ revolution on the crank curve; (b) at rest for $\frac{1}{4}$ revolution; (c) up 4 units in $\frac{1}{8}$ revolution on the parabola curve; (d) down 2 units in $\frac{1}{8}$ revolution on the elliptical curve; (e) at rest for $\frac{1}{8}$ revolution; (f) down 6 units in $\frac{1}{4}$ revolution on the parabola curve. In Problem 3 there were only two motion assignments, (a) and (b), in the data, and they were the same except for direction. Consequently only one computation was necessary. When two or more dissimilar assignments are made in the data, as in the present problem, it is advisable to make a computation for the length of the chart diagram for each motion specification as follows:

(a) $4 \times 2.72 \times 8 = 87.04$, which is the length of chart and of the pitch circle circumference = 13.86 pitch circle radius.

(c) $4 \times 3.46 \times 8 = 110.72$, which is the length of chart and pitch circle circumference = 17.62 pitch circle radius.

(d) $2 \times 3.95 \times 8 = 63.20$, which is the length of chart and pitch circle circumference = 10.06 pitch circle radius.

(f) $6 \times 3.46 \times 4 = 83.04$, which is the length of chart and pitch circle circumference = 13.22 pitch circle radius.

The cam factors, 2.72, 3.46 and 3.95 are taken from the Table of Factors, which is here repeated from Article II.

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of f 20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion'
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

Inasmuch as there is a different length of chart and a different pitch line for each item in the data one cannot tell which pitch line to take without some preliminary construction and computation. For this purpose a chart diagram is well adapted as follows: Construct a rectangle, Fig. 39, with a height AT equal to the total motion of the follower in one direction, 8 units in this case. Make the length AA' of rectangle any convenient value entirely independent of any of the

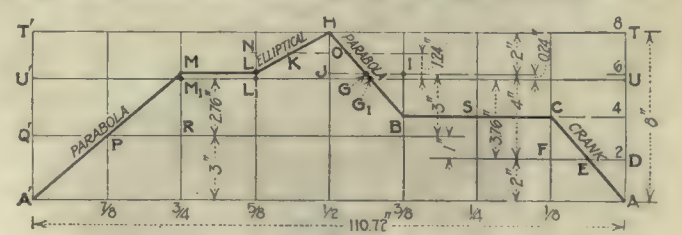


FIG. 39. PROBLEM 5, CAM-CHART DIAGRAM FOR DOUBLE-STEP CAM

values computed above and label this according to the longest chart length as computed above. Lay off straight lines to represent the component parts of the base curve as assigned in the data and label them as shown at AC, CB, BH, etc. Draw the several pitch lines as at FD, JI, etc.

For general procedure consider the pitch line which passes through the point calling for the longest chart length. This will be the pitch line JI passing through G, Fig. 39, which calls for a chart length of 110.72 and a pitch radius of 17.62. If G is to be at a radius of 17.62 in the cam, E will be at a radius of 17.62

— 4 = 13.62. But from computation (a) it is seen that E must be at a radius of 13.86. Therefore if the radius of cam pitch circle is retained at 17.62, the trial pitch line JI on the chart diagram will have to be lowered 13.86 — 13.62 = 0.24, giving the new pitch line UU'. If the line UU' now becomes the pitch circle

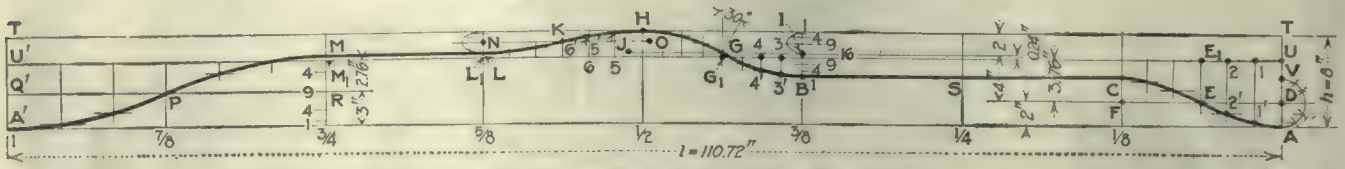


FIG. 40. PROBLEM 5, CAM CHART

the point E will be at 17.62. — 3.76 = 13.86, just as called for in computation (a), and the pressure angle will be 30 deg. at the point E on the cam.

The other critical points at P and K must also be tested with respect to the proposed pitch line UU'. With this pitch line the point P will be 2.76 inside of the pitch circle, or at a radius of 17.62 — 2.76 = 14.86. This is safe, as the computed radius for P was only 13.22 according to item (f). The point K is also safe, for it will be at a radius of 17.62 + 1.24 = 17.86, whereas a radius of only 10.06 is required.

The cam may now be drawn by constructing the true cam chart, as in Fig. 40, which is lettered the same as Fig. 39, and plotting the cam from it, as in Fig. 41. The pitch line UU' of Fig. 40 becomes the pitch

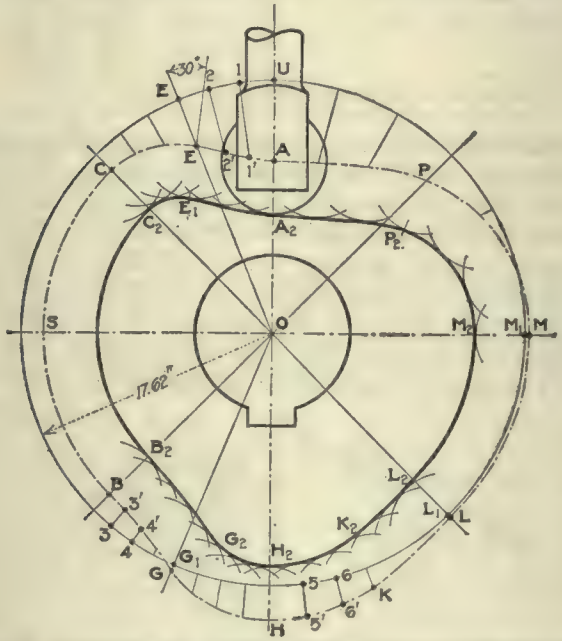


FIG. 41. PROBLEM 5, DOUBLE-STEP CAM CONSTRUCTED FROM CAM CHART

circle, having a radius OU, Fig. 41, and the ordinates of Fig. 40 become the radial measuring lines, Fig. 41; or the cam may be drawn directly, without the use of a cam chart, as indicated in Fig. 42, where the pitch circle OU' is first drawn with a radius of 17.62. The assigned angles are then laid down and the several pitch curves, such as $A'EC$, are constructed at the proper radial distances as determined in Fig. 39 and as illustrated for one case at EE_1 (3.76) in Fig. 42.

Determination of maximum pressure angle for each of the curves making up a multiple-step cam—If it is desired to know the exact pressure angle at P, Fig. 41, it may be readily determined by making the value of r = (17.2 — 2.76) = 14.86 in the formula, $r = 0.159 \frac{hf}{e}$ and solving for f,

$$f = \frac{14.86}{0.159 \times 6 \times 4} = 3.89.$$

Consulting the chart of cam factors in Fig. 21, Article II, it is found that a factor of 3.89, when applied to the parabola chart curve, shows a cam pressure angle of about 27 deg., which is under the assigned limit, and therefore need not be further considered. In a

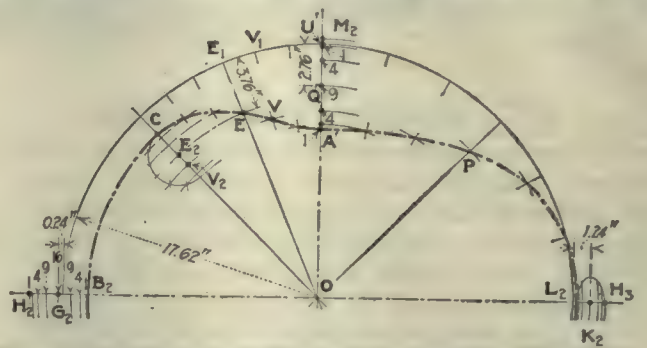


FIG. 42. PROBLEM 5, DOUBLE-STEP CAM CONSTRUCTED WITHOUT USE OF CAM CHART

similar manner the pressure angles at G and K on the cam may be computed, the former being slightly under 30 deg. and the latter less than 20 deg.

Cam With Offset Roller Follower

Problem 6. Required a single-step radial periphery cam in which the center of the follower roller moves forth and back in a straight line which does not pass through the center of rotation of the cam. The maximum pressure angle when the follower is at the bottom of its stroke is to be 30 deg., and the follower is to move: (a) Up 3 units in 90 deg. on the parabola curve; (b) down 3 units in 90 deg. on the parabola curve; (c) and to remain at rest for 180 deg.

Problems of this nature are totally different, both in pressure-angle action and in methods of construction, from the preceding ones. As may be noted in the data it is required that the pressure angle, when the follower is at rest at the bottom of its stroke, shall be 30 deg. It will appear presently that the pressure angle, when the follower is in motion, may be zero or even negative on one of the strokes in this form of cam. It will also be shown that the maximum pressure angle during the follower motion cannot be assigned in advance and obtained in any practical manner. From the above it follows that the offset radial cam has a peculiar advantage in keeping considerable side pressure off the follower guides during the time that the follower is moving in one direction, although at the bottom of the stroke the pressure angle may have any desired value, and during the period of motion in the opposite direction the pressure angle will reach a maximum value

much larger than the assigned angle at the bottom of the stroke.

The method of construction for the offset roller cam is illustrated in Fig. 43. Simply as a guide the diameter of the pitch circle *UF'ST* may be computed as before by the formula $d = 114.6 \frac{hf}{b}$. It will be found to be 13.22 units as shown at *TY*. An angle equal to the assigned pressure angle is then laid off at *UOU'*, *UO* being parallel to the direction of motion of the follower. Draw a line *DW* parallel to *UO* and so located that it has an intercept *DA* between the pitch circle and the inclined line *OU'*, equal to one-half of the follower motion. This may be done as follows: Lay off *OZ* equal to one-half the travel of the follower. With *Z* as a center and *OU* as a radius draw a short arc intersecting *OU'* at *A*. Draw a vertical line through *A*. The point *A* will then be the lowest point of the stroke, *D* will be the center of the stroke, and *WO* the radius of the "construction circle." The distance *AV* is equal to the assigned 3 units of motion, and the divisions *1, 4, 9* . . . are made according to the requirements of the parabola curve. The assigned 90 deg. is laid off on the construction circle at *WF* and divided into a number of equal arcs at *H, I, J* . . . corresponding to the number of divisions at *AV*, eight being used in the present example. Tangents to the construction circle, such as HH_1, II_1, JJ_1 . . . are then drawn at *H, I, J* . . . and the distances *W1, W4, W9* . . . laid off on these tangents, thus giving the points $H_1I_1J_1$ . . . on the pitch surface of the cam. Or these latter points may be obtained by swinging arcs through *1, 4, 9* . . . about *O* as a center until they meet the respective tangents at H_1, I_1, J_1. . . .

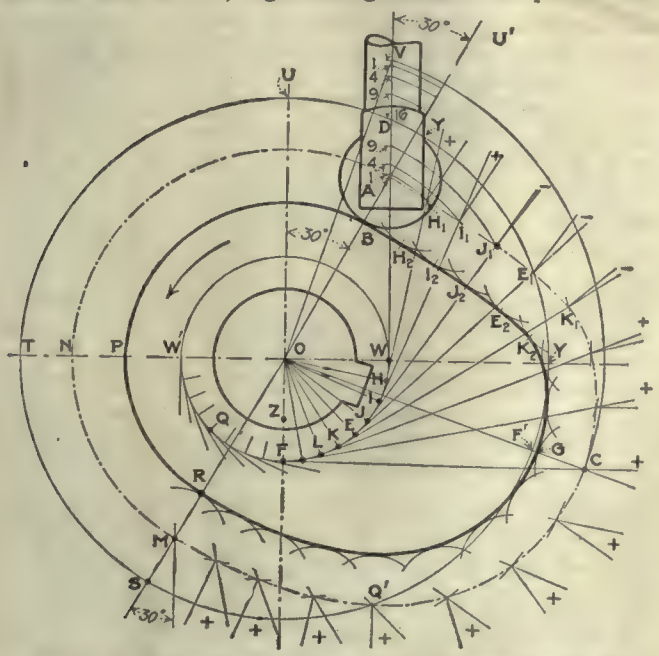


FIG. 43. PROBLEM 6, CAM WITH OFFSET ROLLER FOLLOWER

An examination of the pressure angles for a cam with an offset follower shows that during the up stroke the pressure angles are very small, being, in fact, negative from J_1 to K_1, Fig. 43, and, when measured, the average pressure angle for the working or up stroke is between 6 and 7 deg. in this problem although on the down or return stroke it reaches an average of between 37 and 38 deg. and a maximum of 46 deg. near *Q'*. In this class of problem the computation for diameter of pitch circle serves merely as a guide in determining a size that will give a small cam and a small average pressure angle on the working stroke. If the diameter of the pitch circle is arbitrarily taken either larger or smaller than the value, as above computed, or if other base curves are used, the negative pressure angles at J_1, E_1, and K_1 may disappear entirely, which would be an advantage where it is desired to have pressure on the follower guides on one side only.

It has doubtless been observed that there is a decided lack of symmetry in this form of cam even though the data are similar for both strokes of the follower. This is illustrated in Fig. 43, where the portion *AC* of the pitch surface for the outstroke is quite different from the portion *CM*. It is also characteristic of this form of cam that the pitch and working curves each embrace either a smaller or a larger angle than the assigned angle for a given stroke of the follower, as shown by the angle *AOC* being less, and the angle *COM* being greater, than the assigned 90 deg. This of course is due to the fact that when *C* has traveled 90 deg. to *V* the line *OC* will have passed the original zero line *OA* of the pitch curve and will be in the position *OV*. Therefore the cam angle for one stroke of the follower will be less than the assigned angle by the amount of the angle included by *VOA;* for the other stroke it will be greater than the assigned angle by the same amount.

Radial Cam With Offset Mushroom Follower Disk

Problem 7. Required a radial periphery cam to operate an offset follower which has a flat circular disk surface instead of a roller. The follower to move: (a) up 3 units in 90 deg. on the parabola base; (b) down 3 units in 90 deg. on the parabola base; (c) at rest for 180 deg. Followers of this type may be offset without any change in the general method of construction. In this problem the follower will be offset as shown in the side and top views in Fig. 44, where the center line *N"Y"* of the follower spindle is set the distance *P"O"* in front of the center of the cam plate. In this case there will be a part sliding and part rolling of the cam on the follower and the follower will turn about its own axis N"Y" as it is being raised and lowered. When the follower is not offset, i.e., when the center line *O"N"* is placed in line with *M"P"*, the action will be all sliding and there will be no turning of the follower spindle on its axis. In this case there will be localized wear on the follower, while in the former case the wear will be more widely distributed over the follower surface. In both cases the construction is the same and is explained in the following paragraph.

In cam followers having flat surfaces perpendicular to the line of action the line of pressure is *M"Q"* and is parallel to the line of action of the follower instead of being inclined to it as in the case of cams having roller followers. Because of this characteristic action the ordinary pressure-angle factors do not apply in cams of this class in computing or obtaining the diameter of the pitch circle *DFST*, and this circle may be assumed. In some cases a fair guide for the size of this circle may be obtained by using the regular formula $d = 114.6 \frac{hf}{b}$ for diameter of pitch circle, assuming the

30 deg. pressure-angle factor. Solving, r is found to equal 6.61, and is laid off at O D. The assigned three units of motion are then laid off, one-half on each side of D, as at A and V. The assigned 90 deg. are next laid off at AOF and divided into the desired number of construction parts, four being used in this case, as at OD_1, OD_2. . . . The distance AV is also divided into four parts, AH and VK being each equal to 1 unit and HD and KD equal to 3 units. Only four divisions are taken in this case to avoid confusion of lines in the illustration, but in student problems 6 or 8 points should be taken, and in practical work 12 to 24 divisions should be used. The first division point H is now revolved to meet the first radial division line OD_1, thus giving the point H_1, where a line H_1E is drawn perpendicular to H_1O. This line H_1E represents the bottom of the follower disk AC with reference to the cam when the cam has turned through the angle AOH_1. The points D_2 and K_1 are obtained in the same manner as was H_1 and corresponding perpendiculars are drawn, as at D_2D_4 and K_1K_2. As smooth a curve as possible is now drawn tangent to these perpendiculars and the points of tangency marked as at H_2, D_4 and K_2. This smooth curve AG is the working surface of the cam.

The size of the follower must also be determined. The most satisfactory way of doing this is to find the locus, or path, of the line of contact between the periphery of the cam and the follower disk. This is obtained by considering that when H_1 is at H the point of tangency H_2 is at H_2, the length HH_2 being equal to H_1H_2. Likewise when D_2 is at D, D_4 is at D_2, and the same for the other points of tangency. The dash-line curve through the points $AH_2D_2K_2$ . . . is the locus of contact between the cam and the follower. The point L is the extreme point of this curve, and if the follower were not offset, the length of an ordinary toe or flat extension of the follower would have to be at least equal to $N'X'$. If the follower is offset, say by the amount $N'M'$ $(= N''M'')$, the radius of the disk will have to be at least equal to N' L', and the extreme line of contact will be $L'J'$. The other extreme line of contact will be a similar line through L''', and the area of the flat disk which will be subject to wear will be the annular surface between the periphery and the dash-line circle whose radius is $N'A'$. As to the wear on the cam itself there would be pure sliding of the curved surface AG on the flat surface AX if the follower were not offset. With an offset follower there is an effective turning radius equal to the offset $N'M'$ tending to rotate the follower about its axis $N''Y''$, and this changes the action of the cam on the follower entirely by causing part rolling and part sliding.

The presure angle in this form of cam must be considered differently from cams which operate against rollers. In roller-follower cams it is the angle between the normal to the cam pitch surface and the line of action of the follower that determines the side pressure on the bearings, whereas in flat surface followers it is the distance that the line of contact is away from the line of action that determines it. This distance varies constantly, and in the illustration in Fig. 44 the limits of variation are $M'N'$ and $Q'N'$. These are in reality lever arms on which the pressure acts to produce a turning moment, which must be resisted by the follower guides. Since there can be no pure rolling action between the cam and the follower in constructions of this type there is nothing to be gained in this particular by a large offset. On the contrary, there is much to be lost due to the large bending moment that would be set up in the follower rod. A fair guide as to the offset would be to keep the angle formed by the center line $Y''O''$ of the follower motion and the line $Y''M''$ or $Y''Q''$ joining the center of the bearing with the midpoint of the line of contact to within say 30 deg. or any other maximum value that circumstance might warrant. The angle here defined might be termed the pressure angle in this type of cam. The minimum pressure angle $N''Y''M''$ is seen in its true size. The pressure angle at the top of the stroke is shown at $U''Y''Q''$.

Limited use of cams with flat surface followers—Cams with followers of this type are not well adapted in

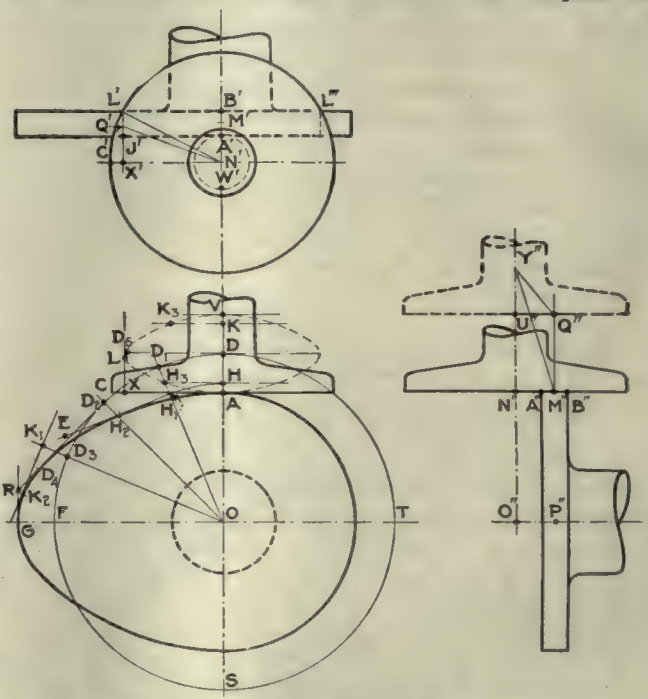


FIG. 44. PROBLEM 7. CAM WITH FLAT SURFACE FOLLOWER—MUSHROOM CAM

general for cases in which the follower must have specified velocities during its stroke. If the follower is required only to move from one end of its stroke to the other in a given period of time, independently of all intermediate velocities, this form of construction may be readily applied. The principal difficulties to be met in the building of these cams when the intermediate velocities are specified, are, first, the large time angles necessary for a desired follower motion, or, second, a comparatively large cam. The cause of these difficulties may be pointed out in Fig. 44, where it may be seen that the construction point K_1 might have been so much further out radially that the perpendicular line K_1K_2 would have passed to the left of R and it would have been impossible to draw the smooth cam curve AG tangent successively to *all* the perpendiculars. The limiting practical case appears when any three successive construction lines meet in a point, in which event the cam will have a sharp edge and be subject to excessive wear at that point. This subject is further considered in a later article.

If one is not limited in the time, or angle, in which

the follower must do its work, or if not limited in the size of the cam, this form of construction may be used for any set of velocity values so long as they produce a working surface which always curves outward or which has an edge which points outward.

Controlling a Shop System

By W. T. Edwards

On page 34 is an article by John H. Van Deventer, which deserves to be studied carefully by all shop owners and managers, for it deals with conditions that they have no adequate knowledge of.

Even Mr. Van Deventer writes as one having no inner knowledge of what an elaborate and entirely uncontrolled system may become; for he suggests as a remedy that workmen be paid for telling about the bad points in the system. In this he ignores the fact that not only are workmen not encouraged to report the faults in a system or suggest improvements, but are actually punished for doing so.

Of course punishment for this reason is not provided for in the written or above-board side of the system, but is inflicted by the systematizers; probably in unconscious obedience to the instinct for self-preservation that all must feel and follow if left free to do so. The punishment varies from discriminations against the offenders and preferences given to fellow workmen who are more "discreet," up to being discharged and secretly discountenanced to other firms in the same line of work. The precise cause for dismissal would not read well on the records but other reasons may easily be given; for all workmen (like shop owners and managers) have many faults, and by dint of recording these and none of the good qualities, a bad case may be made against anyone.

If the offender has influence with the firm or has no faults worth mentioning, it is quite easy to make an "improvement" whereby his work is done in another department, or by another process and a much less important position offered him. More commonly his job is split into several small jobs that may each be done by a man receiving a smaller wage than himself though their aggregate wage is much larger. If any of the above plans are impracticable he may be "promoted" to a job that he is utterly unfitted for, where he is likely to give indisputable proof that the firm would be better off without him. Precisely when he is discharged, or leaves of his own accord, is then only a matter of time.

So the system not only gets rid of a thorn in its side but it also receives commendation for the infallible way in which it picks out an "inefficient" man. The system must win whether it works for or against a firm, not because of some mysterious power in a system but because its perfection is taken for granted by those who should be its judges, but who really are its advocates. Any one person or institution that is sincerely trusted will also be right in all they do; for the shop owners' and managers' mental attitude is usually that of the little girl who said: "What my mother says is so, whether it is so or not."

Should the culprit's offense be so slight that it is punished only by the disapproval of the persons who comprise a shop system it is quite sufficient to teach him that the "loyalty" so loudly preached to him means loyalty to the system and not to the firm when the interests of the two are not identical. So he either conforms to the system and silences his conscience, or he obtains employment elsewhere and again elsewhere, in the hope of finding a firm that will not punish him for working in their interest but will allow him to earn his wages without searing his conscience. What his thoughts are when he reads the advice of experts on how to reduce the labor turnover may be imagined.

Now the prevention of this enormous loss is not in merely offering rewards for reporting defects in a system; for the system will "get" those who do so, unless provision is made to prevent it. It could be accomplished by a plan that has been tried in Europe and approved by workmen and foremen. The plan is to post a notice in the shop instructing the workmen to carry all complaints and ideas for improvements to the foreman immediately above him, as is usual at present in this country. But should he fail to obtain satisfaction the notice directs him to whom to go next, giving him the right to appeal until he reaches the highest authority; always providing that he has previously appealed to all those of lesser authority mentioned. This will not throw much extra work on those higher up, for the minor officials (causes of almost all labor troubles) knowing that their decision is subject to revision will take care to decide fairly and wisely and this will nip almost all trouble in the bud. Should a case reach the highest authority (who should be one who is financially interested in the firm's success) through sheer persistency of the workmen, an example could be made of him that will teach others to have a case that can be proven before they make complaint. If a brief summary is posted of the facts regarding the cases decided against the workmen, they would have a helpful effect and aid materially in preventing charges of unfairness.

Chart for Finding Volume of Metal Removed or Area Machined in Turning or Grinding*

By R. Poliakoff

Assistant Professor of Mechanical Technology, Technical Institute, Moscow, Russia.

In the description of the chart for finding the volume of metal removed or area machined which follows, reference is made to machining operations only. It should be noted that all that is said refers to grinding operations as well.

The divisions on the left side of the column above the division marked *1* represent the speed in feet per minute and also the *inverted* feed in inches per revolution. For instance, the division marked 100 represents a speed of 100 ft. per minute or a feed of $\frac{1}{100}$ in. The divisions on the left side of the column below *1* represent depth of cut in inches. The divisions on the right side of the column represent either volume of metal removed in cubic inches per minute or area machined in square inches per minute.

How to Use the Chart

a. *To find volume of metal removed,* take (with calipers) the distance between the depth of cut in inches, as shown on the left side of the column below *1* and the inverted feed shown on the same side of the column above *1*. Set off this distance above the division *1* on the left column.

Let division x represent this set-off distance. Select on the left side of the column the number correspond-

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ing to the speed expressed in feet per minute. Take the distance between this number and the division x and set it off from *1* upward, if the number representing the speed is above x, and downward if it is below x. The number on the right column opposite the end of the set-off distance will represent the volume of metal removed expressed in cubic inches per minute.

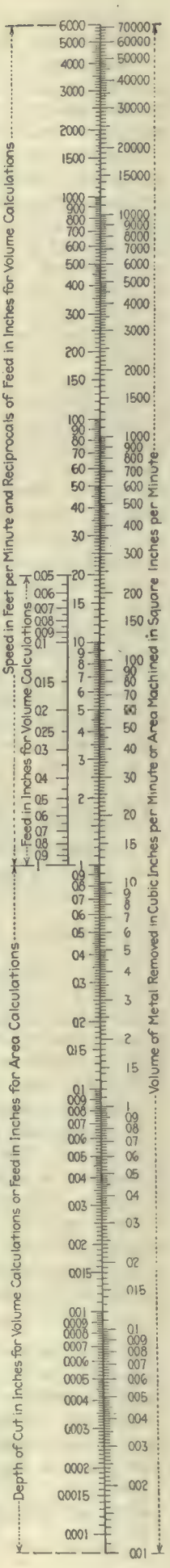
b. *To find the area machined,* the speed in feet per minute is to be read on the left column from *1* upward, the feed in inches on the same column from *1* downward. In order to find the area machined in square inches per minute proceed as follows: From the number representing the speed in feet per minute on the left column set off the distance corresponding to the feed in inches taken, from *1* downward. The number on the right column corresponding to the end of this set off distance will represent the area.

Example 1.—Speed $V = 100$ ft. per minute; depth of cut $= \frac{1}{4}$ in. $=$ 0.25 in., feed $= \frac{1}{21}$ in.; to find volume removed.

Take distance between division 21 (inverted feed) above *1* and division 0.25 in. (depth of cut) below *1* on the left column and set it off from *1* upward. Take the distance between the point obtained and the number 100 (speed) on the left column and set it off from the division *1* of the left column upward; the end of the distance so set off coincides with 14.3 on the right column, which is the number of cubic inches removed per minute.

Example 2.—$V = 40$ ft., depth of cut $= \frac{5}{16}$ in. $= 0.31$ in., feed $= \frac{1}{25}$ in.; to find volume removed. In this case the end point of the distance between 0.31 in. (below *1*) and 25 (inverted feed above *1*) set off from *1* upward will fall above division 40; therefore the distance between 40 and this point has to be set off from *1* on the left column downward. The number on the right column opposite the point so received will be 6.

Example 3.—$V = 4000$ ft., depth $= 0.01$ in., feed $= \frac{1}{12}$ in.; to find volume removed. In this case the distance between 0.01 (below *1*, left column) and 12 (inverted feed, above *1*) is smaller than the distance between *1* (left column) and 4000 (speed number) and the distance between 4000 and the sum of 12 and 0.01 set off above *1* has to be set off from *1* upward and will give the number 40 on the right column.



Example 4.—$V = 120$ ft., feed $= \frac{1}{30}$ in. $= 0.033$ in.; to find area machined. Take number 120 on the left column; set off from it downward the distance between *1* (left column) and division 0.033 (left column below *1*. One will read on the right column 48, which is the number of square inches of area machined per minute.

Example 5.—$V = 30$ ft., feed $= \frac{1}{50}$ in. $= 0.02$ in.; to find area machined. Take number 30 on the left column; set off from it downward the distance between *1* (left column) and division 0.02 (left column below *1*). One will read on the right column 7.2, which is the number of square inches of area machined per minute.

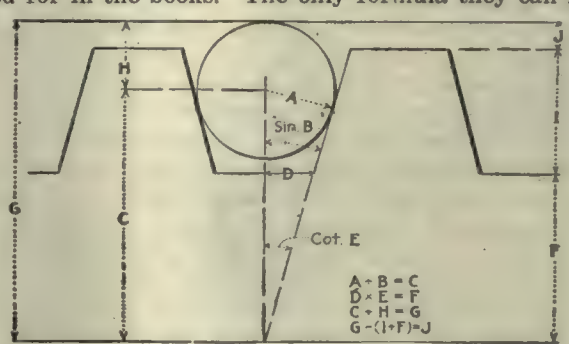
Example 6.—$V = 4800$ ft., feed $= \frac{1}{4}$ in. $= 0.25$ in.; to find area machined. A similar procedure gives 14,400 sq.in. per minute as the area machined.

It will be noticed that a short piece of the chart with divisions marked from 1 to 0.05 in. $= \frac{1}{20}$ in. is shown a little to the left of the main chart. This is really the part of the main chart corresponding to feeds from 1 to $\frac{1}{20}$ in., which feeds are shown on the left column of the main chart by inverted numbers. But in order to be able to read feeds down to $\frac{1}{20}$ in. (such as 0.95 in., 0.90 in. . . . 0.065 in., 0.06 in., 0.055 in.) more accurately, this part of the left column of the main chart has been brought out separately.

Measuring Acme Threads Without Special Wires

By Herbert H. Miller

Lately I have come in contact with a good many men who seem to have trouble in measuring Acme threads on account of not being able to get certain size wire called for in the books. The only formula they can find



FORMULA FOR MEASURING ACME THREADS

is the one which figures a wire that would extend 0.01 in. over the top of the screw and come flush with the top of the tap. This prompted me to make the formula here shown which is of value especially in female gage work, since you cannot get balls of special size very easily.

Example for 8 pitch:

B 0.25038 — A 0.312500000 — C 0.12481

25038

62120
50076

120440
100152

202880
200304

25760

3.8667 = E
0.02055 = D

193335
193335
77334

0.079460685 = F

0.07250 = I
0.07946 = F

0.15196

0.12481 = C
0.03125 = H

0.15606 = G
0.15196

0.00410 = J

Industrial Democracy*

By Dr. CHARLES A. EATON

According to Doctor Eaton, democracy is not a set form; it is an underlying principle. If it is a good principle upon which to base our political government, it is a good principle upon which to order our entire lives. Democracy as a principle of government is considered the best that has been so far conceived; then why not extend this principle as a foundation for our social and industrial institutions?

IN THESE dark and difficult days when the whole world, spent with the exhaustion of unbelievable struggle, is groping blindly after peace, there seems to be practical unanimity upon one fundamental fact. Democracy is to be the organizing principle upon which and by means of which the new age is to be builded.

Since men began to live together in ordered societies, they have been haunted by this ideal. But never before has the world consciously accepted democracy as the only possible scheme of life.

The modern Athenian is today being forced to make practical application of principles which Aristotle set forth as theories in his politics millenniums ago. The myriad peoples of the dreamy East are as eager as the most practical of Occidentals in their quest for full and free democracy. Even Germany, with awkward reluctance, is changing the medieval armor of her beloved autocracy for a brand new suit of Anglo-Saxon working clothes.

Government of the people, by the people, for the people has long been the possession and pride of English-speaking races. Problems of political democracy have constituted the staple of our history. Under our system, developed for the most part by orderly evolution, government exists by consent of the governed. We have developed a government of laws rather than of men. Representation in its law-making body is the divine right of our citizenship. Public opinion created and informed by free discussion is the last court of appeal. The majority rules. The minority is protected in its rights by law impartially administered through the courts, which are simply a projection of the public conscience and intelligence. By peaceful agitation and education, the minority is always free to swing public opinion to its view, and thus raise itself to political power.

Democracy Not Only a Political Ideal

Before the war, we in America thought of democracy as a political ideal. We were interested in political rights and liberties and duties and dangers. We had lost sight of the very simple but important fact that a great primary principle always tends to assert its authority over the whole of life. All life is one. A man cannot keep his religion and his politics and his work separated from each other in water-tight compartments of his nature. He cannot be a democrat in politics and an autocrat in business. It is impossible to build one building upon two foundations. Lincoln was right when he argued that the nation could not exist permanently half slave and half free. If slavery were right as an organizing principle of society, then freedom would ultimately be swallowed up. If freedom were the true and right principle, then slavery was doomed.

Science has taught us that the world is governed by one universal law; that all progress is measured by one universal standard; and that all life is organized upon one universal principle. Religion declares that there is one God, who has created all men of one blood to dwell together in one world. Philosophy seeks ever for one supreme central idea, capable of organizing, coördinating and sustaining the entire life of man, individual, social, material and spiritual.

It is therefore strictly in accord with the nature of things that democracy should seek at this time to enthrone itself in all human relations and institutions. If the war was fought to "make the world safe for democracy," then the succeeding period of peace will be spent in trying to make democracy safe for the world. Democracy is not safe for the world if it can be applied to only one portion of our complex life. Nor will it be safe for the world, if when applied to the whole of life, it reveals itself as a mere social makeshift, rather than a universal principle.

The Big Issue of the Hour

The American people must face the issue squarely. We are, and always have been, a political democracy. We entered the world war because we believed that our democratic system of liberties and rights were endangered by German autocracy. Democracy won the war. Will it be able to organize the peace?

It is a singular fact that we are confused, disturbed, and even alarmed, by the sudden necessity, which everyone feels, of attempting to apply the principle of political democracy, in which we all profess to believe, to the whole organized life of the nation. Before the war there was a long period of strife between labor and capital. On the surface, this struggle seemed to be a matter of dollars. We now see that this view was as superficial as it was dangerous to the well-being of the country.

What this industrial unrest and strife really indicated was that the principles of democracy were trying to get themselves applied in the realm of industry, as they had succeeded in getting themselves applied in the realm of politics. And this is now the big issue of the hour for the American people. Can the thing be done? Is the essential nature of industry such that it must be carried on under a system of autocracy? Or can industry be democratized?

We must approach the problem with open minds. It will not do to jump at conclusions; still less to become panic-stricken or stampeded into trying any half-baked, unpractical, Utopian cure-alls. There are several things which I am sure Americans will not do.

We will not lie down, nor lose our nerve, nor hide our heads after the manner of the ostrich. Nor will we accept the Bolshevist substitute for democracy. There will be no proletarian dictatorship in America. The Russian idea may do for Russians; that is for the Russians to decide. But common sense, hard-headed American ideas are good enough for us.

In a letter to the American workingmen, Mr. Lenine, who, having turned Russia into an industrial and political millennium, is now impelled by a heaven-born altruism to grant the manifold blessings of Bolshevism to more benighted countries says, "The Workmen's and Peasant's Soviets are a new type of state, a new highest form of democracy, a practical form of the dictatorship of the proletariat, a mode of conducting the business of the state without the bourgeoisie, and against the bourgeoisie. For the first time, democracy is placed at the service of the masses of the workers, and ceases to be a democracy for the rich, as it is in the last analysis, in all capitalist, yes, in all democratic republics. For the first time, the masses of the people in a nation of hundreds of millions are fulfilling the task of realizing the dictatorship of the proletariat and the semi-proletariat, without which socialism is not to be thought of."

This paragraph is the kind of stuff that throws our parlor Bolshevists into vociferous rapture; but the ordinary American finds it hard to pronounce the words proletariat and bourgeoisie and is not usually in favor of burning down his house in order to roast his pig. Besides, he knows that it has cost centuries of struggle to reach his present condition of economic superiority over the working-

* An address before the Industrial Conference of the New York Business Publishers' Association, April 11, 1919.

men of any other country in the world, and he prefers to go on building step by step upon what he has already achieved rather than try to turn his country into chaos in the hope that, like a grave-robbing ghoul, he may find some imaginary treasure among the ruins.

A majority of the American people will always find in the following noble words of Theodore Roosevelt full and fair expression of their conception of citizenship: "In the unending strife for civic betterment small is the use of those people who mean well but who mean well feebly. The man who counts is the man who is decent and who makes himself felt as a force for decency, for cleanliness, and for civic righteousness. He must have several qualities: first and foremost, of course, he must be honest, he must have the root of right thinking in him. That is not enough. In the next place he must have courage; the timid man counts but little in the rough work of trying to do well the world's business. And, finally, in addition to being honest and brave, he must have common sense. If he does not have it, no matter what other qualities he may have, he will find himself at the mercy of those who, without possessing his desire to do right, know only too well how to make the wrong effective."

One of the extraordinary changes wrought by the war is a new attitude toward industrial questions, not only in our own country, but throughout the civilized world. Every forward-looking man realizes that the first task for all free peoples is to reorganize and rebuild industry upon the principles of political democracy.

The task is difficult, but by no means impossible. If it ought to be done, it can be done. There is a marked willingness on the part of employers to consider plans and methods by which autocracy may be eliminated from their relations with their employees, and genuine democracy substituted therefor. The real American leaders in our labor organizations stand ready to meet employers in a spirit of genuine coöperation in making the experiment.

Before we can achieve an orderly, permanent and workable application of democratic principles to industry, we must come to some agreement as to what democracy is; what are its limitations; and what are the duties, rights, sanctions and principles which are bound up in its adoption

True Democracy Recognizes No Class

True democracy takes no cognizance of classes. It will have nothing to do with class interests as such. It demands equality before the law for every citizen as an individual, and not as a member of a class. It has room in it for all types and sizes of men, guaranteeing to each opportunity to realize his full possibilities of development, achievement and service.

The glory of American democracy has lain in its power to encourage and reward individual initiative. Every boy, in theory, under our system may achieve success. A rich man has one vote; a poor man has one vote. Each alike is guaranteed by our constitution the natural right to life, liberty and pursuit of happiness. Freedom and justice are the twin foundations of American democracy. The right to acquire and hold private property is the very keystone of our social system.

The normal American is more convinced than ever, after the painful experiences of the war period, that the less government we have the better off we are. The best government is self-government. Our theory is that government ought to do nothing for a man or group of men that they can do for themselves. Government is representative of all the people. The majority rules by the sanction of public opinion. The law is simply the practical projection of the public conscience.

Before we can get our industrial system reorganized and running smoothly, it will be necessary for all parties to reach an agreement as to what work and wealth really mean. If there is a natural and therefore necessary antagonism between labor and capital, as the Socialists and Bolshevists teach, it is folly to dream of industrial peace. Capital and labor are doomed by their very nature to seek each other's destruction. If capital is destroyed, labor will fall back automatically to the Stone Age, and the race will begin all over again its slow and painful journey toward civilization. If labor is destroyed the world will starve, for no one can eat money or machinery.

It is plain, therefore, that both capital and labor need to be educated in the school of coöperation. Personal contact must take the place of corporate autocracy. We must have human beings in the director's room and manager's chair, and they must be of the same brand of humanity as the men in the works.

The principles of representation in industry, if properly applied, will make a new era in industrial relations. This idea has been practiced in England and elsewhere for some years, and it is now being taken up by some of our industrial organizations in this country. It rests upon an analysis of the practice of industry into four parts, capital, management, labor and the community. By a system of representation, beginning at the bottom among the men and working up until it includes men, management and capital in the entire industry, it has been found that friendly coöperation becomes easy. Grievances disappear, difficulties are smoothed away and the whole enterprise takes on a new spirit.

The restlessness of labor is only a reflex of the unsettled psychological conditions at present obtaining throughout the whole world. But there are causes peculiar to industry which account for a part of the labor disturbances. The workingman, who is simply one cog in a vast impersonal machine, is irritated unconsciously by the fact that he has ceased to be a man with creative instincts, and has become a machine. The cure for this fundamental disturbance is to make the man a part of the whole enterprise. I hold that we shall never have complete coöperation and partnership between the various parties in interest until each worker receives a thorough instruction in the meaning, origin, purpose, development, difficulties, and successes of the business in which he is employed. When thus his intelligence and imagination have become awakened, his individual task ceases to be a mere mechanical motion, without relation and without beginning or end, and becomes his contribution to the great sum total of the enterprise. He is no longer working for an employer, but is working for the entire organization. If he is working for any one, it is the community, and under this system of education and representation, the man works for the community as a national service in return for protection, voted by the organized law of the community.

This new system of representation does not mean that the workers are to manage the business any more than it means that the shareholders shall manage the business. Management remains a factor by itself, the only difference being that whereas management had as its task the direction of men with personal relationship to the management, now it directs and coöperates with these men as partners in the business. The management no longer represents only capital. It now represents labor as well. Labor no longer represents only itself, but now represents the community and, in a certain sense, both capital and management.

Already Past Experimental Stage

Industrial democracy has already passed the experimental stage in America. The Colorado Fuel and Iron Co., the Standard Oil Co., the International Harvester Co., the Bethlehem Steel Co., the United States Steel Co. and the Eastman Kodak Co. are among the great organizations which have adopted this principle. Generally it has been found to work well. Representation in industry does not introduce the millennium or change the qualities of human nature. It does, however, bring the four parties of industry into knowledge of each other, and out of this knowledge creates a spirit of friendship, confidence and coöperation.

Labor throughout the English-speaking world has formulated its demands on many occasions, and in language easy to understand. The sum total of labor's demands amounts to this: The workingman desires to become a human being; to have proper physical conditions surrounding his labor; to secure a sufficient return to give his family the right kind of a home and to equip him to realize his manhood and discharge his duties as a citizen.

After a wide and varied first-hand acquaintance with workingmen, their leaders and their systems of organiza-

tion in this country, I have reached the conclusion that it is possible for the leaders in American industry, representing management and capital, to meet the old line organizations half way and to effect a system of mutal good will and coöperation by means of representative organization. If this is done we shall have raised an impregnable bulwark against the floods of Bolshevism, anarchy and stupid destructive theorists which threaten to destroy the world. We must get together. We must affect this reunion by discarding our antagonisms, our prejudices and our fears. If we cannot trust each other it is useless to attempt to build any permanent institutions upon distrust.

We must educate the public as well as labor in the difficulties, limitations, and laws which govern the operations of capital. We must learn to understand the aspirations, weaknesses and tremendous possibilities of labor as a social force. We must see to it that all parties get a square deal. Capital is entitled to a fair return; labor the same; and labor must lift restrictions from output in order to receive a larger share of the country's wealth.

In spite of the uncertainties and strangeness of the new conditions created by the war, I am convinced that America is entering upon a new industrial era which will mark a great advance upon the chaotic, short-sighted methods of the past. There will be a period of experiment, with the usual failures and successes. But we shall soon learn to work the institutions of democracy in the realm of industry with greater efficiency than we have ever known in politics.

Some of Our Post-War Problems*

By FRANCIS B. SISSON
Vice President, Guaranty Trust Co.

It is not always the debtor who occupies the anxious seat; there are times when it is exceedingly uncomfortable and inconvenient to be the creditor. Some of the problems connected with untangling the financial conditions resulting from the war are ably considered by the speaker.

DESPITE the heavy financial burdens imposed by the war, America is confronted with an embarrassment of riches—at least so far as indebtedness to this country is concerned. And thoughtful business men throughout the country are beginning to realize that our position as the greatest creditor nation of the world has its serious disadvantages and responsibilities. We gradually are comprehending, also, that whether or not there shall be a formal organization of a League of Nations, we are bound to other peoples by innumerable and far stronger ties than those which any international covenant could impose.

There has, indeed, been no more convincing proof of this fact than that recently provided by the "unpegging" of, or withdrawing of governmental support from, sterling and franc exchange. The larger significance of what was seemingly only a financial operation is daily becoming more apparent. It marks in a dramatic fashion the shifting from a war to a peace basis, not alone in financing but also in practically every economic phase of international relations. It is one of the most immediate, vital post-war financial problems, and concerns the importer and manufacturer of domestically consumed products as well as the exporter and manufacturer of goods which are sent abroad—for it creates an invisible tariff against American goods in England and France which, sooner or later, but inevitably, will affect our domestic trade. We are awakening to a realization that the prosperity of the country today depends upon increased production and, consequently, that it behooves us to expand our foreign markets, instead of letting them contract.

Our Recent Trade Balance

It is true that during January and February of this year, the value of our exports has exceeded the value of our imports in record-breaking amounts. The statistics recently issued by the Department of Commerce show that our exports during January exceeded those of any other month in the history of the country, aggregating in value approximately $623,000,000, which was $57,000,000 more than in December, and $118,000,000 in excess of January, 1918. In February of this year our exports were valued at $588,600,000.

These are decidedly encouraging figures, but we must not be misled by a superficial consideration of their significance, and forget what such unprecedented purchasing abroad of our products entails. We cannot continue to ship such enormous quantities of goods overseas unless the buyers pay us for them. There are three ways in which they can settle their bills, namely, by means of goods or service, by gold, or by securities or other instruments of value.

If we are to increase our production, which, as I have pointed out, is necessary to the maintenance of our prosperity, we cannot take goods in full exchange for our products. Besides, we are nearer than any other people to economic independence, and do not need imports in anything like the quantities necessary to settle the trade balance in our favor.

We Do Not Want More Gold

Payment in gold is as impossible as it undesirable. The value of the excess of our exports over our imports in January alone exceeded the total value of gold produced in all countries, except the United States, during 1918. In addition, we now hold more than one-third of the world's reserve of gold coin and bullion, having added about $1,500,000,000 to our store of the precious metal in the last four years. We could not with safety drain other nations of their remaining low stock of gold, if we would, for as we are already their creditors to the extent of about $12,000,000,000, it is imperative for us to help them maintain their currency on as sound a foundation as is practicable under existing circumstances.

The granting of credits to purchasers of our goods will very materially aid in solving the immediate problem of financing foreign trade, but, at best, it can be only a temporary expedient. Credit, as you are well aware, is merely the giving of a present value in exchange for a promise to pay. It serves to postpone payment of indebtedness to a more propitious time for the buyer or borrower, but it does not settle the account.

This expedient was necessarily resorted to on a colossal scale during the war, and England was able to weather so successfully the financial storm during the early stages of the conflict and to lend large sums of money to her less fortunate allies because she had extensive credits and investments scattered all over the world.

England's Invisible Exports

Before the war England had "invisible exports" amounting to approximately $1,800,000,000 a year, consisting chiefly of interest in foreign investments which totaled about $1,000,000,000. The toll from foreign freight carried in English ships netted her something like $800,000,000. So that while England apparently had an adverse trade balance in 1913 of $670,000,000, in reality she had a favorable balance to the extent of more than $1,100,000,000.

On the other hand, our favorable trade balance of $500,000,000 prior to the war was about equalized by our payment of interest and dividends abroad, freight rates, etc.

Then war came, and Europe, plunged into the most destructive of conflicts, needed in vast quantities the products

* An address before the Industrial Conference of the New York Business Publishers' Association, April 11, 1919.

of our fields, factories and mines. American securities held abroad were sold back to us in wholesale quantities, in order that munitions and supplies might be purchased with the proceeds; more than $2,000,000,000 were lent to foreign governments through private channels in this country, and subsequently, foreign governments floated large loans in our markets.

When we entered the war, the financing of our Allies was naturally taken over by the Government, which advanced credits to them to the extent of more than $9,000,000,000. There remains less than $1,000,000,000 of the fund appropriated by Congress for the purpose to be lent to our Allies.

And it is to meet the situation created by this circumstance that the Government is arranging to aid American exports trade by advancing $1,000,000,000 through the War Finance Corporation. Without entering into consideration of the merits of this plan, it will readily be seen that it consists merely of the granting of credits for purchases here and, therefore, can only be in the nature of an expedient, even though the credits extend over a period of five years. Furthermore, if the value of our exports continues to exceed the value of our imports at the present ratio, even $1,000,000,000 can not be effective as a remedy.

While there has been no official statement issued by the British or French governments as to the reasons for withdrawing their support from sterling and franc exchange, respectively, one result is inevitable, namely, the curtailment of the purchase of American goods in France and England. This is probably one of the two principal reasons for the so-called "unpegging" of these exchanges. The other reason was doubtless the high cost of supporting pounds and francs at the figures at which they had been held prior to the withdrawing of Government support.

The Invisible Tariff

Both England and France realize the danger of piling up huge indebtedness for our products on top of the pyramid of such obligations already existing. They are well aware that by permitting exchange to take its natural course, the American dollar must inevitably be at a premium, which means, of course, that less can be purchased in France and England by the dollar than heretofore, and, consequently, buying of American goods will be discouraged. As I have remarked, an "invisible tariff" is thus created against our products. We cannot criticise England or France for taking this protective measure, particularly when we consider that the support of sterling exchange necessitated the purchase by British agents of between $3,000,000,000 and $4,000,000,000 worth of sterling in the American market during the period in which exchange was controlled by the British treasury.

As one English authority recently explained, England "had been bearing the burden of maintaining the relation of sterling to the dollar not only up to the day when the United States came into the war, but ever since. It has been very costly borrowing dollars daily or weekly at 5½ per cent. in New York to pay for all the sterling bills offered in London at $4.76 per pound.

The Solution

"A point often arises in the relation of debtor and creditor when it is the creditor, and not the debtor, who is on the anxious seat," this same authority observed, and he added, "I think that this is the case now in our relation with the United States. At any rate, I am satisfied that it is quite as much the interest of the United States today to maintain the relation of dollar to sterling as it is ours to maintain the relation of sterling to dollar, and it is about time to leave the exchange to adjust itself."

It might have been advisable, however, to have cushioned the shock by a gradual readjustment, but that would not have altered the fact that so long as our dollar is at a premium, this country will be a good one to sell in, but a poor one to buy from—which is the vital element not only in the present exchange situation, but also in the whole problem of financing foreign trade.

The solution seems to lie, as I have indicated, in the purchase here of foreign securities. We may as well understand now that we can never hope to recall all of our foreign loans, and that, knowingly or otherwise, we have invested abroad on a permanent basis. There is no doubt about our having to invest abroad some of the heavy interest due on foreign loans.

But that should prove to be one of our greatest assets, as it proved to be one of England's when the unparalleled crisis of 1914 shook the foundation of civilization. It means also that we are in world affairs on a scale never dreamed of a few years ago—and we are there to stay. Comprehending that truth, we must take full advantage of it, not only for our own sake but likewise for that of our debtors. Our prosperity now is more than ever contingent upon the prosperity of other nations. In helping them to rehabilitate themselves we are helping ourselves. And we are amply able to render the needed assistance in the form of foreign investments.

We possess the greatest national resources of any people on earth; our yearly income is greater than that of any other nation; we lead the world in production and commerce; we have the largest total of saving as well as the largest per capita savings—amounting in 1919 to $113.45 a person, and to a grand total of more than $10,800,000,000, which represents an increase of more than $2,225,000,000 since 1914. The amount of "free gold," that is to say of excess reserve, in the Federal Reserve System, which represents the surplus lending power of the system, is sufficient to support a reserve note circulation of more than $1,500,000,000, a significant index to our reserve financial power.

But investment in foreign securities involves grave responsibilities, particularly for the uninitiated. Realizing that part of this responsibility will fall upon them, our leading banks, in anticipation of the service which they will soon be called upon to render, are now studying the foreign-security problem with a view to affording their customers the largest possible share of protection.

Government Cooperation Imperative

The utmost care must be exercised in determining what foreign securities shall be offered to the American public. We shall have imperative need for expert knowledge of all factors behind these securities. Our banks can be trusted to do their part in this new field, but they cannot perform their functions fully and properly unless they and our investors have the support of our Government.

Aside from the material security which will guarantee the repayment of capital and interest, there is involved the question of property rights. These rights must be protected by the United States Government. It is high time that a policy which would afford such protection be formulated and put into practice—not perfunctorily but actively, and earnestly—so that our investors in foreign lands will be assured that, regardless of the administration in power at Washington, their property rights abroad will be defended, if need be, scrupulously and sternly.

We cannot expect the American banker, or the American trader, or investor, to start his dollars around the world unless they are followed by the protection which the American flag should afford the property and lives of our citizens. But instead of having such protection assured, we have frequently and recently, and sometimes even scornfully, had it denied in Governmental circles.

Across our southern borderlands more than five hundred American lives have been sacrificed and more than $1,000,000,000 of American money jeopardized by the refusal of our Government to raise a hand in their protection. Surely there is some higher principle involved in such a situation than any theory of a "self-determination" which protects anarchy, murder, rapine and destruction, and which destroys not only the rights and lives of others, but defeats the welfare and progress of the very people for whom it is invoked.

The Railroad Problem

Another very vital post-war problem is that presented by the precarious financial condition of the railroads. Its multiple ramifications affect every phase of our business life. And the situation grows more desperate every day. During 1918 the deficit piled up under Government operation, and which is to be met out of taxation, was in excess

of $200,000,000; to which has been added more than $70,000,000, during the first two months of the present calendar year. Yet rates are 25 per cent. higher and the service poorer than ever. It is true that in February the gross earnings of the railroads increased $61,000,000 over the corresponding month in 1918, a gain of 21 per cent.; but operating expenses, which a year ago had run close to gross revenue, increased $62,600,000, or 24 per cent. And the net operating income of the railways for February was nearly $37,000,000 less than the compensation guaranteed by the Government. In January the deficiency was $55,000,000.

Under the sympathetic management of the Railroad Administration, which yesterday granted a further wage advance of $65,000,000, wage increases of $910,000,000 have been allowed. During the last three years wages have increased $1,260,000,000, and have more than absorbed all additional revenues obtained from higher rates charged for freights and passenger traffic. A revolving fund of $500,000,000, which was voted to meet capital requirements, has become a dissolving fund in the face of railroad necessities. To meet the losses in operation and capital requirements of the roads, a sum aggregating more than $1,000,000,000 for the period covering Government control has already been required in Government funds to be raised from tax resources.

The country was promised, by those responsible for this debt, that vast economy in operation would be effected, which would show convincingly the wisdom of their plan. Experience has proven that the economies effected have been negligible in comparison with the expense added; and that, on the whole, less efficient services—less satisfactory to the public and less promising for future needs—have been rendered at a largely increased cost to the shipper and the taxpayer.

Jack to Bill—Jack in the Navy

Deer Bill:

I havent rote you no leters for a long wile becaus Ive bin in the navey and a guy tole me all our leters was sensured.

A side from this and one or too uther things I likes the navey furstclas tho I doant see wy a mekanik has to bee lurned to stear ships and maik awl kines of nots, do you, Bill. But thay shure apreshates a good man for after weed bin qaranteend fore weaks tho nun of us warnt sik only one man what had the ich and Id had only but three weaks practis in maikin a bolin wen I shode it to the teecher he sed mygawd wich shose he was supprized.

And thay maid us stan on a plattform and heev the led wich thay calls fliein the bloo pijun. An tern a weal like stearin a ship. An sleap in a hamuk an seez it up (seezin meens tiein, Bill) with marlen hichis and I allus thort marlen was a gun for one of my frens wurkd in a shop ware thay maid marlen guns but thees are hichis.

But thay shure yuses fool tawk in the navey for wen we was on a reel bote not a plattform and sales set an too of us me an an uther stearin the bos sed nuthin hire so I poot my side of the weal lore to be safe an he sed giv er a full, carnt you see the wether leach shivr? And a wether is a kine of booll sheap and a leach is a blud sukker, and thay want no sukkers thare and if thay was wood thay be he-sukkers an maid into wethers? Wat foole tawk, Bill.

Thay lurned me sum abowt signulin and it was verry intrestin but wun thing in the wiggwagin I dident like. Wun of the moshuns is like the sacred sine of the Nites wat we musent yuse only but in xtreem distruss and dainjur but the lefft hand is the uther side upp so it dident seam rong to maik it wat do you think Bill?

And just befoar I went onto the destroiur I hitt my hand with a hamr and wen my new yuneform come it hed a red woon stripe on to it ware the sleev jines on to mee and evry man had wun, sum on wun side sum on the uther. Wat a lot of woons thare mus be that doant git into the paypers. An on the distroiur I seen the faymus ashcans and maid upp my mine to invent a improovment for enny wun can see thay aint bigg enuf or hevvy enuf to hert a submreen nun, but I seen a gink fiksin wun to drop an he ajustid a doodad an he tole me it was a sting like wat wassups has so I gess its awl rite.

And thay plays meen triks on ships like in shops for a guy tole me to go to the captin for the kee to wine the cumpus and I miter went only but a kine man sed doant the kee of the stabburd watch fitts it.

An Ime not aloud to tel ware we went to in frans, but its naim is like the parrt of you that wood giv millk if you evver shood giv millk wich of coarse you wunt Bill, and its a fine plaice an thare I was poot to wurk in a masheen shop on a ship cawled a muthr ship mendin distroiurs and such and I run a laith like the wun I hed wen I was alernin to be a laith speshlist you no Bill.

An wun day I cutt threds an the bos sed I dun noable and awl he hed to do was to putt on the geers and sho me how jus wuns an I cut six in a day a ninch and a half long 8 pich. An wun ship we repared the enjuns of dident hav no enjuns but turr beans an I nevr new befoar wy thay cawld um that and a kine man toald me becaus its as full of blaids as a podd is of beans. Aint it fine to keap alernin things Bill and yuseful things to.

And frans is fine only but it ranes evry day and a french gurl giv me a convsashun lozzungur and on it it sed vous êtes très méchant, and warnt she brite to see that Ime a mekanik and yit thay doant no how to spel it, an french is a qeer lingo for you has to tawk it difrunt to a man or a woomun. Youd hardly bleev that, Bill, but wun of the men he lerned to say good mornin like donny mwa un bezzay and he sed it to a gurl an she was so pleezd she up and kisd him but a bigg buc frenchman with wiskers got madd wen he sed it to him. An eavn the kids are hily ejucaitid and swares in french, our country is farr behine in sum things Bill.

An yit sum of the groneups carnt understan thare own tawk fer I was in a restrunt and a man ast fer too dur sweet and the gurl brort him fride egs so I ast fer um too and she dident no wat I ment and dident bring me nuthin and I gut upp and beet it.

An a frenchy come to the shop wen I was runnin the laith an he pointid to the thred and sez vees and I sed, reel nise and kine, no them thare is the Vees and he sed vees, vees, and I tole him he was a lire an he beet it. An thay doant no no betr than to cawl a munki rench a clay anglay. But I gut tiurd of wurkin in the shop and not gittin no Croycks de Gerry nor nuthin and aplied for to be transfurd to the mreens thay beein the furst to fite an so most proberly the furst to come hoam, but nuthin dooin, and wen the armstis come I dident bothur no moar abowt it and now Ime agoin to start fer hoam soon an Ive rote to the ralerode shop ware I yuesd to wurk an ast if thay want me for foarman, Ime qalerfide for super but wood hait to beet him out of a jobb, an wen I gits to New Yawk Ile rite you so no moar now.

JACK.

P. S.—Bill the males aint runin none too good but if you doant git this lett me no and Ile rite anuther as soon as I gits hoam.

The Stabilizing Effect On American Industry Of a Definite Foreign-Trade Policy*

By JAMES W. HOOK
President, Allied Machinery Co. of America.

IT HAS seemed to me that the subject I have been asked to discuss will admit of extremely wide limits of treatment. A definite foreign-trade policy quite rightly embraces every phase of export selling. It includes a shipping policy and the laws that govern same. It includes a financial and credit policy. It involves the products we have to export and their peculiar adaptability to various methods of export selling. To treat this major policy with all of its subordinate issues and express its effect on American industry would, I fear, consume more time than I have at my disposal. I shall therefore take some liberties with the subject and limit myself to a discussion of what I consider to be a cardinal, if not a vital, factor.

There is no denying the fact that the world war had a permanent effect upon America's aspect toward foreign trade. The great demand for almost everything caused an expansion of producing capacity in the United States that today is greatly in excess of the home demand. Export markets must be sought, new methods of selling must be introduced, and the same thoughtful consideration must be given to overseas trade that in the past has featured our highly developed trade characteristics at home. America, perhaps more than any other nation, has learned the art of handling her home markets. She has met the needs of a discriminating demand, and men from other nations tell us that no people on earth are harder to please than our own Americans. They are keen traders and extremely sensitive in matters involving the quality of the merchandise they buy; and, in their demands for service, no people can surpass them. Similar fastidiousness on the part of foreign buyers need not unduly disturb us, much as that bugaboo has been flaunted before us in the past. No people will do more to offer and perform a real and satisfying service to buyers of their merchandise, once it is known what that service should be, than Americans.

The world war has had a permanent effect on the American aspect of foreign trade. Our industrial capacity has increased many fold and if our industries are to be kept running at maximum output an increased amount of their products must be marketed abroad. That American goods shall be properly represented in foreign markets we must no longer depend on foreign selling agencies but must build up selling organizations of our own. As we are specialists in manufacture so must our selling organizations be made up from specialists, trained in the particular lines of goods they are to handle. If our manufacturers will insist on American goods being sold abroad by American organizations many of our export troubles will be lessened.

I am a great believer in the theory that American goods should be sold abroad by Americans. I say this perhaps in a general sense, for it is well known to everyone that native salesmen under American leadership are often necessary. But we should have the American leadership. We ought not to go back to pre-war days when the American producer handed over his foreign selling rights to foreigners, who, in a great many cases, only tested the market with American goods and then manufactured these goods as competitors.

Pre-War Conditions

We only have to go back to the beginning of the war to see the dangers of this practice. Then hundreds of manufacturers in the United States, who had depended wholly upon foreign agencies for their export business, suddenly found a large portion of their foreign selling organization destroyed. Then, and only then, did it dawn upon them how utterly dependent America was upon foreigners for much of her export trade. The situation might have proved disastrous to many had not the war assumed such proportions as to tax the producing capacity of the entire world. This great demand enabled manufacturers to make new connections with other selling agencies; but many of these were not serious in their intentions and are now rapidly going out of business.

Regardless of this experience, American capital and American manufacturers have not prepared for the present-day conditions that the simplest foresight made apparent as the war progressed. I refer to the creation of American selling agencies abroad. We were too busy; our huge war orders blinded us to the future. Manufacturers would not look forward to the means they would adopt to obtain export business when their war orders ceased. Largely as a result there are today few purely American agencies operating in foreign markets. Many manufacturers therefore find it necessary to rush to Europe and elsewhere to make new selling connections.

If there was an incentive before the war for Germany to test the market with American goods and then manufacture them later, the incentive now is many fold greater. If any foreign nation, before the war, could regulate the amount of American material entering her ports by controlling its sale, her incentive to do so now is infinitely greater. Huge domestic and foreign debts make it obligatory upon the part of all former belligerent countries to produce everything they can and to import as little as possible.

Much as we desire to lessen the burden that the late belligerent nations must bear, we cannot disregard fundamental principles; moreover, the business men of other nations do not expect it. They need our products and it is only natural that as long as they create and control the demand we should control the sale of our own merchandise.

It is a formidable barrier to foreign-trade expansion that the manufacturer builds around himself when he entrusts his foreign selling to any foreigner. England and Germany follow no such practice, and, as we all admit, their long experience in developing foreign markets has made them past masters in the art.

America must immediately enter upon the serious business of building a foreign selling organization. She must not operate through foreigners any longer. She must lay the foundation of complete independence from every nation in the world in all matters involving her export trade. She must deal with the problem in a specific and practical way. Producers who have products to sell abroad want to be specifically shown the step-by-step way of doing it. Talk of trade balances, exchange fluctuations, or the probable intrinsic value of a silver dollar five years hence, does not specifically interest them. Once a feasible and workable plan is devised—and many have been—they want it developed so they may take advantage of it.

In a large sense America has come to be regarded as the great specialist manufacturer. Take machinery for in-

*From an address delivered before the Sixth National Foreign-Trade Convention, Chicago, Ill., Apr. 24 to 26, 1919.

stance. The enormous demand caused by high labor costs has enabled the manufacturer to build up a large and paying business by manufacturing one single line or commodity. As a result we find such manufacturing specialists all over the United States. In Providence, Rhode Island, and Cincinnati, Ohio, we find large manufacturers making nothing but a limited line of machine tools. In Holyoke, Mass., is another factory making nothing but textile machinery. And if we look again we find other manufacturers specializing still further. In Milwaukee is a manufacturer making nothing but milling machines; in Cleveland is another making nothing but turret lathes. America is the only country in the world that has a domestic demand for machinery that will warrant such specialization. Therefore, we find that manufacturers of other nations must make many kinds of machinery and specialize in none. The result is a supremacy of the specialist—the American manufacturer—who not only produces cheaper but also leads in design and quality.

Fundamental Requirements

The advantage here (and it is not confined to the machinery industry) is something tangible and can be capitalized in foreign trade. It involves an export selling organization which has obtained exclusive rights by contract from non-competing specialty manufacturers in America to sell their lines in certain foreign markets. It buys the product outright from the manufacturers and stocks it all over the world in reasonable quantities. The significant thing about the plan as just stated is the word "non-competing." No export house operating through contracts with manufacturers can successfully sell competing lines in the same market. This is the first fundamental requirement, regardless of whether the export selling organization involved is owned by the manufacturer or by outside capital.

The second fundamental in such an arrangement is the specializing of the export selling organization itself. It must avoid obligating itself to sell lines which require different kinds of a selling force. Specialized selling abroad is as important and necessary as specialized manufacture at home, and it offers the same advantages.

Another fundamental principle involved in this plan of export selling is the attitude exhibited between the manufacturer and the export selling organization. Regardless of whether the export organization is or is not owned by the manufacturer, the economic problem involved is just the same. In either case the selling force, as far as the actual sale of his product is concerned belongs to the manufacturer. It is all the selling force he has in that particular market. He should, therefore, treat it in just the same way in regard to protection in prices, prompt shipment, and careful service, as he would if it were supported directly from his own treasury. He must realize that while the export selling organization may buy a stock of his product no sale is really made until it is delivered into the hands of the ultimate consumer.

The fourth fundamental is the faithful consideration given by the export selling organization to the obligation it is under to the manufacturer. Many people fail to see the need of such a medium between the manufacturer and the customer abroad. "Why not sell direct?" they say. Whether a manufacturer can sell direct or not depends upon the demand. When the demand warrants it, direct selling of course is the ideal one. But there are in America comparatively few manufacturers whose business in foreign countries alone warrants the establishment of a special foreign sales organization. When such a demand exists manufacturers often find that it is wiser to manufacture in those countries.

Selling Organization

The export selling organization must feel its obligation toward the manufacturers it represents. It must feel that it is a part of their organizations. It must insist upon the manufacturer considering it in that light. It must realize that it is intrusted with all the duties that must naturally be assumed when one undertakes to market goods abroad. And what are these duties?

First, and foremost of course, is the creation of a competent selling organization. This involves proper sales managers with salesmen of local nationality. These salesmen must be properly trained. One by one they should be brought to America and put through a course of training in the plants of the manufacturers whose goods they will sell. Above all, this selling force must be loyal to the manufacturers. In this it must have no reservations, no limitations. Its whole aim must be to import and sell American goods. And, if it must have salesmen of local nationality, it must also have American leaders—men who can inject American push and spirit into the selling problem. The training of this force is of paramount importance; and, whereas the salesman of local nationality should be brought here for training, so must the American leaders be trained for the new land to which they have been assigned. No one with experience in the export field fails to realize the difficulties that attend the selection and training of the men they send abroad.

Back of the selling force is the administrative organization with its departments for dealing in exchange, traffic, credits, shipping, stocks, collections, customs, insurance and corporate matters.

Departmental Experts

The proper handling of all these matters requires experts in every department of the export house. Before the war, foreigners realizing this, and capitalizing America's provinciality in the matter of foreign trade, came here and formed great trading companies for the purpose of selling our products in foreign countries. One such company before the war did an annual import and export business of some $30,000,000 per year with South America. Other foreigners obtained the exclusive selling rights of some of our best manufacturers. This resulted in a large share of our export trade being in the hands and under the absolute control of foreigners.

Shall we revert to the same practices again, now that the war is over? Or, will our manufacturers insist upon American goods being sold abroad by American organizations? If they will insist, more of such organizations will be created. These in turn will encourage the creation of better American banking facilities throughout the world. Better banking facilities will encourage American investment in foreign securities and industry, which in turn will produce permanent markets for American goods. Such a definite policy of handling our foreign trade will insure that America with all of her vast resources of raw materials and creative genius, will take her place beside the other great trading nations of the world.

The Time-Study Man or Rate-Setter

By Gaylord G. Thompson

We have read with interest of the many qualifications, as set forth by various writers, that must be possessed by the individual who aspires to be a foreman; likewise have we assimilated the diverse opinions as to the subtle characteristics that distinguish the draftsman from the engineer; but there is still an individual who has thus far escaped the literary barrage laid down by the long and short range pens of various authorities, and that is the "time-study" man.

While this minor official has not yet assumed proportions of importance in public print, he is by no means a negligible factor in our industrial life. He is, however, without a definite name, having had various monakers wished upon him, such as "time-study man," "task-setter," "speed boss," and sometimes "efficiency man." It is in the hope of stimulating discussion and perhaps arriving at a definite conclusion as to his correct designation and standing that this article is written.

Let us take for example a man who, building upon

the groundwork of a long period of practical experience in mechanical lines, having become well versed in speeds and feeds, methods of handling and routing work, etc., having the gift of concise and exact expression, and having developed a sense of responsibility, considers himself an expert time-study man. This man, whom for the sake of convenience we will call William, sees in one of the technical journals an advertisement the requirements of which, while not quite clear to him, seem to be met by the qualifications he possesses, and he decides to make application for the job.

After passing the outer defenses, he is finally ushered into the presence of the superintendent who wants to know what he can do. William starts out to detail his qualifications but is met almost immediately by a shake of the superintendent's head and the statement that "we have no opening for an efficiency expert; all we want is a rate-setter, one who knows enough about the methods of production to know whether or not a workman is trying to 'put something over on him' to gain a premium or higher piece-work rates than he would normally get."

"But," replies William in surprise and consternation at being taken for an efficiency expert, "I do not claim to be such; I am merely a time-study man."

William Pleads Guilty and Lands the Job

After some discussion as to the applicability to specific duties of the terms "efficiency expert" and "rate-setter," William pleads guilty to the latter and lands the job.

After being on the job long enough to get a knowledge of his duties, he is still further surprised to discover that it is the very job he has been seeking; that his qualifications were being put to the severest test. His analyses were required to be exact in the matters of elapsed time and details of operation. He was held responsible for speeds, feeds and methods of production, and was vested with a somewhat limited authority to make changes. In short, William was called upon to assume the duties of an expert; to reduce costs and increase production.

In view of these requirements, is not the term "time-study man" the correct designation? The setting of a rate was merely the effect brought about by scientific analysis. It was not the number of rates set per day that determined the measure of William's efficiency, but rather how much he was saving his employers in production costs. He was allowed to take whatever time on each analysis that was necessary to make certain of logical and correct conclusions. The result was that William effected a saving amounting to many thousands of dollars a year by the introduction of more efficient production methods, whereas, if he had been required to return a certain number of new rates each day, in the endeavor to live up to the schedule many inefficiencies would be bound to remain unexposed.

Working as a "Time-Study" Man

After a lapse of time we find William employed under the title of "time-study man" in another plant, where rates had already been established but with some few exceptions upon which he was able to demonstrate his ability to make scientific analyses, reduce costs and increase production. Again William felt that here was his chosen line but under a different title.

His complacency was, however, short-lived. There soon came a complete change. New machines were installed, old machinery rearranged and the manufacture began of new parts upon which rates were to be established. Workmen were complaining that their wages were too low, the hourly rates having been purposely set low in the expectation that the piece rates and premiums would bring them up to standard.

William had at this time attained the position of foreman of time-study and was besieged from all sides by foremen and workmen alike to establish rates on the jobs going through the shop in order to restore wages to a normal level. Right in the midst of all this trouble William was informed that two of his time-study men had been laid off. William sought an immediate interview with the superintendent and endeavored to demonstrate to the latter why his men should be retained.

"How many analyses do you think should be the daily average of each time-study man?" asked the superintendent.

"That depends upon the size of the job, the working conditions and ——"

"No! No!" interrupted the superintendent, "there is a conservative average to the number of time-studies to be expected from each man daily. Let me cite you an example," he added, "at Blank & Co. Their time-study men turn in an average of from 15 to 20 studies per day, and if they can do it we can."

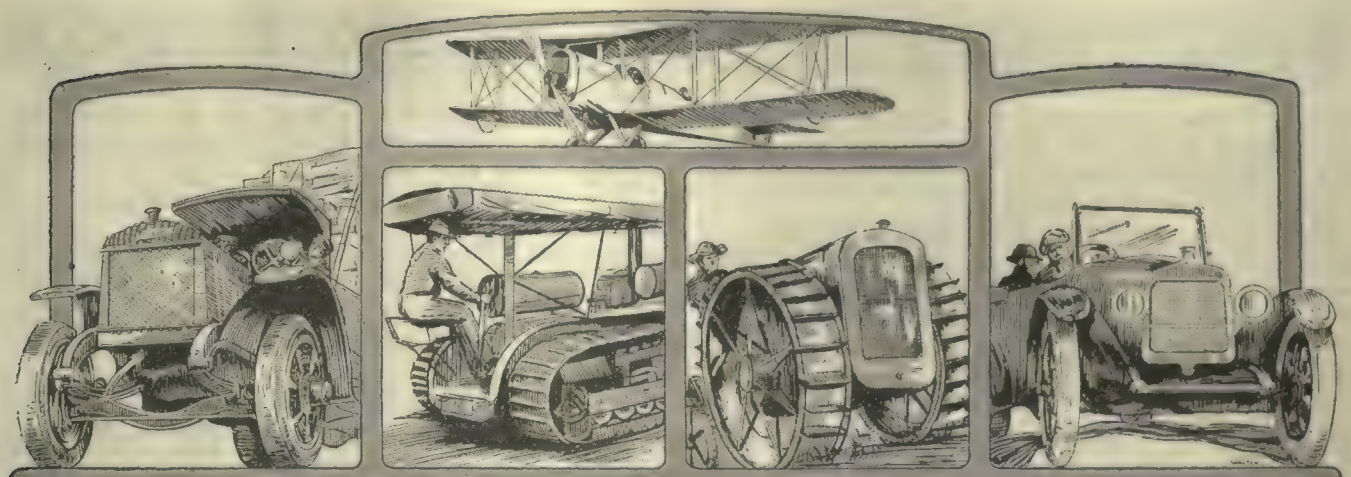
After the interview William returned to his studies undecided as to whether he was a time-study man or a rate-setter. His thoughts drifted back to his previous position where he had been employed under the title of "rate-setter," but where his efficiency was determined by the money he was earning for the company rather than for the daily number of rates set. He compared this position with his present predicament where an average number of rates set per day was to be his schedule. To meet this arrangement would make it necessary for him to slight his work.

Titles Should Have Been Reversed

It dawned upon William's mind that the titles in his two positions should have been reversed, he should have been "time-study man" where he had been "rate-setter" and vice versa. The principal requisite in the first instance was scientific analysis and in the second he was chiefly concerned with rate-setting.

The question is, to which employer was William most valuable? To the first where he saved thousands of dollars without reference to the daily number of analyses made, or to the second where 15 to 20 studies per day were required regardless of the merits of each case or the thoroughness with which it was covered?

It is easily discernible which of the two concerns are getting the best results. The first concern rated their employees high enough so that there was no dissension when they were called upon to work under the hourly rate. The saving by increased production, made possible by the allowance of ample time to investigate each case upon its merits, more than compensates for the difference between the high and low hourly rates. This is a case of increasing wages to reduce costs. The second concern, where low hourly rates prevailed, because of this very condition, found its costs increased by reason of the fact that this condition was conducive to haste and ill-considered methods of setting rates in order to keep the workmen satisfied. This is a case of keeping wages down and increasing costs.



What One Manufacturer Learned About Motor Transportation*

BY F. G. KANE

The motor truck as used in the delivery and hauling service of the big manufacturer is still enough of a novelty to be treated much as was its predecessor, the horse and wagon. When the owner treats it as he does his expensive production machinery and takes as much pains in keeping track of its costs, he may expect results which agree with the claims of the salesman.

ONE of the largest of the machine-tool manufacturing concerns recently uncovered a situation in the transportation department which had neither been suspected nor considered. At no period in this business has the going ever been easy. Profit margins were always narrow as is characteristic of staple necessities. Each year's earnings depended upon an increased volume of business, with the most minute and accurate cost records for every department, so that economies might be effected and leaks stopped. The best technical minds available were centered on each phase of the business, from the testing and purchase of raw materials, through the intricate processes of the factory, and right up to the packing of finished goods for shipment at the factory door.

Almost by chance the management discovered that the motor transport was far below the standard of efficiency maintained in its manufacturing and distribution. Accidental comparison of two sheets of cost figures aroused a suspicion as to the efficiency of one section of the motor transport, and then it was found that the records did not furnish a basis for thorough analysis, because they were incomplete.

At this point the company's motor-transport problem was submitted to experienced transportation engineers, with a request for investigation and suggestions. The engineers found that the motor equipment was operated in two widely separated cities, in each of which the company had a good garage with its own system of cost records. But the system followed in each place was different. Both sections of the motor fleet were under the supervision of men who had risen from the ranks of drivers. Their experience in operation, mechanical upkeep and management of men was excellent, and they were entitled to commendation for high standards in keeping equipment actually at work, and for good human organization. But they were not familiar with accounting, much less scientific cost management, and when each devised his own cost system, it was naturally limited to details with which he was most familiar. For example, blanks were provided for keeping track of items like gasoline, oil, tires, repairs, garage expense, wages of chauffeurs, helpers and mechanics. From these records a sincere effort was made to figure out general operating costs in miles, tons, days of operation, cost per mile, cost per ton and cost per ton-mile.

The first inspection of the motor equipment itself by the engineers revealed the fact that not one of the 60 vehicles had a speed or distance-recording appliance in good working order. This reduced the figuring of ton and mile costs to rough estimates. It was also found that rule-of-thumb methods had been largely followed in keeping track of gasoline, oil and the like. A clerk intrusted with recording these items would perhaps ask a driver how many miles he made to a gallon of gasoline, and if the driver replied, "About two miles," the busy clerk in good faith said, "Well, you had 20 gallons of gasoline today, Jim, so you must have run about 40 miles," and 40 miles would probably be entered on the records as the performance of that truck that day.

A motor fleet of that size necessarily consumes large quantities of supplies, such as tires and parts. In neither garage was there any stock-keeping system for supplies. No correct inventory had been made for years and no correct pricing of the different materials for quick, accurate debit entries against each motor was

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on hand. The company was compelled to merchandise its products in the light of accurate cost records and pricing, but it had never made any effort to merchandise the supplies used in its motor fleet.

Even if each garage superintendent had worked out a satisfactory system of records for the above items, which gave a faithful accounting day by day, with the lack of uniformity in the two systems, it would have been impossible to make fair comparisons. As a matter of fact, when the general management tried to run down obvious discrepancies the cost records were not capable of comparison. Furthermore both systems were deficient in monthly and yearly summaries, whereby identical items of experience could be compared, one month with another, and one vehicle with another. Thus hundreds of wastes and leaks were possible and could not be corrected because they could not be found. For the same reason many genuine economies and efficient operating methods were concealed and could not be brought to light and turned to advantage.



THE MOTOR TRUCK IN THE MANUFACTURER'S SERVICE

This company's motor equipment includes vehicles of various makes, types and capacity. Records did not show which maker's cars were most efficient nor the sizes and types of vehicles best adapted to that business.

Among the 60-odd drivers there was a wide range of ability. Records did not reveal the incompetent man, nor furnish a basis upon which to overcome his shortcomings by instruction, or by directing his attention to important factors of operation. Nor was it possible to discover the most efficient drivers and make their methods available to others. Real injustice was often done drivers because they could not be given credit for skill, carefulness, economies of fuel and supplies, and other praiseworthy service to the company.

What this company learned from a verbal report, following a brief investigation of garage records and methods by transportation engineers was, that it had never secured a clear mental picture of its motor equipment, much less of its motor transport requirements.

The engineers were asked to study the situation further and make recommendations. They began by ascertaining the kinds of material to be hauled, and made a study of the territory to be covered with reference to distances, systematic routing, character of pavements and roads, branch distributing points, facilities for quick loading and unloading at freight terminals, etc. Then followed an inventory of motor equipment in use, as to make, type, capacity, age, condition, kinds of bodies and general suitability to service requirements. This included a study of idle equipment during slack periods and a maximum use of motors during busy periods with investigation of the outside trucking service required in busy seasons.

With this groundwork of facts the engineers were assigned to ride routes with drivers, keeping accurate route records of gasoline, oil and supplies, mileage, time spent on each trip, time of loading and unloading, time lost by delays of every kind, whether due to mechanical mishaps or outside causes, such as waiting at terminals.

Route records were worked out in terms of cost and hours, with almost startling discrepancies revealed in actual ton-mile values between two vehicles which had been credited with identical performance. It was found that, because garage superintendents had no trustworthy figures of cost for vehicles of various types and capacities, freight hauling and delivery service were not clearly separated and vehicles of widely different character were used indiscriminately for all classes of service. A heavy truck might be subjected to too many stops and waits by reason of the kind of freight carried, while lighter vehicles were used in hauling solid loads over direct routes when they should have been assigned to mixed loads with many stops to relieve large trucks of peddling work.

Opportunities were also found to get the drivers' viewpoints on important matters such as causes of delay at terminals, mechanical mishaps to equipment, the efficiency and dependability of different motors, the convenience of bodies, and loading and unloading devices, their feeling toward the company, their interest in efficient operation, and so forth.

As an upshot of this investigation the company is now using the National Standard Cost System adopted by the Truck Owners' Conference, which is recognized as fully covering every essential point of motor transportation costs, and possessing a flexibility which permits its application to motor transportation plants of every size and character. Furthermore it now recognizes the difference between motor trucks as an important auxiliary service, tacked loosely to the outside of its business, so to speak, and real motor transportation as incorporated into the business, taking its place as part of the whole process of production, from import of raw materials to final customer deliveries.

Taking this view, motor transportation is machinery. It eliminates hand labor, boosts up output, reduces cost. It demands study as machinery. It demands scientific management, as well as cost keeping. It is an intimate part of the industrial equipment and the factory process,

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and should be so regarded. Only on that basis will it yield maximum production, and any other basis of operation is unfair, both to the motor equipment and the business itself.

In delivery and hauling by horse and wagon the equipment was looked upon as an auxiliary, if not a necessary evil. Investment in a horse and wagon was small compared with the motor truck. The average motor truck represents an investment of at least $3000 while a horse will cost about $350 and a wagon about $500. Motor trucks operated by the business concern whose experience was dealt with above, cost $6000 each. The horse has a limit of travel and work; he will haul 1½ tons maximum about 18 miles a day. He could be driven 10 or 12 hours daily and then had to rest. When he was not busy his owner felt satisfied because he was at least resting and could later be called upon for work. The relatively smaller cost of investment and driver's wages led his owner to look upon loss by idle time as negligible. When motor vehicles were substituted for horse equipment the owner persisted in regarding them upon much the same basis, as auxiliaries of the business instead of costly, high-capacity machinery of an entirely new type. A 5-ton motor truck will travel, on the average, 50 to 60 miles a day, carrying from three to four times the load of a horse truck. It requires no periods of rest but can be kept running twice as many hours as a horse. In other words, it is modern high-power equipment, and requires an entirely different viewpoint.

Employment "Systems"

By John P. Commentz

In nearly every industrial magazine one picks up today are articles on employment, setting forth ideal methods of obtaining the help that is needed in our factories all over the country. One writer starts by saying that a "straight line is the shortest distance between two given points," and then proceeds to lay before the reader a most wonderful system, incorporating organization charts, card indices, applications, applicant's introduction to foreman, applicant's acceptance, applicant's engagement, etc., together with a record folder to contain all the data collected in open file while the applicant is in employment. When the employee leaves, this folder with contained information is transferred to the closed file.

Now I am not aiming at any particular system, for I know that all large as well as small business enterprises of today should have a well-oiled routine in which they should run, and that all departments working in harmonious coöperation makes for their successful management.

From the writer's personal experience covering the last five years, especially during the war, this straight line between two points has been sadly neglected. It was rather a long line which led around Robin Hood's barn before the applicant was brought face to face with the individual who would ultimately decide whether or not he would be hired.

Employers were crying for men, especially skilled mechanics, and the response of the unemployed was inadequate to meet the requirements. With the Government forcing men to leave their positions and enter war industries, matters were still more complicated.

Let me illustrate one instance of this: One of the largest airplane-motor plants in the East made preparations to hire about 10,000 men within the space of four months, most of whom were to be skilled workmen. Advertisements were placed and from early morning to late at night a line of men extended some 300 or 400 ft. from the employment office with as many as 300 men inside waiting to be interviewed. Each man had to take his chance in line, consequently men would lose a large part of the day before they could come within range of the interviewer, who, with the aid of a micrometer, would ask a few questions as to name, age, nationality, experience, etc.

Now what happened? One out of 20 or 25 men would prove acceptable to the interviewer who would pass him along to the foreman to be accepted or rejected; and one man out of 10 so passed along would be accepted by the foreman. Men turned away today would be accepted tomorrow by some other interviewer who was perhaps a better judge of men or understood mechanical matters better than the other.

The work of the writer at that time was largely in and around the employment department, and at times he could not help overhearing remarks made by the men. "Well," said one of them, "I have been here three hours and will not stay any longer. If they want a mechanic I am here, but I do not intend to stand around all day." This man, like others, was justified; good mechanics would not stand in line for hours; it meant bread and butter to them and each day out of employment set them back so much more in money and lost time.

Men refused by one foreman, because he felt that they were not fitted to fill the position, would be accepted by another, and perhaps prove to be most efficient. Again men refused by interviewers were brought in contact with foreman and accepted. One thing of which we may be certain is that not all men are qualified to pass on the merits of others.

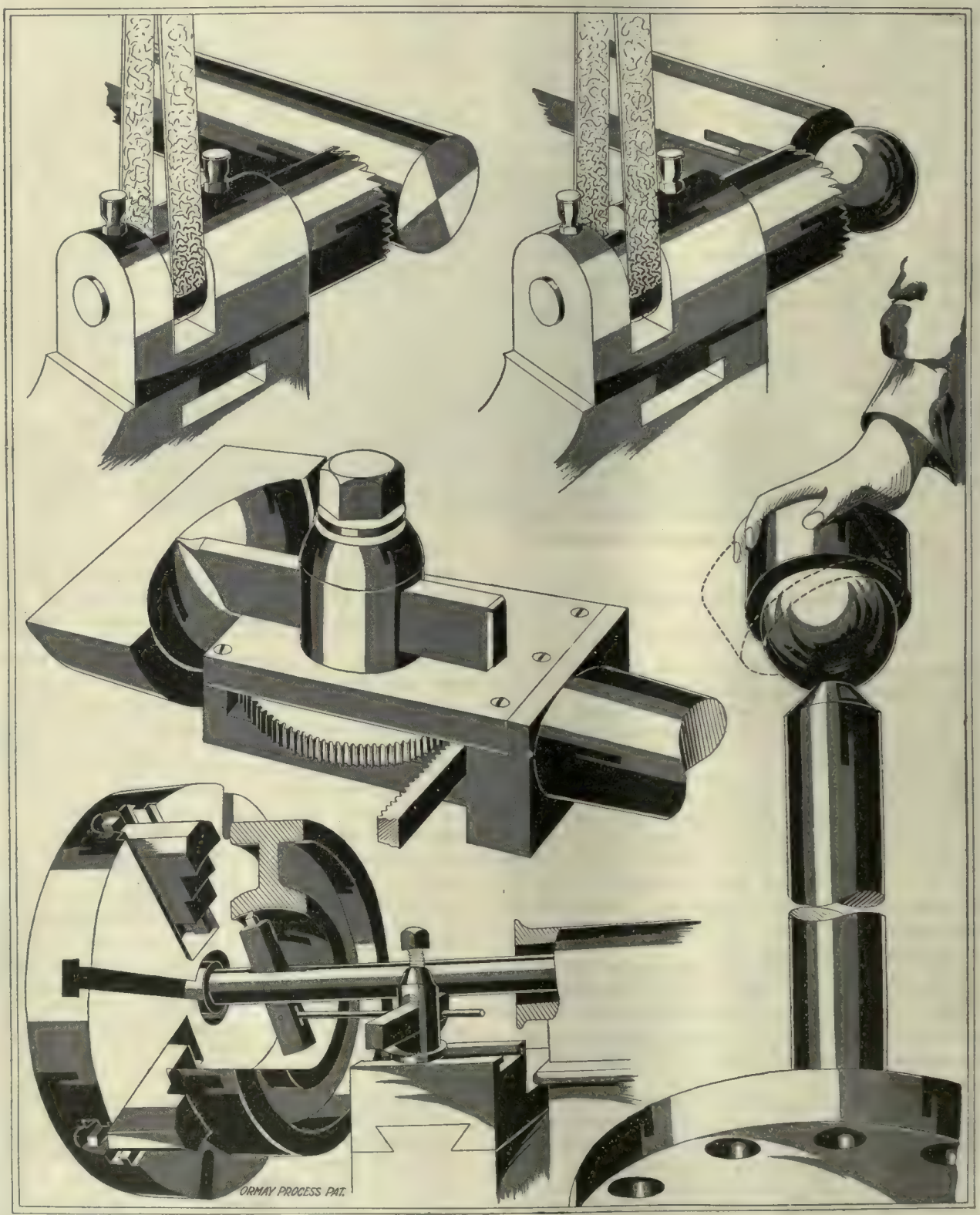
A case that was brought to the attention of the writer was that of a man who, with an experience of seven years as an accountant in two of the largest concerns in the state, applied for a position in the accounting department, and was turned away under the plea that he lacked experience. The Government later accepted him with a rating of 81 per cent. on his application and immediately placed him in a $2400 position. This man was acceptable to the employment supervisor, but was turned down by the office executive, yet he proved so efficient as to handle a staff of 40 men under the Government.

Planning an Exposition in Norway

Efforts are being made to hold an exposition in Christiania, Norway, in the summer of 1919, which will include all branches of American goods. This has the approval of the American minister at Christiania. The idea is an excellent one, because, since the outbreak of the war, Norway has come into closer commercial relations with America.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



METHODS FOR TURNING SPHERICAL SURFACES

American Machinery In Australia

Bureau of Foreign and Domestic Commerce

Australia being widely separated from industrial nations must perforce depend more and more upon her own industries for many manufactured articles for home consumption. This means that she must produce and keep in repair an ever-growing volume of machinery. To do this, machine tools of every description will be needed, the demand for which will offer to the American machine-tool builders a promising outlook for a permanent export market.

AUSTRALIA is rapidly becoming a manufacturing country and the demand for certain American machinery and machine tools is increasing. As a majority of the engineering establishments are also jobbing shops, the engineers in charge are averse to buying from catalogs but desire actual demonstrations, especially of new machines, and the majority of sales are accordingly made after a sample machine has been received by the agent or importer. A substantial additional discount on introductory orders should be allowed, particularly in highly specialized lines, as otherwise there is not sufficient incentive to warrant the importer taking the risk of the machine not being a success. Types of American machines, which have subsequently enjoyed exceptional sales, have been kept off the Australian market for years because the manufacturers did not put a sample machine into the hands of a good agent and were finally introduced by the importer who took a chance on their success.

Location of Manufacturing Industries

The majority of the manufacturing plants and the largest engineering shops are situated in Sidney, New South Wales, and Melbourne, Victoria, which places produce an equal amount of manufactured goods. The former took 53 per cent. of the imports of machine tools in 1916-17, and the latter 37 per cent. The territory of Queensland, however, with its rapidly expanding meat trade and meat-canning industries will show an increased demand for machinery and machine tools in the next few years, although taking only 4 per cent. of the total imports of machine tools in 1916-17. The same is true of Western Australia with its gold-mining developments. Wool and textile manufactures are the leading industries in Victoria and New South Wales, and their growth has been hastened by lack of shipping facilities which has cut off Australia from foreign markets.

Exclusive Agency Most Acceptable

The exclusive agency is accepted as the most satisfactory method of selling machinery and accessories in Australia. Some of the established agencies have certain circles of customers, but progressive agencies make themselves of general service to all customers. Moreover, in a country like Australia where vast distances must be traveled seeking orders and modern machinery is just being introduced, it is only fair to the agent who has stocked a machine, which may sometimes prove unsalable, that he be protected by an exclusive contract. If proper care is taken in the selection of a progressive house there is little fear that an arrangement will be used to stifle competition, such firms generally being just as anxious to develop business as the manufacturer.

Since the war, Australian importers have arranged for cash payments against documents in New York, and there is little probability of an early return to the old method of sight drafts with documents. The price list in almost universal use in Australia is made on a small loose sheet punched with three ¼-in. holes at 3 in. centers. The advantage of conforming to such styles of price lists and insuring the maintenance of complete files of prices is apparent. This same suggestion holds good with reference to delivery information sheets and sheets showing machines in stock.

American War Deliveries

The Australian import agent seems to have legitimate fault to find with the American manufacturers' optimism in making delivery promises. It is, of course, open to question whether under the abnormal war conditions any industry can function with the same precision as in peace times, and now that peace is at hand American manufacturers will be quick to convince Australian importers that they are ready and willing to make as satisfactory deliveries as other countries. All the Australian agent seems to request is that orders be delivered in the same rotation as received; any other treatment is not only unfair but a source of embarassment and expense to the importer who has given his customer a specified date of delivery. Perhaps the importers would not complain if they were quoted definite dates of delivery even three times as long as those given, as they would then know what to expect and could explain to their customers. But a short-sighted policy of accepting all orders at delivery dates impossible of execution is to be avoided.

Information and Instructions Wanted

Foundation plans, instructions for setting up, and information regarding the working of machines are all greatly desired. Such information is usually the sole guide of the employees who operate the machines, and in many cases newly introduced types of machines can be satisfactorily set up in no other way than by following printed instructions. In one instance a fairly intricate automatic gear-cutting machine was ordered and instructions specifically requested, but no attention was paid to the request. When five more of the machines were ordered the same thing occurred, so that the matter could not be attributed to oversight.

The Australian importer is a close reader of the leading American machinery trade journals, and information regarding new types of machines is often requested on the strength of these advertisements. Naturally the importer who writes for a particular machine is interested in other types and a sale of some other machine might be effected at once if other catalogs were sent, whereas the order for a similar machine is placed with a competitor of the manufacturer because of this lack of business foresight. This situation will be better appreciated when it is realized

that under present conditions it requires 10 weeks for a letter to reach Australia and a reply to be received. For this reason it is sometimes advisable in case of unstable price conditions to state that prices will hold until a definite date, so that the Australian merchant will be able to cable his order in case the letter is delayed.

Practically all machinery is subject to customs tariff in Australia and must undergo inspection, and for this reason it is preferable to leave one board on the top of the case not hoop ironed and nailed but simply screwed down. This board should be located so as to allow a good view of the machine. The loading and warehousing facilities in Australia are not the best, and few cranes are employed, so that strong packing is desirable.

Machines in Demand

Lathes are the most important essential in the machine shops which are springing up in Australia. As the majority of the work of these shops is jobbing, the machine tools should be universal. Gap lathes, for instance, permit one machine to cover a large range of work and are very popular in Australia. One American machine of this universal type has enjoyed a very large sale. Most of the American gap lathes before the introduction of this one were cheap, and light tools are not in demand. A popular lathe of English manufacture has very large bearings and a rugged headstock which appeals strongly to the Australian market and is in more universal favor in large mining shops than any other tool.

The price of American planing machines as compared with those of English make is disproportionately high. Though the American machines are very high grade with a number of automatic and convenient feeds, these conveniences have made the price too high for the Australian market, and at present there are not half a dozen of these machines in use in that country. A moderate-priced simple planing machine could be introduced to advantage. This is equally true of punches, shears, rolls, and other tools used in shipbuilding and structural work, our price of which is out of all proportion to the prices of British makes.

Table I shows the increase by countries in imports of machine tools since the beginning of the war.

TABLE I. INCREASE BY COUNTRIES IN IMPORTS OF MACHINE TOOLS FROM 1914 TO 1917

Imported from	1914–15	1916–17
United Kingdom	$265,039	$424,846
United States	226,307	407,618
Germany	9,081	.....
Sweden	6,964	1,883
Belgium	4,993	.....
New Zealand	1,153	5,767
Canada	3,236	4,803
All other countries	346	8,370
Total	$517,119	$853,287

Table II shows the principal lines of machinery, imports of which have increased during the past five years, and the countries of origin of these imports in 1916-17 are given in Table III.

TABLE II. KINDS OF MACHINES WHICH SHOW INCREASED IMPORTATION FROM 1912 TO 1917

Kinds of Machinery	1912	1913	1914–15	1915–16	1916–17
Cream separators	$445,674	$510,389	$311,295	$266,636	$468,313
Harvesters	306,015	376,059	669,090	88,634	691,247
Mowers, reapers and binders	534,775	789,740	472,722	793,400	639,585
Dynamos up to 200 hp.	1,803,885	1,910,802	1,668,265	2,230,419	1,987,060
Electric starting apparatus	415,706	357,882	431,551	437,975	519,747
Weighing apparatus	195,599	191,672	192,120	223,902	211,479
Total	$3,701,654	$4,136,544	$3,745,043	$4,040,786	$4,517,431

TABLE III. COUNTRIES OF ORIGIN OF IMPORTS GIVEN IN TABLE II

Kinds of Machinery	United Kingdom	Canada	United States	Sweden	All Others
Cream separators	$13,178	.....	$11,441	$430,826	$12,867
Harvesters	.....	$448,248	242,999	.....	.....
Mowers, reapers and binders	14,069	273,186	352,315	.....	14
Dynamos up to 200 hp.	766,459	5,265	1,148,932	27,409	40,455
Electric starting apparatus	225,908	78	292,121	1,148	492
Weighing apparatus	124,680	638	84,755	.....	1,406
Total	$1,144,294	$727,415	$2,132,563	$459,383	$55,234
Per cent. of total	25	16	47	10	2

The decrease in imports of the classes of machinery given in Table IV is attributed mainly to war conditions involving scarcity of tonnage and an abnormal demand on the machinery manufacturers at home, although the fact that the number of establishments in Australia using machinery increased from 9264 in 1910 to 11,438 in 1915 with an increased horsepower requirement from 298,601 to 504,834 would point to a healthy industrial growth which has been fostered by war conditions. Table V shows the countries of origin of these imports in 1916 to 1917.

TABLE IV. KINDS OF MACHINES WHICH SHOW DECREASED IMPORTATION FROM 1912 TO 1917

Kind of Machinery	1912	1913	1914	1915–16	1916–17
Adding and computing machines	$364,384	$481,501	$313,631	$210,418	$257,365
Churns	90,308	114,557	107,248	93,490	73,932
Gas and oil engines	850,825	936,427	897,314	755,709	539,987
Portable and traction engines	830,731	705,360	293,917	277,877	218,404
Locomotives	2,280,306	2,070,185	1,620,228	534,609	381,976
Ploughs, harrows, etc	687,223	604,244	635,521	613,846	516,141
Other agricultural implements	1,009,088	854,003	720,768	727,878	627,087
Clothes wringers and washing machines	167,417	146,092	98,240	79,927	58,237
Dynamos over 200 hp	245,096	335,891	227,942	64,870	85,042
Mining machinery	469,393	541,096	388,926	412,416	361,211
Motive-power machinery	2,483,686	2,486,490	2,358,126	1,454,587	1,205,817
Printing presses	886,044	940,962	575,381	504,223	254,065
Sewing machines	1,489,679	1,260,073	731,508	1,069,203	1,133,442
Typewriters	533,155	477,973	343,624	381,480	471,394
All other machinery	6,360,082	6,750,668	5,959,049	4,194,198	4,615,773
Total	$18,747,417	$18,705,522	$15,271,423	$11,374,731	$10,799,873

TABLE V. COUNTRIES OF ORIGIN OF IMPORTS GIVEN IN TABLE IV

Kind of Machinery	United Kingdom	Canada	United States	Sweden	All Others
Adding and computing machines	$9,329	$2,394	$236,463	.....	$9,178
Churns	3,562	.....	43,195	$16,561	10,614
Gas and oil engines	225,737	16,600	264,640	30,406	2,604
Portable and traction engines	62,758	.....	155,646	.....	.....
Locomotives	315,018	.....	64,608	.....	2,351
Ploughs, harrows, etc	62,033	268,072	173,472	.....	12,565
Other agricultural implements	72,603	204,296	335,443	4,102	10,643
Clothes wringers and washing machines	13,563	.....	44,237	.....	437
Dynamos over 200 hp	64,000	.....	21,043	.....	.....
Mining machinery	81,173	1,475	274,685	3,285	594
Motive-power machinery	827,466	13,728	336,826	11,188	16,609
Printing presses	55,576	5,217	188,781	.....	4,492
Sewing machines	536,254	185	583,226	6,205	7,572
Typewriters	16,254	1,231	453,777	.....	131
All other machinery	2,029,511	13,529	2,393,321	96,493	82,920
Total	$4,374,837	$526,727	$5,569,363	$168,240	$160,710

Promising Outlook for American Trade

The United States is, therefore, the leader in the machinery market of Australia according to latest available statistics. Whether this leadership can be maintained will of course depend upon a great many considerations, not the least important of which are closely related to the suggestions made above. The Australian machinery merchant is fully alive to the advantages and good points of American machinery, just as he appreciates most keenly the weakness in our export methods, the brunt of which eventually must be borne by him. The closest attention should be paid to his wishes if we are to encounter a full measure of success.

US
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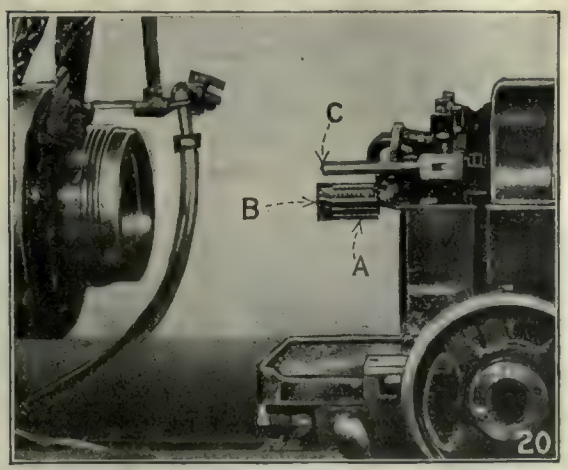
Manufacturing the 9.2-In Howitzer Shell

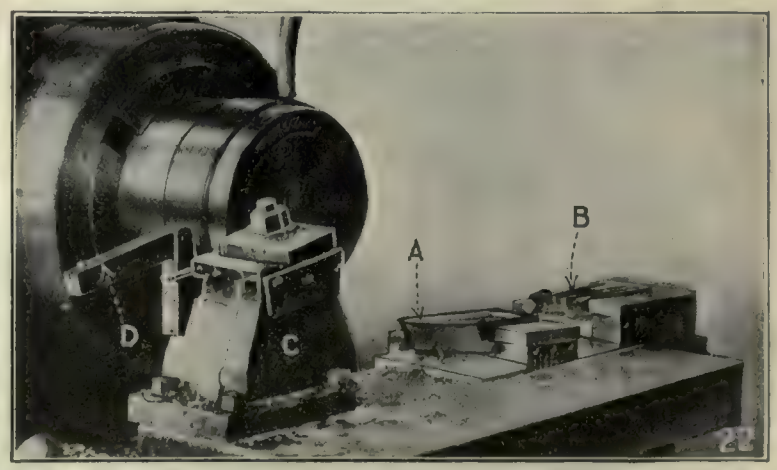
By S. A. HAND.

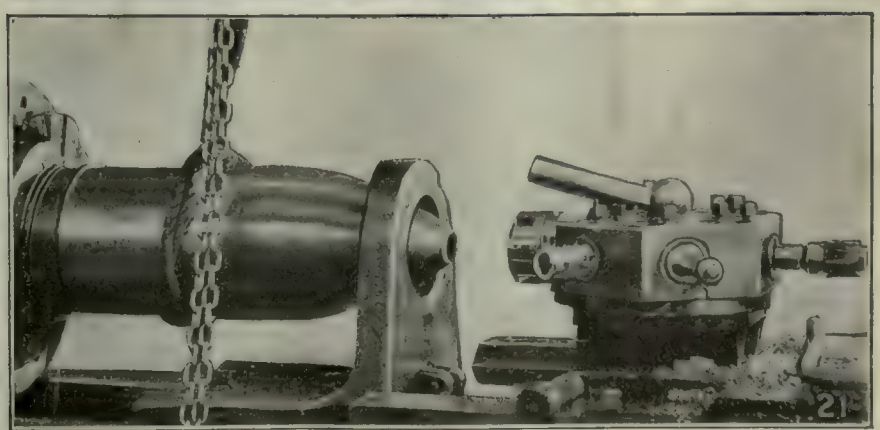
(*Continued from Page 897, May 8 issue*)

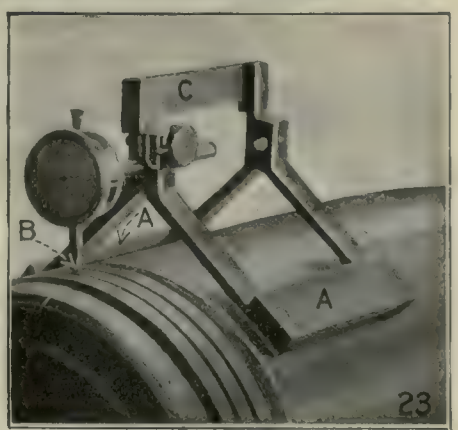
THE thread is milled in a Lees-Bradner thread-milling machine, Fig. 20, the shell being held in a draw-in collet. The hob *A* is of high-speed steel and is without lead, the lead being given to the carriage of the machine by the usual lead screw and change gears. The hob is set to cut the full depth of the thread so that the operation is completed in one revolution of the shell plus a slight overtravel to insure a perfect thread. After completion of the thread the hob is withdrawn from the shell and a milling cutter *B* attached to the outer end of the arbor. This is used to finish the counterbore for the base-plug flange by circular-milling without disturbing the shell in its setting. For this last part of the operation the cutter is positioned for distance by bringing the end of the stop *C* against the shell base and for depth of cut by a stop on the cross-slide. For this part of the operation the lead screw is out of commission and the carriage clamped to the bed of the machine.

The nose must now be faced, countersunk, bored, reamed to size for threading, thread clearance cut and the hole tapped. These operations, Fig. 21, are done









FIGS. 20 TO 23. THREAD MILLING, TURNING AND TESTING

Fig. 20—Milling the thread. Fig. 21—Finishing the nose. Fig. 22—Turning the copper band. Fig. 23—Testing the copper band for concentricity.

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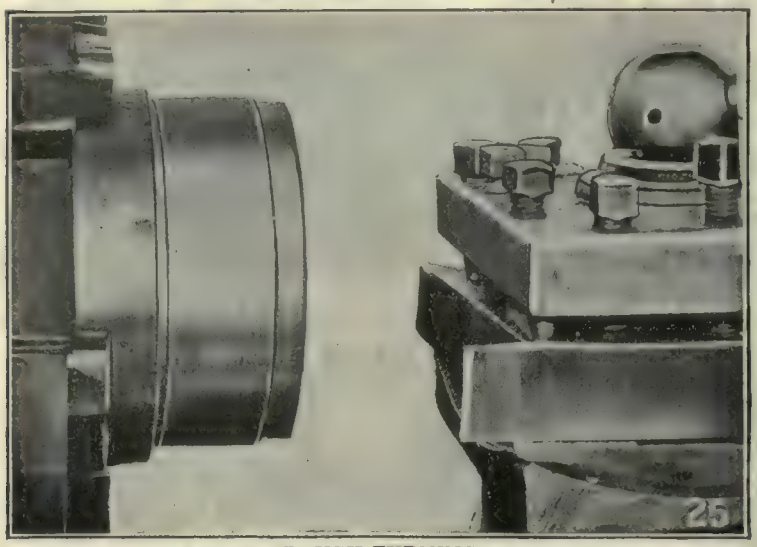


FIG. 25. ROUGH-TURNING

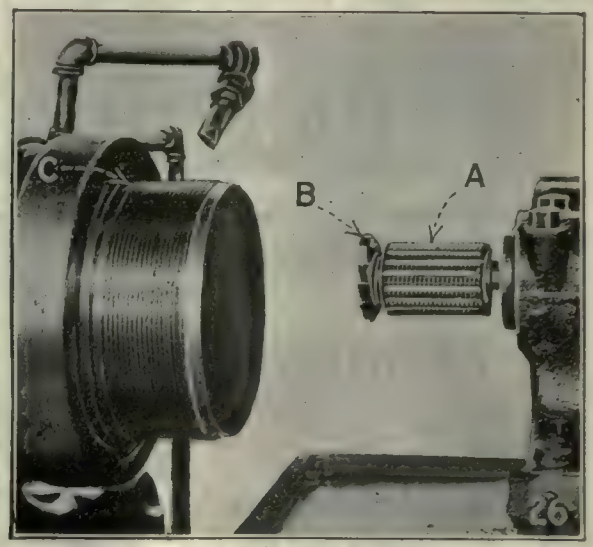


FIG. 26. MILLING THE THREAD

in a 22-in. lathe provided with a hexagon turret on the carriage. The shell is held at the base by a split-ring chuck and supported at the nose by a special steadyrest having a copper ring of the same profile as that of the shell. The operations are such as are used in every-day screw-machine practice and with the exception of cutting the thread clearance, need no further description.

The tool for cutting the thread clearance is single pointed, with the point projecting downward.

In operation the turret-binding lever is slacked off and the turret is raised from its seat by a spring. This allows the tool to clear the bottom of the hole, and while in this position it is fed in beyond the hole and the turret clamped down to its normal position, setting the tool to cut to the proper diameter. The carriage is then fed by hand to the right until a swinging stop on the tool bar (not shown) can be swung clear of the nose. This makes a roughing cut. The feed to traverse the carriage to the left is then thrown in and the spring of the tool makes a finishing cut, when the binding screw is again slacked off and the tool clears the hole by the rising of the turret and is withdrawn without touching the hole.

This arrangement is very simple and obviates the necessity of an auxiliary slide on the turret face.

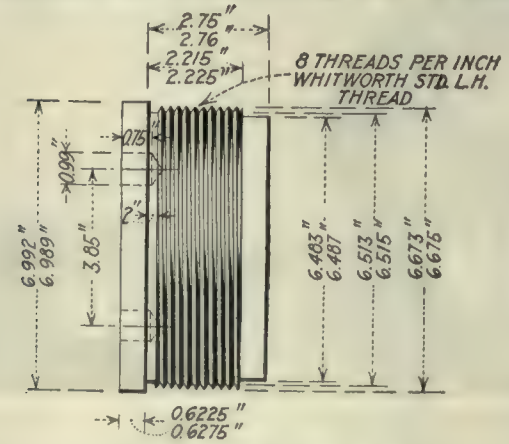
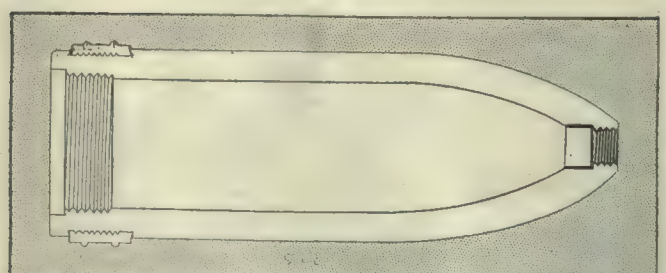


FIG. 24. THE BASE PLUG



TRANSFORMATION FOR OPERATION 512—FINISH NOSE

Machine—Davis 22-in. lathe. Number of operators—One. Work-holding device—Split-ring chuck for base; nose run in special steadyrest. Tool-holding device—Turret on carriage. Cutting tools—High-speed steel. Number of cuts—Four, one counterbore, one ream, one relief, one tap. Cut data—Speed, 58 ft. per minute; feed, 0.021 in. per revolution. Coolant—Mineral lard oil. Gages—Profile, plug, go 1.900 in., No-go, 1.907 in.; plug thread; length of thread. Production, 45 per machine in eight hours.

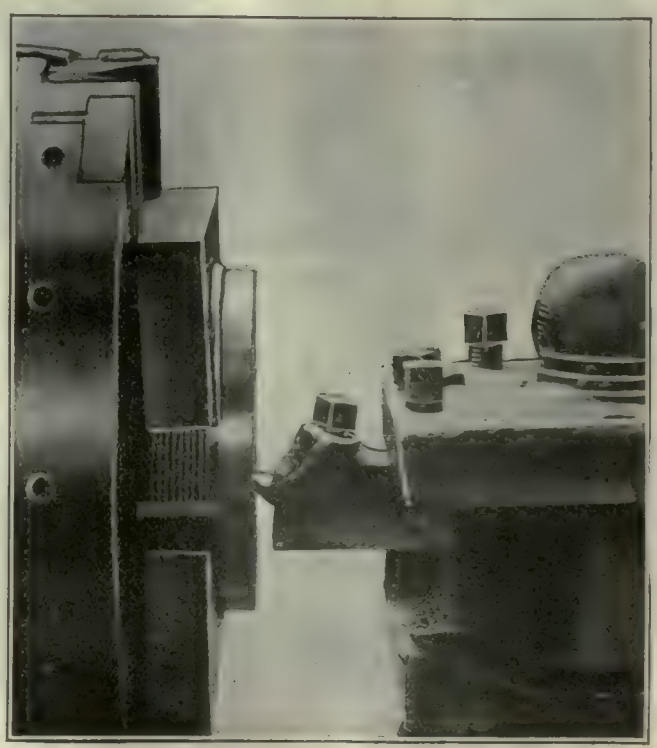
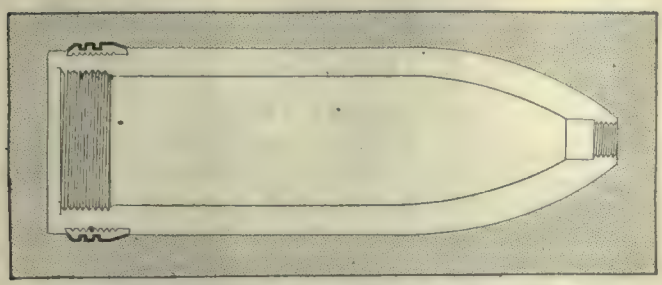


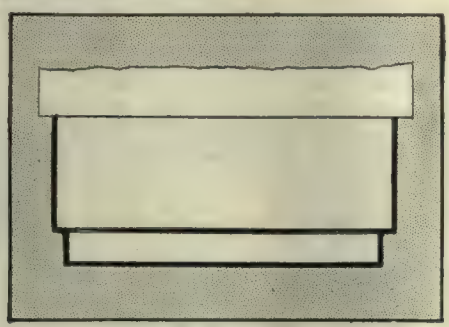
FIG. 27. FINISHING THE FLANGE DIAMETER

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TRANSFORMATION OF OPERATION 515—TURN BAND

Machine—Root & Vandervoort band-turning lathe. Number of operators—One and helper. Work-holding device—Air-operated chuck. Tools—High-speed steel, two trimming tools and one serrating tool in tool block, one roughing and one finishing tool working in slide underneath. Number of cuts—One rough, one finish, one trim and one serrating. Cut data—Speed, 132 ft. per minute; hand feed. Coolant—Soluble oil. Gages—Snap, go, 9.345 in., no-go, 9.335 in. Profile and concentricity. Production—Not definitely known as these machines have just been installed and are as yet an experiment.



TRANSFORMATION FOR OPERATION 540—FACE PILOT, ROUGH-TURN BODY AND PILOT

Machine—Davis 22-in. lathe. Number of operators—One. Work-holding device—Lathe chuck. Cutting tools—High-speed steel. Number of cuts—One facing and two turning. Cut data—Speed, 40 ft. per minute; feed, 0.047 in. per revolution. Coolant—None. Gages—Snap, go and no-go for both body and pilot diameters; length for body. Production—38 per machine in eight hours.

The machines now used for turning the copper band are more or less of an experiment in this plant. While the production on the former type of machine used was fair, the concentricity between the shell and the band was not up to the standard.

The machines now in use were made by Root & Vandervoort, and in them the shells are held in an air chuck. The roughing and finishing tools are formed high-speed steel tools and are set tandem on the cross-slide of the carriage at *A* and *B*, Fig. 22. As will be readily seen they make the cut by passing underneath the work. The feed is by hand and is so heavy that it requires the use of a lever between the spokes of the operating handwheel. The space between the two tools is small and the copper chips or shavings choke there to such an extent that a man is stationed behind the machine to clear them away.

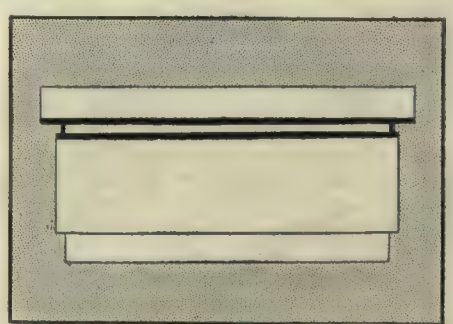
The tool *A* is the roughing tool. The tool *B* finishes the band to diameter, tapers the front edge and cuts the lubricating grooves. The tool block *C* carries a tool on each side to trim the band to width. There is also a pivoted tool *D* shown in the out position. When this tool is swung forward and fed to the work it cuts a number of fine serrations in the tapered part of the band.

Upon completion of the band turning the shell is laid on a bench and the band tested for concentricity with the body by the apparatus shown in Fig. 23. The frame of the device rests on the shell by its feet *A* while the plunger *B* of the dial gage rests on the copper band. The shell is rolled along the bench and the gaging device held in an upright position by holding the bar *C* with the hand. It will readily be seen that any variation from concentricity will be shown by the dial gage. After this test a spliced-rope grommet is put on the base to protect the finished copper band from injury. This grommet is kept in place during subsequent operations until it is necessary to wash the shell prior to varnishing.



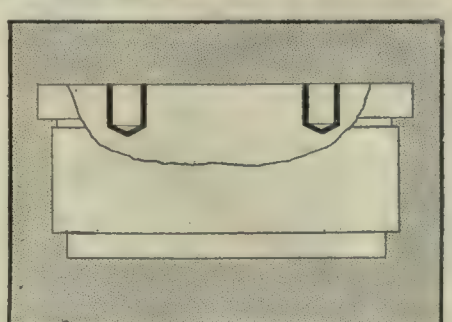
TRANSFORMATION FOR OPERATION 543—ROUGH-TURN AND FACE FLANGE

Machine—Fairbanks-Morse 16-in. lathe. Number of operators—One. Work-holding device—Lathe chuck. Tool-holding device—Square turret on carriage with two tools. Cutting tools—High-speed steel. Number of cuts—Two on face and one on diameter. Cut data—Speed, 82 ft. per minute; hand feed. Coolant—None. Gages—Snap, go, 7.020 in.; no-go, 7.015 for diameter and thickness, 0.680 in. for flange. Production—60 per machine in eight hours.



TRANSFORMATION FOR OPERATION 544—FINISH FLANGE SEAT

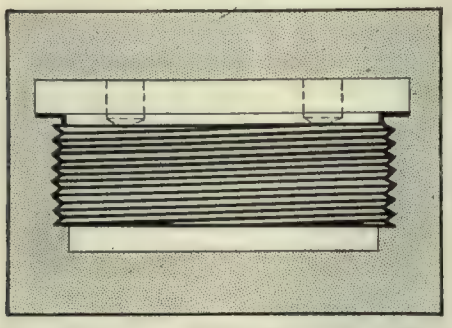
Machine—Warner & Swasey. Work-holding device—Ring chuck. Tool-holding device—Turret on carriage with two tools. Cutting tools—Stellite. Cut data—Speed, 156 ft. per minute; hand feed. Number of cuts—Two. Coolant—None. Production—250 per machine in eight hours.



TRANSFORMATION FOR OPERATION 545—DRILL KEYHOLES

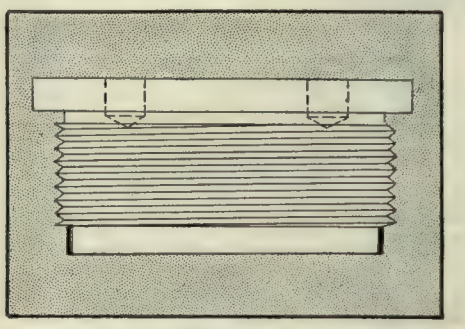
Machine—Upright drilling. Number of operators—One. Cutting tool—¾-in. high-speed drill. Number of cuts—One for each hole. Cut data—Speed, 60 ft. per minute; hand feed. Coolant—None. Special fixture—Jig. Gages—Center to center of holes. Production—350 per machine in eight hours.

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TRANSFORMATION FOR OPERATION 546—MILL THREAD AND CUT CLEARANCE

Machine—Lees-Bradner thread-milling. Number of operators—One. Work-holding device—Draw-in collet. Cutting tools—Threading hob and plain milling cutter (high-speed steel). Number of cuts—One for threading and one for clearance. Cut data—Speed, 89 ft. per minute. Coolant—Mineral lard oil. Gages—Plug thread, go, 6.675 in.; no-go, 6.671 in., thickness, go, 0.63 in.; no-go, 0.61 in. Production—70 per machine in eight hours.



TRANSFORMATION FOR OPERATION 547—FINISH PILOT DIAMETER

Machine—Lodge & Shipley 20-in. lathe. Number of operators—One. Work-holding device—Ring chuck. Cutting tool—Stellite. Number of cuts—One. Cut data—Speed, 145 ft. per minute; hand feed. Coolant—None. Gages—Ring, go, 6.490 in.; no-go, 6.480 in. Production—500 per machine in eight hours.

The shell is now ready for fitting the base plug, and it will be well at this point to consider the manufacture of that member.

The Base Plug

The forgings for the base plugs are of the same composition as the shell forgings, and like the latter are furnished to the manufacturers by the Government. They weigh in the rough about 55 lb.

SEQUENCE OF OPERATIONS

540. Face pilot. Rough-turn body and pilot.
543. Rough-turn and face flange.
544. Finish flange seat.
549. Face flange to thickness.
545. Drill keyholes.
546. Mill thread.
547. Finish pilot diameter.
548. Finish flange diameter.

Fig. 24 is a drawing of the finished base plug and shows all the working dimensions.

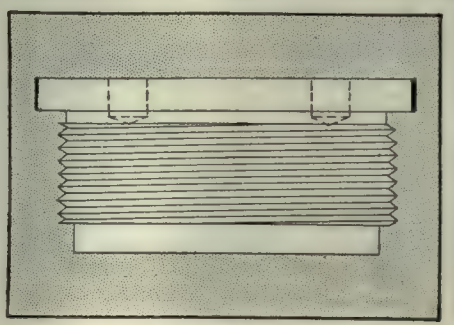
With the exception of drilling the wrench holes, milling the thread and its clearance, the operations on the base plug are all done in lathes of the regular type. The work in the greater part of the operations is held in ordinary lathe chucks and the tools in square turrets on the carriages. High-speed steel is used for roughing, Stellite for finishing and no coolant is used. Fig. 25 illustrates the first lathe operation and is so typical of the ones that follow that a description of them would be monotonous.

The wrench holes are drilled in an upright drilling machine and a jig that slips over the flange is used. The holes are $\frac{3}{4}$ in. in diameter and $\frac{3}{4}$ in. deep.

Milling the Thread

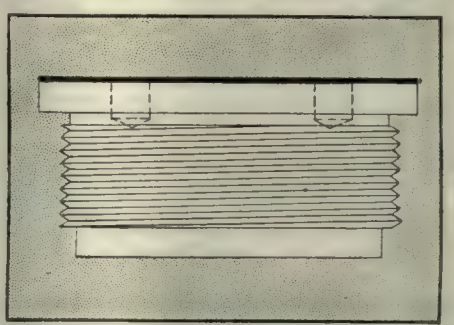
The thread, 8 per inch Whitworth left hand, is milled in a Lees-Bradner thread-milling machine, Fig. 26, and the plug is held by the flange in a draw-in chuck.

The hob *A*, which is high-speed steel, is without lead,



TRANSFORMATION FOR OPERATION 548—FINISH FLANGE DIAMETER

Machine—Lodge & Shipley 20-in. lathe. Number of operators—One. Work-holding device—Chuck gripping work by threads. Cutting tools—Stellite. Number of cuts—One. Cut data—Speed, 147 ft. per minute; hand feed. Coolant—None. Gages—Snap, go, 6.992 in.; no-go, 6.989 in. Production—500 per machine in eight hours.



TRANSFORMATION FOR OPERATION 549—FACE FLANGE TO THICKNESS

Machine—Lodge & Shipley 20-in. lathe. Work-holding device—Draw-in collet. Cutting tools—Stellite. Number of cuts—One, or two if necessary. Cut data—Speed, 156 ft. per minute; feed, 0.047 per revolution. Coolant—None. Gages—Thickness, go, 0.63 in.; no-go, 0.61 in. Production—200 per machine in eight hours.

the lead being given by the movement of the carriage through the usual lead screw and change gears. The full depth of the thread is cut at once, and the threading is completed in one revolution of the work plus a slight overtravel to insure a perfect thread. Upon the completion of this operation and before removing the plug from the machine, a milling cutter *B* is attached to the arbor outside of the hob and is used to finish the clearance *C* back of the thread by circular-milling. For this part of the operation the carriage is clamped in position, the feeding mechanism for the thread lead being thrown out of gear.

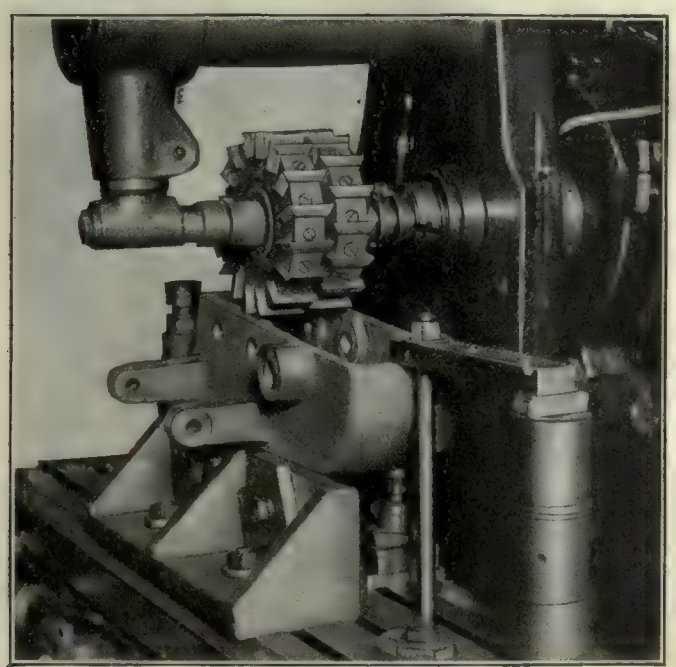
The last operation, Fig. 27, is to finish the diameter of the flange. This, like other operations, is performed in an ordinary engine lathe, the only difference being in the manner of holding the work. To prevent injury to the threaded part, by which the work must be gripped, it is held in a two-jawed chuck having a thread milled in the jaws of the same form and pitch as that on the plug.



Facing Off Inside Bosses

By E. V. Allen

A simple and quick method of facing off inside bosses is shown in the illustration. This work is done in the shop of the Acme Machine Tool Co., Cincinnati, Ohio. The gear-box casting is lined up and clamped to the milling-machine table under the correctly spaced side-



FACING OFF INSIDE BOSSES

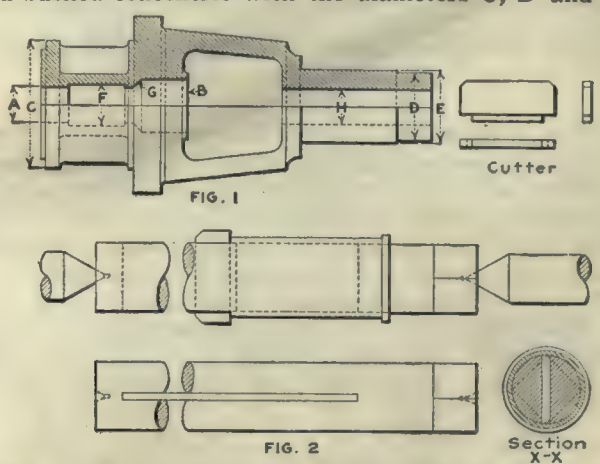
milling cutters on the arbor. The table is then raised and the opposing bosses on the inside of the casting are milled off at once.

Re-boring a Corliss Valve-Bonnet

By A. M. Stiles

Metallic packing when used on worn valve stems of the Corliss type is very likely to give trouble unless the stem is cylindrical and turns perfectly true. Even where the design of the packing provides for lost motion in the stem, better results will be obtained by truing up the latter and bushing the bonnet.

While attaching metallic packing to six triple-expansion pumps in water-works service, the writer observed that only a short bearing was provided at the back of the bonnet at *A*, Fig. 1; also that the face at *B* had not been machined. The design of the bonnet provided for fibrous packing and a short loose bearing at *A* was considered good practice, for it insured an ample supply of steam on the packing to keep it lubricated. Neither was it necessary to face the surface *B*, the gland studs not requiring it, but the adoption of metallic packing necessitated having the bonnet bored and bushed concentric with the diameters *C*, *D* and *E*,



FIGS. 1 AND 2. THE PIECE TO BE REBORED AND THE BORING BAR

for the bearings were badly worn and out of alignment. Diameter *F* was cored.

There were 40 steam and exhaust bonnets to be bored and the bar used is shown in Fig. 2. But one set-up was used and the cuts were taken with the job revolving. Several attempts had been made to enlarge the holes with reamers with extended shanks, but these

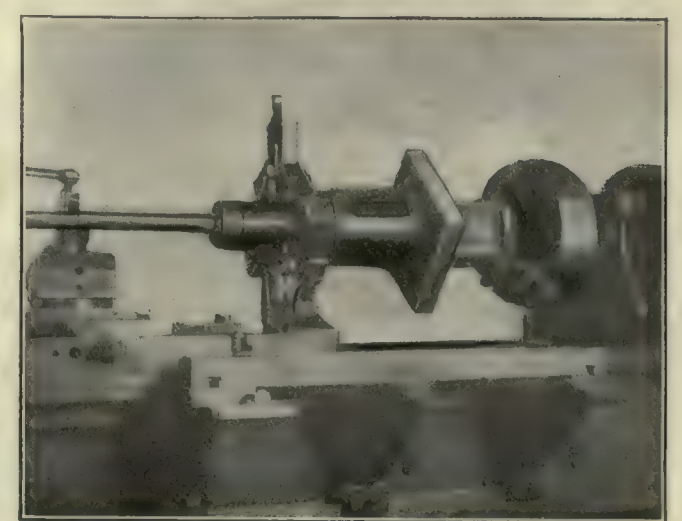


FIG. 3. REBORING A LONG PIECE

invariably followed the worn or cored holes with unsatisfactory results. This type of boring bar is not new and, as usually made, carries but one sleeve of sufficient length to bore ordinary holes. The regular carriage feed is used, and the cutting rate therefore depends on the speed of the lathe. Its adoption for this job required that the sleeve be made up in sections to keep the bar as short as possible.

The cutters were made of flat stock $\frac{5}{16}$ x $1\frac{1}{4}$ in. and finished only at the diameters and bevels as shown. The bar is of machine steel and the sleeves are made of cast iron.

The bonnet was faced at *B*, Fig. 1, for the gland gasket, by passing a cutter through the hand space into the bar and fitting it into the sleeve. The stuffing-box was also trued up in this way and the bevel at *G* faced square for the spring retaining washer. These cutters were too long to pass through the diameter *H*.

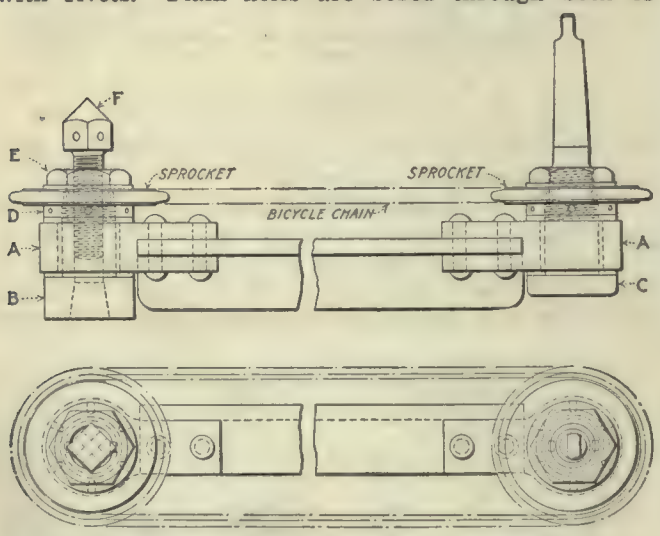
The holes were very smooth, free from taper, in alignment and concentric with the valve chamber, bell crank, and cut-off collar bearings, thus making the fitting of bushings an easy job. The set-up is shown in Fig. 3.

A Simple Corner Drilling Device

By J. Gardner
Gourock, Scotland

The sketch shows a simple corner drilling attachment for use in conjunction with either pneumatic or electric drilling machine. Although this attachment was designed to complete a difficult bit of corner drilling which was beyond the range of the standard corner machines, it has since proved quite a useful tool to have in the shop for drilling in awkward corners.

The body of the attachment consists of a piece of angle iron to both ends of which the pieces *A* are fixed with rivets. Plain holes are bored through both of



DEVICE FOR DRILLING IN A CORNER

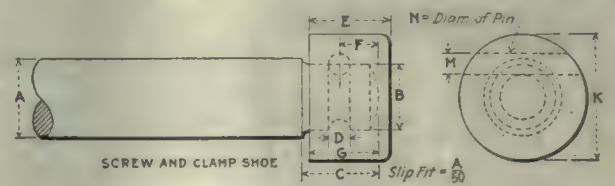
these pieces and gun-metal bushings are driven therein to form bearings for the shanks *B* and *C*. The lower end of *B* has a tapered square hole in it to fit the ends of drills used. A portion of the shank *B* is threaded to receive the circular nut *D*, the latter being provided with holes around its periphery for a tommy-bar. Above the nut *D* the diameter of the shank is reduced slightly and threaded to take another nut *E*. Between nuts *D* and *E* a sprocket wheel is placed and as additional means of securing it, two small feathers are set in it. Apart from serving to clamp the sprocket wheel in place the two nuts are used to adjust for wear. A hole is bored through *B* and threaded to take the center *F* used for feeding the drill into the work. The arrangement of the other end of the device is similar except that the upper end of *C* is made a standard taper to suit the driving machine. The two sprocket wheels are connected by a chain which gives a suitable drive.

[While this device will no doubt serve its purpose satisfactorily, an unguarded chain in the position designated would constitute a very serious menace to the operator's fingers. A chain guard should be considered an essential feature of the device.—Editor.]

Standard Sheet for Clamp Shoes

By C. H. Dengler

How much easier is it when designing jigs or fixtures to have a satisfactory set of standard parts to work with than to have to design practically the same parts every time when working in a place where either the standard data sheets are few or else they have none at all! No doubt many readers like myself have worked in both kinds of plants and found when they possessed a good and reliable set of standards many a big job



A = Diam of Screw,
B = Root Diam of Thds

C = A
D = 4/3 N
E = 7/6 A
F = 1/2 A
G = 11/12 A
K = 5/3 A
M = 1/2 B
N = 1/4 A

	SIZE SCREW	HEAD DIAM	HEAD LENGTH	WIDTH RECESS	SHOE LENGTH	LOCATION	DEPTH	SHOE DIAM	LOCATION	PIN DIAM
No	A	B	C	D	E	F	G	K	M	N
1	3/8 × 16	19/64	3/8	1/8	7/16	3/16	11/32	5/8		3/32
2	7/16 × 14	11/32	7/16	5/32	1/2	7/32	5/16	3/4	11/64	7/64
3	1/2 × 13	13/32	1/2	5/32	19/32	1/4	15/32	27/32	13/64	1/8
4	9/16 × 12	7/16	9/16	3/16	21/32	9/32	1/2	15/16	7/32	9/64
5	5/8 × 11	1/2	5/8	3/16	3/4	5/16	9/16	1 1/16	1/4	5/32
6	11/16 × 10	9/16	11/16	7/32	13/16	11/32	5/8	1 1/8	9/32	11/64
7	3/4 × 10	5/8	3/4	1/4	7/8	3/8	11/16	1 1/4	5/16	3/16
8	7/8 × 9	3/4	7/8	9/32	1	7/16	13/16	1 7/16	3/8	7/32
9	1 × 8	27/32	1	5/16	1 1/16	1/2	29/32	1 5/8	27/64	1/4

TABLE OF STANDARDS FOR CLAMP SHOES

was finished with much time saved both in the drawing office and the toolroom.

With the double result to be gained of a better tool produced at less expense, why is it that so few plants appreciate the benefit of a complete set of standard tool parts as well as standards for the important machines? How many hours have you wasted running out in the shop to know the width of this machine table, the taper on that machine spindle, the length through the spindle, the distance between the shears, and many other dimensions that must be known exactly before a fixture can be fitted to a machine?

Now this data should be furnished by the machine builder if he wants his customers to get full service from his machine. Some manufacturers are most willing to help the users of their machines to adapt them to

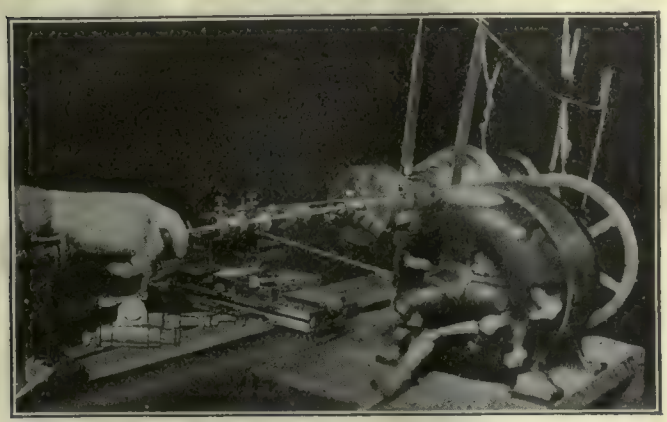
their requirements, while others act as if they were giving away secrets by setting forth the before mentioned sizes.

The sketch shows a table of standards for clamping shoes that has been in constant service since the war started. The table is self-explanatory. The formula for deriving the various sizes is given, as is also a table of screw sizes between ⅜ and 1 in. We generally cyanide the bearing end of the screw to resist wear. The radius on the screw gives us a one-point contact, which allows the shoe to take up any unevenness of the work.

Driving Grinding Attachment of Bench Lathe With Motor

By J. J. McIntyre

The cut shows the means by which we avoid the extra countershaft over a bench lathe used to drive the grinding attachments. A ¼-hp. motor is mounted on a suitable stand and the armature shaft fitted with a grooved driving wheel. This method of mounting provides ready portability so that the motor may be used on any one of several lathes.



DIRECT DRIVE OF GRINDING ATTACHMENT

Reverse Drawing a Shell

By G. R. Smith

A brass shell was to be made in two drawing operations from 0.020-in. sheet brass. It was blanked and cupped from the strip, then redrawn with practically the same tools. The second drawing operation turned the shell completely inside out. No special stock was required, only a single annealing operation between draws which would have been required under any conditions.

In Fig. 1 are shown the tools set up for the first operation of blanking and cupping from strip stock, the blanking operation being done at *A*, which is a tool-steel ring hardened, sunk in the die holder *G* and held in position with fillister-head machine screws. After the disk is blanked from the stock it is drawn over the core ring *B*, which is also tool steel hardened, sunk in *G* and held with fillister-head screws. The radius on the outside of *B* is the shape required in the bottom of the shell from the first draw. The inside radius of *B* is the shape required to permit an easy draw in the second operation. The pressure ring *C* governs pressure on the stock during the draw. Pins *Q* pass through *G* to the steel ring *D* resting on the rubber bumper *E*, which is held in position by the rod *F* screwed into a removable plug *M*. The pressure is controlled by a nut at the bottom of the rubber bumper.

In Fig. 1 *H* is the tool-steel blanking and drawing-ring punch hardened and sunk into the die holder *I* and held in position by fillister-head machine screws. A round stripper plate *J* is fastened to a rod passing through the spring *K* and through the removable plug *L*. Its downward travel is limited by a pin *N*. This

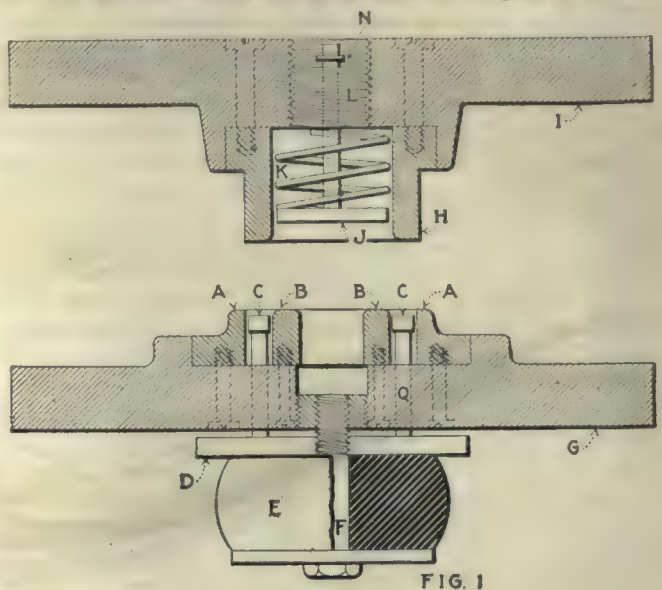


FIG. 1

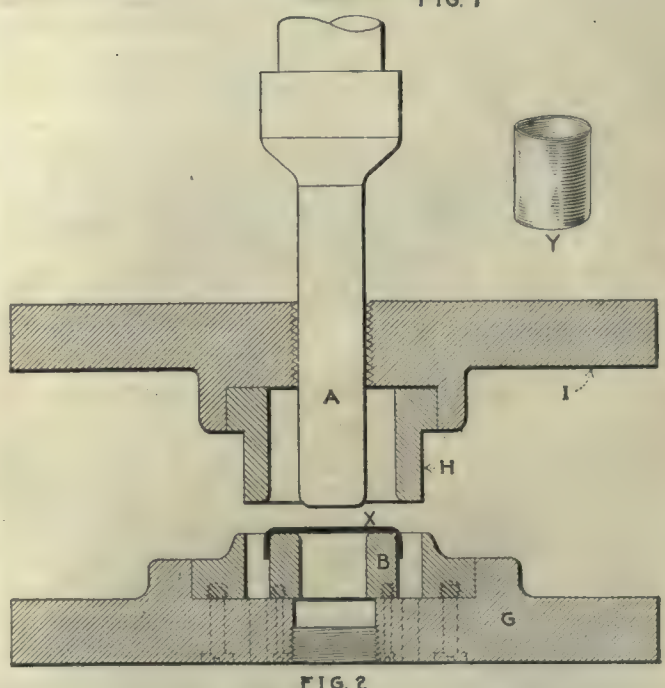


FIG. 2

FIGS. 1 AND 2. FIRST AND SECOND OPERATION TOOLS FOR A BRASS CUP

stripper forces the drawn shell out of the punch should it tend to stick there after the draw, while the pressure ring *C* acts in the same way should the shell cling to the center core ring *B*.

At *X* the shell is shown as it comes from the die after the first operation. Lard oil is used to lubricate the stock. The present production is from 1200 to 1500 an hour with the operator removing the shell from the die by hand. In shops where compresesd air is used this production could be materially increased.

If these tools are carefully set up and watched oc-

casionally for scratches on the side of the shell and for metal clinging to the radius of the die they will be found to be very satisfactory. Plenty of oil must be used as, in brass drawing, dry stock causes more trouble than anything else. The radius on the punch *H* and the radius on the die ring *B* must be polished off occasionally, and great care must be taken to see that no small particles of emery or grit are left in the die.

Fig. 2 shows the same tools prepared for the second draw. The pin *N* in the end of the stripper rod in the punch, Fig. 1, is removed and the stripper arrangement is completely removed from the punch, then the plug *L*, Fig. 1, is taken out and the punch is ready. In the die the rod *F*, Fig. 1, is removed, the rubber bumper and the plug *M* taken out of the die, together with the pressure ring *C* and riding pins. This prepares the die for the second draw.

In this operation another punch is used, which is simply a tool-steel piece turned up to the required shape and hardened. It is shown at *M*. In Fig. 2 at *X* is shown the first operation shell in position for the second-operation draw. At *Y* the finished shell is shown as it comes from the second draw. The first operation shell is simply slipped back over the core ring *B* where it was first drawn, and as the center ram of the press descends it turns it inside out and pushes it down through the ring *B* and die holder *G* and out. The punch ring *H* holds the shell rigid and in position while the punch *A* is in operation on the second drawing.

These tools were set up in a No. 1½ toggle-action Bliss drawing press. In the second operation the punch holder *I* is left in position after being stripped down, and the steel punch *A* is screwed or pinned to the center ram of the press.

The shell is stripped from the punch in the second drawing operation by the lower edge of the die *B*. When the draw is completed and the punch has forced the shell below this edge the shell expands enough to strip from the punch on the upward stroke.

Thus we are blanking from the strip stock and doing first and second drawing operations on practically the same set of tools.

Milling Pulley Faces

By A. Des Angelis

A machine for milling pulley faces built upon the principle shown on page 528, vol. 49, of the *American Machinist* may be seen in the cut. The machine consists of a horizontal spindle running in bearings in a suitable bracket or pedestal, another horizontal spindle lying at right angles to and considerably below the plane of the first, and means of driving the two at suitable speeds.



MACHINE FOR MILLING PULLEY FACES

The first spindle has no movement other than rotative. It is arranged to receive the bored and faced pulley casting at one end, this casting being held in place by a large washer and retaining nut, while at the other end of the spindle is keyed the large wormwheel which serves to drive it.

The bearings in which the second spindle rotates form part of a carriage that is movable in a direction parallel to the center line of the spindle. This spindle is driven through a large spur gear at the outer end and at the inner end carries a face mill with a single circle of inserted tooth cutters.

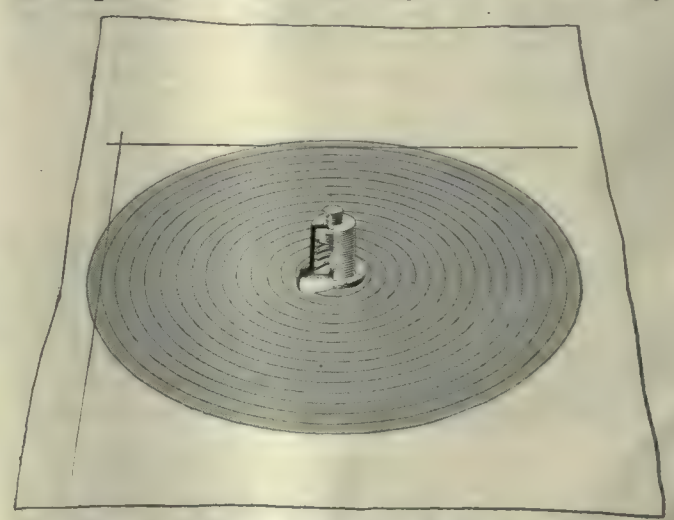
This cutter faces the pulley and the difference in level of the two spindles is so calculated in relation to the diameter of the circle of cutting edges that these latter travel across the pulley face in an arc of large radius leaving the desired crown. A driving shaft turns the cutter spindle by means of a pinion meshing into the large spur gear and it also drives the work spindle by a belted speed-reducing gear and the worm and wormwheel.

It is the sole duty of the young lady shown in the illustration to remove finished pulleys and replace them with castings on ten of these machines. As each machine finishes a pulley in one revolution of its work spindle, the work, while it does not overtax her strength, leaves her very little time for reflection.

Center-Locating Device

By Robert Liebrich

A handy device for draftmen's use by which it is easy to locate the center of tangent circles, is shown in the sketch. It consists of a circular disk of transparent celluloid about $\frac{1}{16}$ in. thick, large enough in diameter for the largest circle which one may wish to use. Any



CENTER LOCATING DEVICE FOR DRAFTSMEN

graduation desired can be made with a pair of sharp dividers, the resultant lines being filled with ink. A plunger with a needle point and spring is fitted into a tube riveted to the center of the celluloid disk. The sketch shows the device set on a piece of paper with the outer lines tangent to the right angle lines on the paper beneath. By pressing on the plunger a center is provided for the point of your compass. This is a simple device, but saves a great deal of time where there is much of this line of work on hand.

Hiring In and Hiring Out

BY ROY A. MONTAGUE

JUST before the armistice was signed directing a cessation of hostilities between the warring nations of the world the necessity of engaging the services of additional detailers and tracers arose in the factory where the writer has charge. Accordingly there was placed the following advertisement in several newspapers circulating in the city, where the plant is located:

> WANTED—Mechanical draftsman; first-class detailer and tracer, at least six years' experience. Shopman preferred. Salary, $20 to $25 weekly. Bring small sample of work. THE SO-AND-SO MANUFACTURING CO.

The response was very feeble, and what few applicants there were seemed to be mostly youngsters with an exaggerated idea of their own value and who calmly proposed that we pay them $25 a week while teaching them the rudiments of mechanical drawing.

Much as I deplored the necessity of blighting their young lives, and indeed much as I needed help in the drafting room, I did not feel justified in placing the firm under obligations to them by accepting their altruistic offers, and in consequence I later suffered the displeasure of several irate mothers who took me severely to task for not recognizing the exceptional ability of their precocious offsprings.

Times, however, have changed since then, and later a single insertion of the same advertisement brought immediate response from about 75 applicants ranging in character all the way from unwashed and more or less untutored exponents of the Bolshevik element to courteous and capable ex-chief draftsmen—this notwithstanding the concise and unmistakable terms of the notice.

It is amusing, though somewhat discouraging, to note the dominant idea of the former that "the world owes them a living," and apparently a good one, too, for they openly and somewhat violently denounced my refusal to increase the amount stipulated in the advertisement, calling the rate offered "a starvation wage" and declaring that the lowest thinkable rate for the kind of man I wanted was $32 a week.

Two of the number called with the express intention of having a good look at me and giving me (presumably without charge) a piece of their minds, but they were sickly looking individuals who apparently possessed little enough of that commodity for their own use to say nothing of passing any of it on.

In sharp contrast to the host of human mediocrity there stood out a number of capable, intelligent men who were a credit to their profession. I was sorry my requirements were so small, as I would have liked to hire them all. These men were for the most part ex-soldiers just released from camp or troopship, and their courteous and respectful demeanor set them apart from the motley civilian crowd whose sullen mood and slouchy manners were anything but an asset.

The army men had complied with all the specifications of the advertisement, had brought samples of their work, and several had their tools with them ready to demonstrate their ability. None of them was without money, another point in which they were in marked contrast to the civilians, every mother's son of whom complained of being broke despite the fact that the preceding four years has been a period of unparalleled prosperity.

One of the ex-soldiers had written to me asking permission to call after 5 o'clock, and this had decided me in his favor. A busy chief never leaves his desk strictly on the hour anyway, and after that time he can give a man his undivided attention for as long as may be necessary, while earlier in the day there are endless interruptions to distract his mind. Further, a logical deduction is that if a man does not wish to cheat his present employer out of a half-day's time he will be equally considerate of his new employer.

Another had sent a written application which I had noted for its brief and matter-of-fact statements, but had not at that time acted upon owing to the numerous mail and personal applications. This man, however, sent a well-timed and well-written follow-up letter which induced me to investigate his record and later to engage him.

When I questioned him about his follow-up system he admitted that he had first written a long letter setting forth his qualifications in detail, but, trying to put himself in my place, he decided that the letter was altogether too long to receive fair consideration, so he conceived the idea of sending it in four installments, dated three days apart, putting all absolutely essential points into the first letter and using the following letters to emphasize details.

Obviously a man smart enough to think up a scheme like that is smart enough to think up other things, and among them may be some that make for dollars and cents in the drafting room. He has since given other evidence of clear thinking and I believe I have made no mistake in hiring him.

The third man had a subtler method. He was on the spot early in the morning watching the shopmen going in to work, figuring that he would know one or more of them. Finding this to be so he buttonholed his friend and elicited from him such information concerning the work, the bosses and his chances as he desired, and fixed it with friend workman to speak to the man higher up.

This scheme worked fine, for later my employer told

Reminiscences by the Old Man

Being a series of reminiscences by the Old Man showing how the fellow on the outside looks to the fellow on the inside and vice versa when they face each other across the office railing. He tells some of the ways in which men go about getting a job and also elucidates some of the reasons why they do or do not get them.

me that "Jim" had a friend who wanted a job; that Jim was a good fellow, and if the friend was all right it might not be a bad idea to engage him. That is the way one man got a job and he is making good. Even now when we know how he did it we bear him no malice.

This concludes my hiring experience with uncivil civilians and civil soldiers, and having brought out my point I will sidestep a little and relate some of my experiences when I was on the other side of the railing.

Outside, Looking In

Some of the before-mentioned soldier applicants had made the not unusual offer to work a week or two on approval, and while this for some reason that I am unable to analyze does not seem to appeal to the average red-blooded employer it serves to remind me of the time when I worked it myself on a wealthy Scot who was the owner of a large plant.

When I had succeeded in getting into his presence and had submitted proof of my fitness for the job he told me that he wanted a practical man; he would not have an M. E. around the place. I knew that there had been three engineers (successively) on the job, two of them of the deadly species known as efficiency engineers, and that each had left in his wake some thousands of dollars in wreckage and junk, therefore I humbled myself to the extent of offering to make good in record time or no pay.

His comment was that the offer was not good enough—he would not be any better off for owing me a few hundred dollars in exchange for some more wasted labor and material.

I wanted that job badly for other reasons than its intrinsic worth; it was to be a stepping stone to another and bigger job that I then had in mind. I took a check book from my pocket and without a word of explanation wrote a check for $500 in favor of Old Scotch, who watched me without moving so much as a muscle of his face.

He seemed to grasp the idea, reached out his hand for the check which, after scrutinizing closely he handed to the treasurer, grabbed his hat and cane and bade me follow him out through endless offices, corridors and departments to the basement of the factory where a gang boss and crew of workmen were gathered about a machine.

Symptoms of uneasiness were visible on the faces of the gang when the "old man" walked in, but he came right to business, ordered the men to remove the upper portion of the machine which had evidently been built on, and assisted them in the process of dismantling and taking it away, using language more or less appropriate to the job and freely expressing his opinion of engineers in general and particularly the one who designed that obnoxious machine.

Inferring that what remained of the machine was to be my trial job I took off my coat and got busy, and when Old Scotch got back from stowing the discarded part in a dark corner of the cellar he explained in a not unfriendly way what was wanted and told me to go to it. He then left me to my own fate.

I soon had all the necessary data and when I left for home that night I had no fear for my $500. I got the check back in my first pay envelope, but I never was able to make any headway in the good graces of Old Scotch. He never commented upon the fact that I had got his machine to work satisfactorily within a very short time. I had the freedom of the plant, was trusted with responsible assignments, and Old Scotch was painfully civil and polite whenever he could not help meeting me, but he studiously avoided me whenever possible and I felt that he never forgave me for disproving his pet theory that engineers were no good.

Another early boss of mine judged his men entirely by their physiognomy. A broad, high forehead and ample-sized nose were his requirements for a designer, and as he strictly adhered to his formula the 12 designers looked like a family of brothers, or at least first cousins. A certain type of face broad in the region of the chin and narrower at the top was supposed to indicate that its possessor was capable of doing good repetitive work without being entirely devoid of intelligence, and this was the face prescribed for the tracer and detailer. He never advanced these poor unfortunates to a better class of work though he did occasionally raise their pay.

Foremen and executives had to have the "hatchet" face with prominent chin, and for every job, big or little, around that plant some particular type of face was prescribed. In some cases this boss went the limit and seriously contended that it was advantageous in a woman clerk to have a tendency toward chronic sore throat as she would talk less and be less likely to muss up the pages of her ledgers with chewing gum.

A Successful Employer

With all his superpsychology this boss was a successful employer and still wields absolute power over his organization. Our opinion as to his personal ability was quite definite and not at all complimentary, but he surely had the knack of picking men who could do the things he wanted done.

Still another boss had a remarkable gift for picking the wrong men. Assurance and a little not too subtle flattery would go a long way in landing a job, while a flashy, gaudy attire unquestionably commanded his attention. His employees of course knew this and unblushingly worked upon his weakness to land themselves in fat positions.

One morning shortly after returning from an extended absence in the South I got a telephone message to report for work at a Jersey City factory. It was a temporary rush job, with salary, hours and everything very definitely arranged. The boss gave me the once over and then the twice. I evidently passed muster, for he immediately took me into the works, gave me clear, concise instructions as to what was to be done and told me pointedly that he must have the work in eight days. If I could not do it say so now or forever hold my peace. There would be extra pay for each day ahead of time.

Although he changed his instructions every day I managed to get the work out on time and was right away assigned to another rush job. At the end of the fourth week I was called to the office and confronted with an iron-bound, rock-ribbed contract covering a period of years and containing the usual clauses con-

cerning patent and secret-process rights, etc. Nothing was forgotten, but unfortunately I had accepted and signed up for another position the night before.

Presenting such a contract after having offered "strictly temporary" employment, with emphasis on the "strictly," made me somewhat sore, as it kept me unnecessarily looking for other work; but it was too late now, as I was already pledged to the other place.

When my employer heard my decision he tore up the contract and bade me good day. He made no remark, but I knew that he felt aggrieved, and when in later years I again applied to him for employment he did not take the trouble to reply to my letter. I found out that he had me classified in his index as unsteady.

Just before the war, having been out of work for a considerable period, I applied for a job with a rather unimportant concern, and during my examination the chief made inquiry as to my religious antecedents. I was considerably surprised and sparred for time to learn his own predilections in order to admit myself to the same fold. I do not consider this to be unjustifiable. If your employer knows no better than to base his estimate of your ability upon your religious convictions, by all means humbug him if you can.

Pipe Dreams of a Tramp Machinist
Why the Scales Didn't Work

By Glenn Quharity

It was near the middle of a strenuous summer in which everybody had been working and worrying a little beyond the point of human endurance to get out production, but the need was urgent and workers were scarce.

The Brookdell Co., a medium-sized manufacturing plant located "somewhere in America" had for many years been in the habit of taking a week off at this time of the year while Mr. Williams, the superintendent, and Tom Jones, the general master-mechanic, with the aid of a few trusty helpers would occupy a portion of this rest period in taking inventory after the manner of our fathers since shops first came into being.

They "took inventory" at this time, not because Mr. Williams did not know about the perpetual inventory system, but because he had long since discovered what many advocates of that system overlook; that it is necessary wherever the perpetual inventory system is in operation to take an ordinary inventory every now and then to find out what is the matter with the perpetual one.

This year it was different. With a shop running night and day to get out material that an impatient Government official was trying to get cased up and started on its way to France a little bit faster than it was being produced, it would not look well to loaf a whole week out of respect for even so time-honored a custom as an annual inventory, so Mr. Williams and Tom, already overburdened with their regular work, were trying at the end of this particular July to take the inventory without stopping the wheels of industry, doing the work with the aid of only such men as could be secured without taking them off a manufacturing operation.

This is how Peter Brown came to be in charge of the weighing of raw stock in the stock-receiving department. Peter's regular job was sweeping floors and "ileing" the shafting, but as the shop was running overtime and Peter was getting old, he had been given two husky assistants to do the actual sweeping and oiling while he "bossed the job." As the assistants could do their work to better advantage when Peter bossed them from a distance, it thus came about that Peter was weighing stock all alone and working quite hard for him.

Along about 11 o'clock one morning as Mr. Williams was crossing the yard, he saw Peter beckoning wildly from the door of the stock shed. Going over to him he was met by the information delivered in a lugubrious voice that "the domd scales is bruk." He went inside and found that Peter had finished weighing up



the bar stock and had wrestled a small keg of castings onto the platform of the scale. There didn't seem to be anything the matter; Mr. Williams jiggled the scale beam up and down with his finger and stepped on the platform, the scales responding readily enough, so he told Peter to go ahead and weigh up the castings.

Peter's back was tired. He started to move the counterpoise along the scale beam, and to avoid having to bend over, he sat down on the keg. After putting another 100-lb. weight on the pan and moving the counterpoise along some more, the scale came to balance. Peter leaned forward, one forearm resting on his knee, to peer at the graduations and the beam came down with a bang. He hitched the counterpoise along toward the fulcrum a little at a time, gradually bringing more weight upon his knee, and finally in his excitement rising to his feet in a stooping posture.

It was now necessary to remove the 100-lb. weight he had just added, and he gave up in disgust. "That's jist th' way th' dom thing's been actin' f'r an hour," he said. "Swelpmegawd, Mr. Williams, I never seen nothin' like it before. 'S'long's I was aweighin' thim bars she was all right but jist the minit I started weighin' that kag she begun actin' crazy. I recken I must've bruk her putting th' kag on."

"Step round in front of the scale and try," said Mr. Williams. Peter stepped and tried. He had no trouble in balancing the scale. Another keg was placed on the platform and still no trouble.

"Let me tell you something, Peter," said Mr. Williams solemnly, "whenever you weigh kegs, always stand on that side of the scale. You may be able to weigh bars from this side, but not kegs."

"I never supposed th' dom things was that sensitive," said Peter wearily.

EDITORIAL

The Need of Training Workers—Now

THE emergencies thrust upon us by the necessity for war production developed possibilities in rapid training which surprised even its advocates. The cessation of the demand, however, followed by the closing of many strictly war activities, stopped the work of the training schools in most cases, and left us almost where we were before.

No careful observer can, however, fail to be impressed with the ever-present need of trained men and women for all our mechanical industries. This need is sure to be more insistent as the months go on and we come into active competition with the greatly increased production of shops in foreign countries.

The training of workers for the machine industries is more important than ever before. And now that we have seen what can be done, even in a very short space of time, we must not let our efforts lag or fail to carry on the good work. It is of course true that more men are available than was the case six months ago and there is also a large body of more or less skilled women workers who have gone out of the shop since the armistice. But anyone who tries to get even a few skilled men often has difficulty in finding them.

With several thousand men reported as unemployed in a certain manufacturing city, the superintendent of a large plant had great difficulty recently in finding 20 men sufficiently trained for various departments of his shop. Common labor was plentiful, but a good lathe hand and a number of similar men were almost impossible to find.

Even if we did not expect to have greatly increased business in the near future it would be the height of wisdom to train what workers we have to a state of higher efficiency, to "up-grade" them, as the modern term describes the process of making them more efficient. Even without increasing our plants we can add to their product by a careful training of the workers in improved methods. And by training the most capable to teach others, we have the nucleus for a largely increased force when the necessity arises.

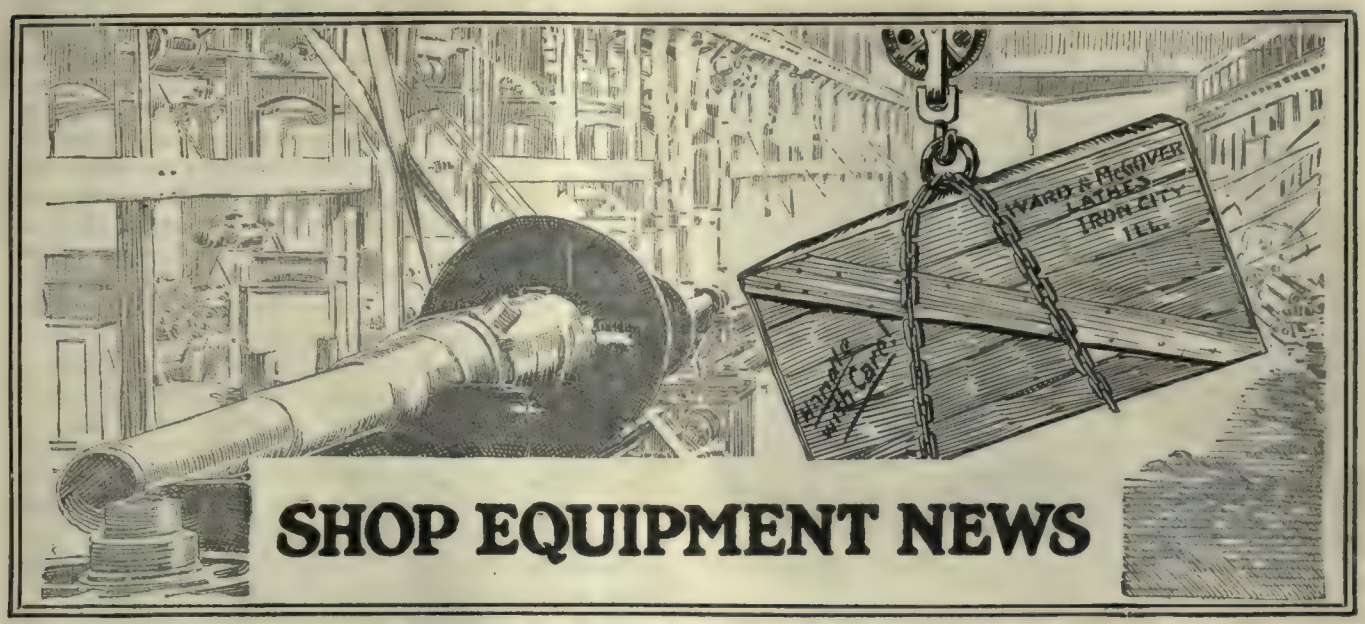
Going beyond this, we have the great possibility of training a certain percentage of the unemployed so as to make them more valuable to industry when the demand comes and also to increase their opportunity for obtaining early employment. It would not be difficult for the business men of a city like Buffalo to finance a method of giving a few weeks' training to several thousand workers. The expense would be little in comparison to the return when these workers could be absorbed into direct production. And the very fact of training them would, itself, have a good effect upon business.

If anyone doubts the necessity of training workers, or feels that we are likely to have a large surplus for months to come, he has but to consider a few of the facts which stare us in the face. It is reported on good authority that there are several million foreign-born workers who are waiting for the opportunity to return to their native land. The State Department is confronted with the issuing of passports in enormous quantities and there is no legal or equitable way to prevent them from going as soon as transportation is available.

These foreign-born workers realize better than many of us that there is a vast amount of work to be done in their devastated countries and that labor is sure to be very scarce. With 15 million workers removed from industry by death or disability as a result of the war, out of an estimated total of not over 75 million before the war, we are faced with the problem of doing the greatly increased work of the world with 20 per cent. fewer workers than before. That we must supply a good portion of the material of reconstruction goes without saying, and yet we are facing an exodus of several millions of workers from our midst.

They have a perfect right to go, and the only alternative is to so train our remaining workers as to enable them to be vastly more productive, and to prepare to again call the army of women workers into the shops when the necessity arises. Many of these are already trained or have the foundation which will make further training easy and rapid. Many shops are retaining a good nucleus of women, both on account of the good work they are doing and the fact that it will make it easier to expand the force when it becomes necessary.

The main consideration at the present time, however, is to pay close attention to the problem of training the men and women we already have, as previously suggested. The experience of such concerns as the Packard Motor Co., the Norton Grinding Co., the New Britain Machine Co., the Yale & Towne Manufacturing Co. and others leaves no doubt as to the advantages of careful training and its effects on production. There is no time like the present. Do not wait until the great demand is here but prepare for it just as you are doing in the sales end of your business; for without economical production and plenty of it, the sales department will not be able to bring success to the enterprise nor to produce the dividends which are so pleasant to contemplate. A little investment in training now will add greatly to the dividends of next year.



SHOP EQUIPMENT NEWS

Multiplex Combination Machine Tool

A machine tool that combines a planing machine, a lathe, a horizontal boring mill, a vertical boring mill, a milling machine, a drilling machine and a slotting machine has recently been placed on the market by the Multiplex Tool Co., Inc., 76 South 8th St., Brooklyn, N. Y. The changes from one type of a machine to another can be quickly made, and it is stated that the machine could handle all operations necessary to reproduce itself except for finishing the bed casting. The machine is primarily intended for repair work in stationary engine rooms, on shipboard, in garages, shipbuilding and repair plants, machine shops, mines, etc.

Fig. 1 shows the machine arranged as a planing machine. In this rôle it performs its functions in a similar manner to most machines of this character, being operated from the right side. A locking device is provided so that the feed for the table will not be accidentally thrown in while other operations are being carried on, and a clamping device is also provided for clamping the table securely to the bed while operations of other

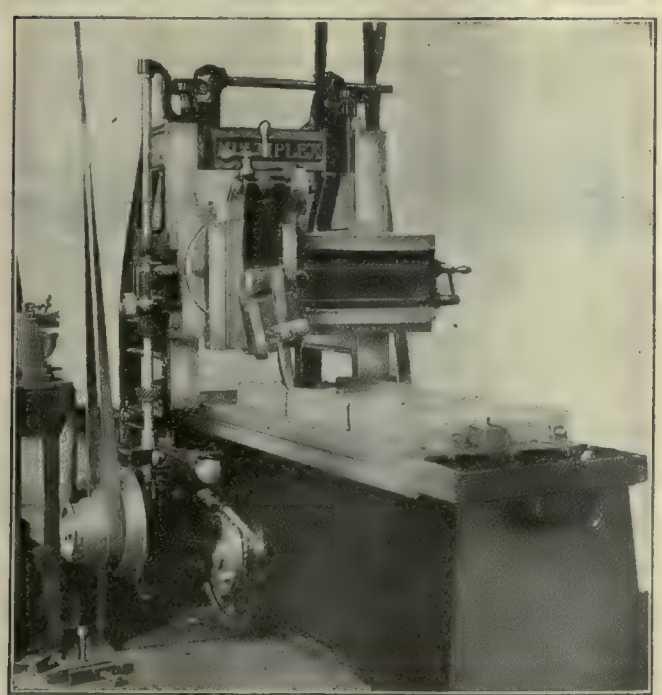


FIG. 1. COMBINATION MACHINE TOOL SET-UP FOR A PLANING OPERATION

Length of table, 5 ft. 8 in.; length of bed, 8 ft. 2 in.; height over-all, 5 ft. 7 in.; width over-all, 5 ft.; planing capacity, 20 by 20 in. by 5 ft.; turning capacity, 14-in. swing, 44 in. between centers, arranged for thread cutting and taper turning, index head arranged in headstock; horizontal boring, 2-in. bar, 24-in. feed; rotary table, power or hand driven 20 in. in diameter and adjustable to swing 96 in.; spindle speeds, 16 to 350 r.p.m.; slotting, 3½-in. stroke which may be increased by making use of the vertical adjustment of the toolhead; drilling can be accomplished at any angle; shipping weight complete, 3500 lb.; floor space required for operation, 4 x 10 x 7 ft.

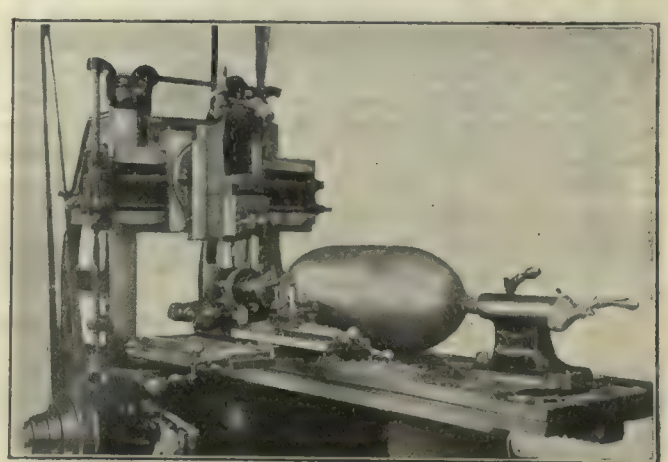


FIG. 2. THE MACHINE IN USE AS A LATHE

character than planing are being performed. The crossrail can be securely clamped to the uprights, the up and down motion being accomplished by hand. It should be stated that this motion and the up and down feed for the toolhead are the only motions on the machine that cannot be power driven. All slides are provided with locking devices for holding them securely against movement when this feature is desired.

Fig. 2 shows the machine performing a lathe operation. The headstock and tailstock have tongues on the base which slide in the center T-slot of the table, while the rest is also tongued and slides in the T-slot on either side. The spindle is driven by means of a bevel gear secured on a taper arbor placed in the drilling spindle and is provided with a complete set of change gears for

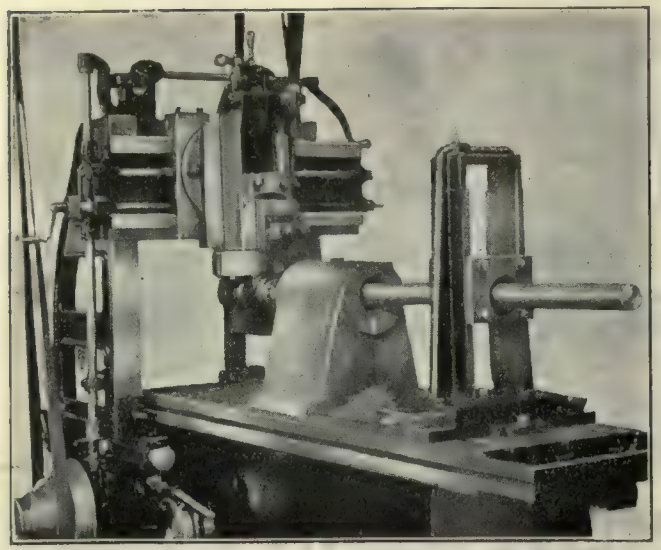


FIG. 3. USING THE HORIZONTAL BORING ATTACHMENT

thread cutting. Motion is transmitted from the gears to the slide through a telescopic shaft equipped with universal joints. The toolpost has a considerable travel on the slide, but in case greater travel is necessary the whole slide assembly can be slid along the top of the table. The slide rest is graduated in order that taper turning may be accomplished. The headstock is also arranged with an index head for milling work carried between centers.

In Fig. 3 the machine is shown in use as a horizontal boring machine. For this type of work a horizontal head is secured to the toolhead, this serving as a bearing for the horizontal boring bar, which is driven by a pair of bevel gears from the drilling spindle in the toolhead. A rest is furnished to support the outer end of the boring bar, and this is adjustable in three directions, longitudinally, crosswise of the table, and vertically. Both the table and toolhead have continuous power feed and automatic stops. It should be stated that this horizontal boring head turns completely around and where it is desired to handle work too large to be mounted on the table, the boring bar can be placed at an angle to the table, and the work mounted on the floor beside the machine.

Fig. 4 shows the machine with a milling cutter mounted in the drilling or milling spindle. This spindle can be driven in either direction as desired, and has either hand or bar feed in a horizontal direction, the vertical feed being by hand. This illustration also shows the rotary table in place. This is turned by hand or by power as desired. When boring work is done the tool is held in the clapper box, or if desired the work can be done with a milling cutter, as shown in the illustration. The rotary table can be placed at any position on the planer table and it will be seen that when placed on the end farthest from toolhead, work of considerable diameter can be handled. The drilling or milling spindle has a No. 10 B. & S. taper hole.

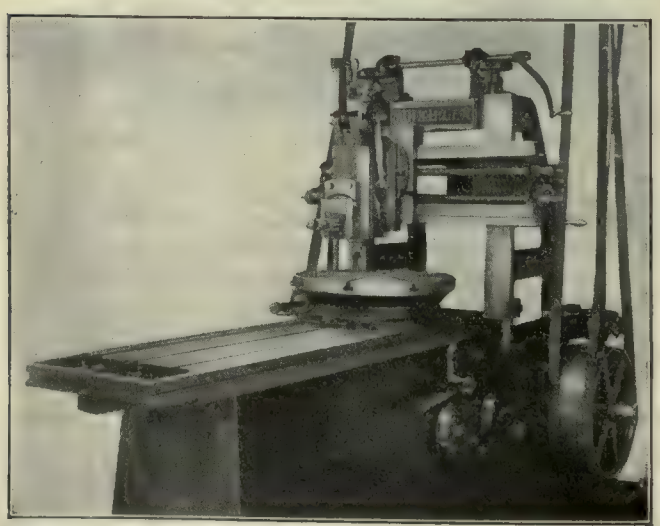


FIG. 4. THE MILLING, BORING AND SLOTTING ATTACHMENTS

Fig. 4 also shows the slotting attachment that is mounted on the side of the toolhead. This slotting attachment has an adjustable stroke up to 3½ in. but greater lengths than this can be machined by taking advantage of the vertical feed of the toolhead.

The spindle of the drilling or milling head is hollow so that arbors can be held in place by means of a draw rod and that the head can be set to an angle so that holes can be drilled or milled at any angle desired.

A particular feature claimed for the machine is that where a piece of work requires a number of operations for completion these can be carried out on the same machine by simply changing the attachment, saving considerable time that would usually be occupied in setting up the piece on various machines.

Greenfield Receding Pipe Threaders

The Greenfield Tap and Die Corporation, Greenfield, Mass., has recently placed on the market the receding pipe-threading device shown in the illustrations; Fig. 1 showing the plain receding threader, while Fig. 2 shows the same device except equipped with a ratchet

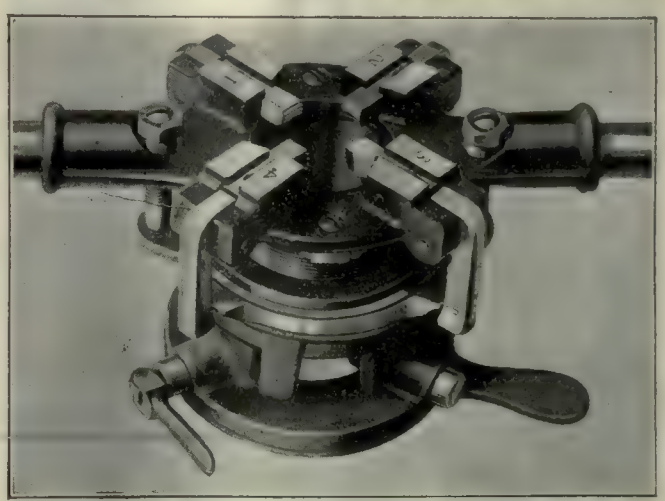


FIG. 1. GREENFIELD RECEDING PIPE THREADER

mechanism for use in close places. In operation the tool is screwed onto the pipe until a thread of the desired length has been cut, after which the threader may be pulled straight off. By releasing the lead screw, lifting the head and resetting the trigger the chasers are again pushed in to the proper point, and the device is ready to start another thread.

One of the advantages is that none but the actual cutting teeth follow around the threads. The chasers are narrow and travel along the pipe parallel to the thread they are cutting and not parallel to the axis of the pipe. The chasers are interchangeable and made

in such a way that it is possible to replace a single one in case of breakage. At the beginning of the threading operation, the chasers cut a full depth of thread, but as the work progresses the levers which support them gradually change position, permitting them to recede until they are finally backed completely away from the pipe, when the threader can be pulled straight off, avoiding lost time in unscrewing. A single turn of

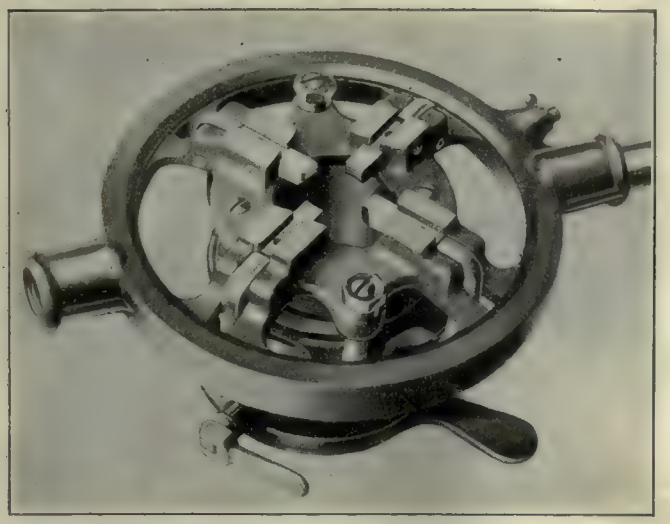


FIG. 2. PIPE THREADER WITH RATCHET ATTACHMENT

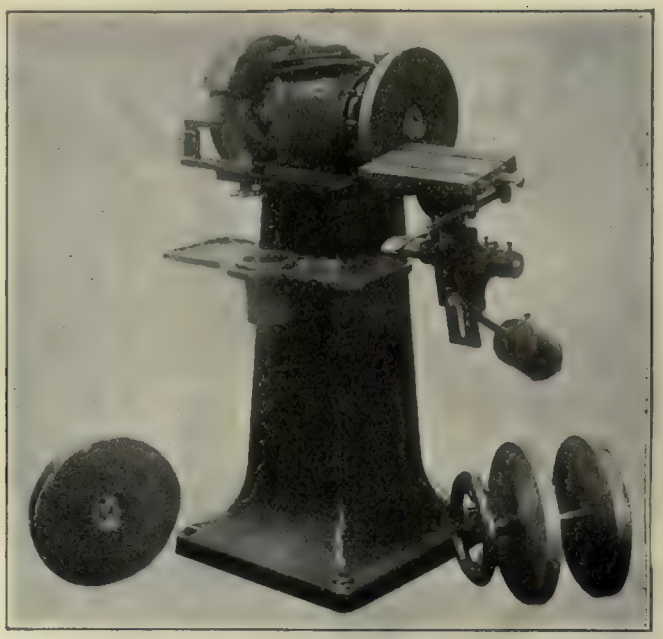
either of three conveniently placed lugs disengages the lead screw so that the head may be pulled back to the original position and reset at that point.

A three-jawed universal chuck guide is provided and after the jaws are tightened against the pipe, one turn of a grip screw working inside of the chuck completes the tightening. The jaws are wide enough to take in a coupling of the largest pipe size that comes within range of the tool. Adjustment may also be made for cutting shallow or deep threads, such adjustment being easily made by changing the setting of the locknut and adjusting rods that project through the sides of the threader. The lead nut is made in three segments which clean themselves, so that no chips can gather on the lead screw. Both the lead screw and nut can be replaced without returning the tool to the factory. The threader is regularly furnished with one set of narrow chasers for each pipe size, Briggs standard right-hand threads being furnished unless otherwise specified. Chasers can also be furnished for cutting British standard threads.

The ratchet receder shown in Fig. 2 has been provided to allow threading operations in trenches, near walls or other places where the amount of space is limited. The only difference from the preceding tool is the ratchet mechanism. The head is so made that the pulling strain of the handle comes directly back of and in line of the chasers in order to minimize the trouble caused by twisting strains. When used with the ratchet mechanism one of the handles is removed, and the tool will swing in a 14-in. circle.

United States Electric Grinding Stands

The United States Electrical Tool Co., Cincinnati, Ohio, has just placed on the market two new electric grinding stands which are made in one- and two-horsepower capacities. These are driven by Westinghouse



UNITED STATES GRINDING STAND

electric motors and can be furnished for direct current of 110 or 220 volts or alternating current of 220 or 440 volts, 60 or 25 cycles, for either two- or three-phase circuits. The weight of the smaller machine is 360 lb. while that of the larger is 480. The diameter of the emery wheel on the smaller machine is 10 in., and the diameter of the emery disk is 12 in. On the larger machine the diameter of the emery wheel is 12 in. with 1½-in. face, and the diameter of the emery disk is 12 in. SKF ball bearings are used and ball-thrust bearings are fitted on the emery disk side of the motor to take care of the end thrust from the emery disk. The speed of the alternating-current machine is 1700 r.p.m. while that of the direct-current is 2000 r.p.m.

The Allen Plier Wrenches

The new series of plier wrenches shown in the accompanying illustration are being manufactured by A. C. Allen, 6441 Eggleston Ave., Chicago, Ill. The wrenches are convenient to manipulate, quick acting, and take a firm grip on the object clamped in the jaws. At any opening the jaws are parallel. The slotted opening for the fulcrum pin permits adjust-

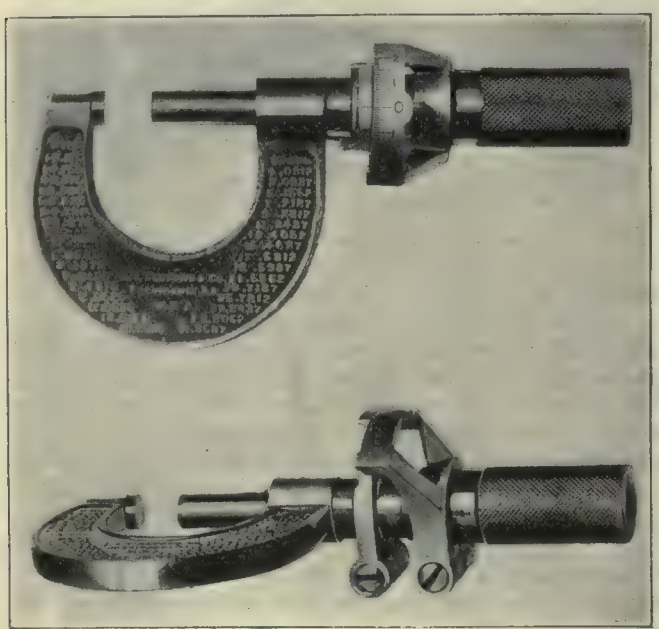


ALLEN PLIER WRENCHES

ment for three sizes of openings. In wrenches Nos. 3 and 4 a different type of adjustment is used with a curved slot for the fulcrum pin. It is claimed that with these plier wrenches a ratchet motion may be obtained on nuts and pipes by releasing the handle and taking a new grip.

Slocomb Quantity-Production Micrometer

The quantity-production micrometer shown in the illustration is a recent product of the J. T. Slocomb Co., Providence, R. I., and is intended for use where a large number of pieces are to be made of one size,



SLOCOMB QUANTITY-PRODUCTION MICROMETER

the micrometer saving eye-strain and allowing accuracy in inspection. The graduated portion is clamped to the micrometer spindle and the indicator is clamped to the sleeve or stationary part of the micrometer, the attachment being so adjusted as to read zero at the correct size and 0.002 in. on each side, plus or minus. Because of the large diameter, the distance between graduations is increased three times, making the distance between the thousandth mark $\frac{3}{16}$ of an inch and allowing for the reading of ten-thousandths direct. The parts are made of aluminum for lightness and are furnished to read in half thousandths or in tenths of thousandths.

Lewis-Shepard Type M "Singlelift"

The Lewis-Shepard Co., 48 Binford St., Boston, Mass., has recently placed on the market the Type M "Singlelift" truck shown in the illustration. This is a light-duty model elevating truck, designed to handle loads up to 2000 lb. only, and the elevation of 2 in. is accomplished by one stroke of the handle. The truck is made in nine styles with heights lowered of 6, 7 and 9 in., and wheel diameters of 6, 7 and 9 in. The over-all lengths vary from 40 to 61½ in., the wheel bases from 31½ to 51½ in., while the lengths of the carrying platforms vary from 28 to 48 in. The weights vary from 140 to 170 lb. The truck has a lift of 2 in. and no release check is used, it being as easy to lower the load as it is to raise it. To raise the load it is simply



LEWIS-SHEPARD TYPE M "SINGLELIFT" TRUCK

Made in 9 styles. Heights lowered, 6, 7 and 9 in.; diameter of wheels, 6, 7 and 9 in.; width, 17¼ in.; over-all lengths, 40 to 61½ in.; wheel bases, 31½ to 51½ in.; wheel face, 2¾ in.; lengths of carrying platforms, 28 to 48 in.; net weights, 140 to 170 lb.

necessary to press the foot pedal which engages the lifting handle with the load. To lower the load, the pawl is thrown back with the foot but the load cannot be lowered until the operator takes the weight of the load on the handle to control its descent, this feature insuring that the operator must be ready to control the load before it can be lowered. It is stated that the locking device is so built that wear cannot reduce its effectiveness. The handle is always free for steering, whether in an upright or steering position or whether the truck is raised or lowered. The wheels have a face width of 2¾ in. and run on Hyatt roller bearings, each being held in place by means of a single split pin.

American Double-End Detachable Plug Gage

The illustration shows a plug gage just introduced by the American Gage Co., Bridgeport, Conn. The handle is drilled through and drilled and reamed to a specified depth in each end to fit the shanks of the



DOUBLE-END DETACHABLE PLUG GAGE

plugs. The plugs are held in place by hardened-steel screws. The plug holes are countersunk to prevent difficulty from burring in case the gage was used with only one plug in place and roughly handled. The plugs are carried in stock heat-treated, seasoned and rough-ground, and are finish-ground and lapped to the customer's specifications when the order is received. It is claimed that the facilities of the factory are such that deliveries can be made almost as promptly as though the finished plugs were carried in stock.

The Smith Universal Radius Former

A grinding-wheel dresser, so made as to produce the proper form of wheel for grinding various radii, has just been introduced by the W. T. Smith Manufacturing Co., Bridgeport, Conn. It is known as a universal radius former and its main feature is a diamond holder mounted in a trunnioned yoke. The device is designed to cut a radius in less time than by the

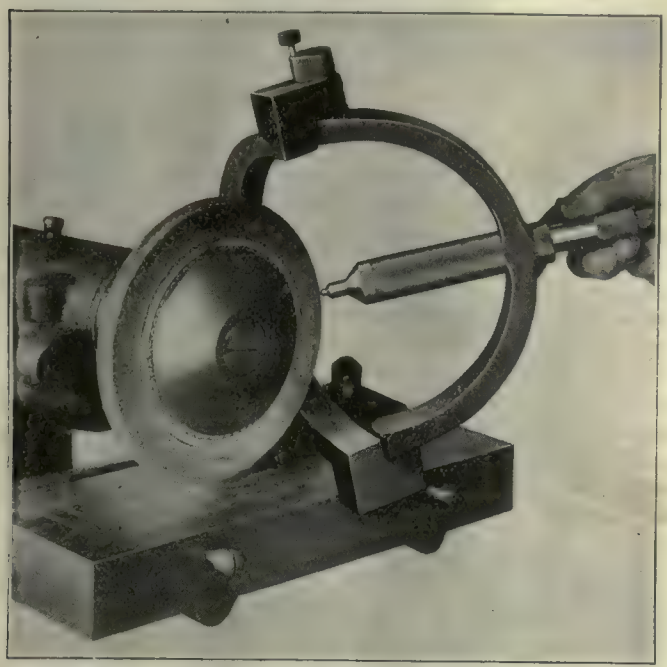


FIG. 1. SMITH UNIVERSAL RADIUS FORMER

old methods. In Fig. 1 the tool is shown set for cutting an inside or concave radius. To do this the diamond tool is pushed in so that it is beyond the trunnion centers of the movable member. For an outside or convex radius the point of the tool will be drawn back to the other side of the center line. In either case the exact radius is determined by the micrometer adjustment under the fingers of the operator, which is more clearly shown in Fig. 2. The micrometer is graduated in thousandths of an inch for radii from 0.030 to 3.500 in. The knurled housing which supports the diamond holder inside of the arc is supplied in several lengths which screw into each other and into the movable member so that no more than half an inch of the diamond

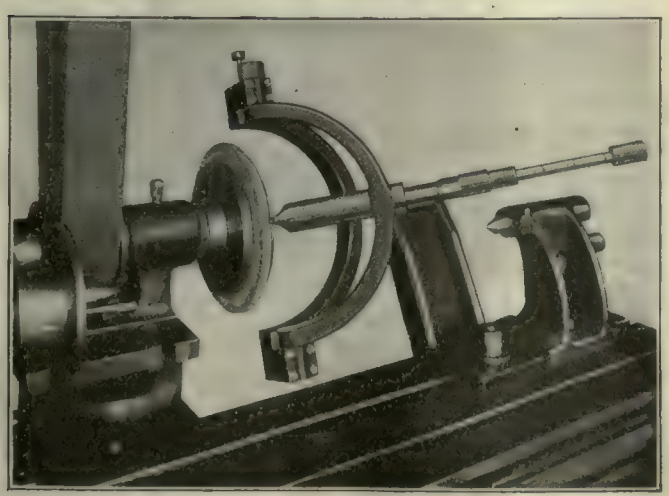


FIG. 2. CUTTING CONVEX RADIUS

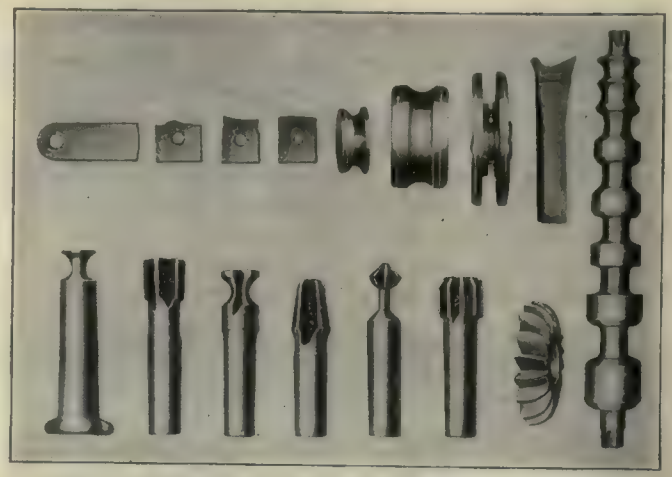


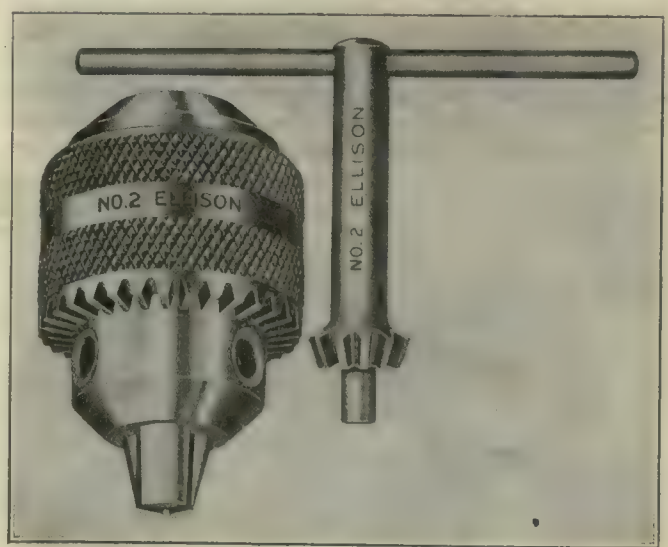
FIG. 3. SOME WORK DONE BY DRESSED WHEELS

holder need protrude from the supporting tube. By loosening the locknut back of the micrometer barrel, the holder rod may be moved in or out by half inches.

With the cutting point set to the correct radius on the micrometer scale it is only necessary to swing the movable arm through 90 deg. for a radius and through 180 deg. for a half circle. Thus no templet or cutter is required and the time of the operation is materially reduced. Fig. 3 shows some of the work which has been ground by wheels shaped with this tool.

The "Ellison" Drill Chuck

The chuck shown is made by the American Machine Co., 104 Wellington Ave., Hartford, Conn. The body and large, powerful jaws are proportioned to stand the strain of the largest drill within the capacity of the chuck. The jaws are accurately finished and placed in the body at an angle to give the maximum gripping power with the least mechanical effort applied to the sleeve. For this reason, the jaws are very easily tightened and released by hand for light work, or by means of the wrench for work requiring a strong, non-slipping grip. The upper ends of the jaws and the ring nut have accurately cut Acme threads, and the ring is hardened and ground. The sleeve is knurled and hardened and has accurately cut teeth in the lower end into which mesh the steel pinion teeth on the wrench. The



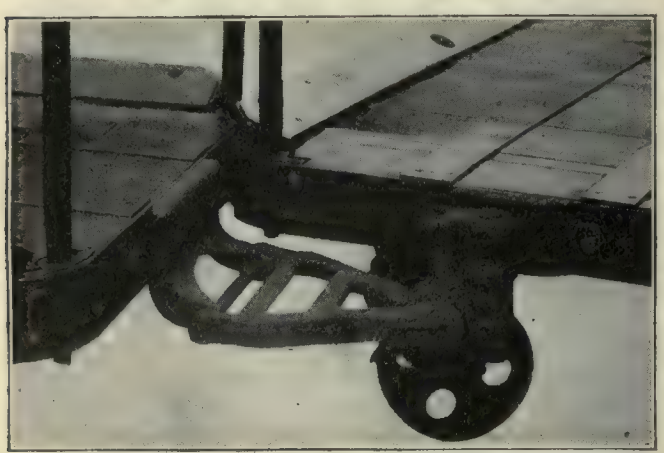
THE "ELLISON" DRILL CHUCK

holes into which the end of the wrench is placed when tightening the jaws are steel bushed to prevent wear and distortion. This gives long life to all the parts. Each part is carefully hardened where necessary.

These chucks are made at present in three sizes: No. 1 has a capacity for drills up to $\frac{7}{32}$ in.; No. 2, up to $\frac{11}{32}$ in. and No. 3, up to $\frac{17}{32}$ in. Two other sizes will be ready by July 1. No. 4 will have a capacity of from $\frac{1}{16}$ to $\frac{3}{4}$ in., and No. 5, from $\frac{3}{8}$ to $\frac{7}{8}$ in.

Carlton Industrial Trailer Coupler

The illustration shows a coupler built by the Lansing Co., Lansing, Mich., to join industrial trailers together and to the tractor drawing them. It is built of mal-



CARLTON INDUSTRIAL TRAILER COUPLER

leable iron and permits trucks to be operated at any angle up to 90 deg. to each other as shown. When uncoupled the drawbar clears the floor or remains up against the load when placed in that position.

Sanford Quick-Acting Cam Vise

A milling-machine vise which is operated without tools has been brought out by the F. C. Sanford Manufacturing Co., Bridgeport, Conn. It is shown in Fig. 1. The jaws are brought to the work by a chrome-nickel steel screw running in a steel floating nut and operated by a fluted handwheel. They are closed on the work by a quick-operating cam operated by the hand lever shown. The movement of the lever is from either side toward the center so that it may be operated by either hand. The screws which hold the jaws are readily accessible, thus making the changing of jaws a simple matter. The company is prepared to supply special jaws. The base and movable slide are made of semi-

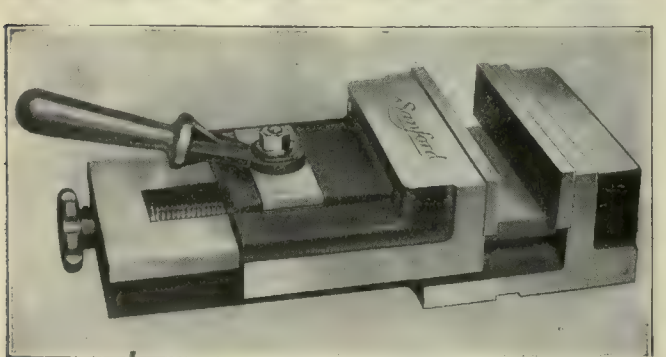


FIG. 1. SANFORD QUICK-ACTING CAM VISE



FIG. 2. SANFORD SWIVEL

steel and the slide, handle and gibs, of steel. The jaws are of hardened and ground tool steel. Accuracy sufficient to meet all the demands of the toolroom is claimed by the maker. Reciprocating parts are hand scraped, including the base in which key slots are provided fitted with hardened movable keys. The vise is clamped by a tee-bolt with hardened tee-slot nut.

Fig. 2 shows the swivel made by the same company which may be used for various purposes but is designed to be used with the vise described. The hold-down bolts are also used to lock the swivel in any position.

The Sanford company is also introducing the heavy-duty milling-machine vise shown in Fig. 3. This is an all-steel vise and is made for the heaviest work

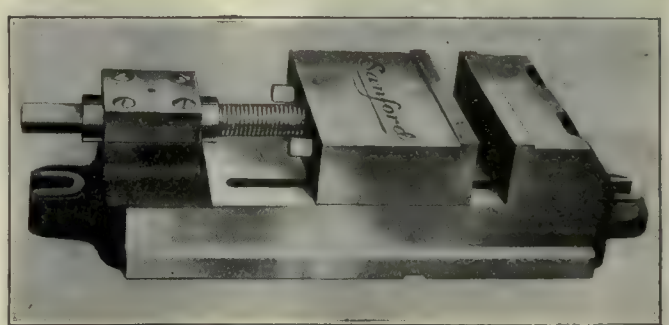


FIG. 3. SANFORD HEAVY-DUTY MILLING-MACHINE VISE

that a triple back-geared milling machine can handle. The movable jaw is operated by a 24-in. socket wrench working on a $1\frac{1}{4}$-in., 6-pitch, nickel-steel screw. This vise is made with either a 4-in. or 9-in. opening.

"Scusa" Micrometer Adjustable Snap Gage

The Lowry-Knise Tool Co., 211 West Adams St., Syracuse, N. Y., makes the combined adjustable-limit snap gage and micrometer shown in Fig. 1. It embodies the usual features of the ordinary adjustable-limit snap gage and in addition provides a ready means for determining the exact amount of stock to be removed to permit the piece to enter the limit gage. The possible time-saving features of this arrangement are obvious.

The micrometer attachment is similar in construction to the ordinary micrometer and has a $\frac{1}{4}$-in. diameter screw with 40 threads to the inch. It is graduated to thousandths and has a range of from $\frac{1}{8}$ to $\frac{3}{16}$ in. oversize. The screw is of tool steel with a positive stop on each end. The frame is made of cast iron with two strengthening ribs which afford an easy grip and

is finished in black enamel, baked on. The gage limit sizes are stamped on a detachable brass plate.

The two hardened measuring plugs on the same side with the micrometer head are ground and pressed into accurately reamed seats until they rest on two headless screws which are sealed in place. The three plugs on

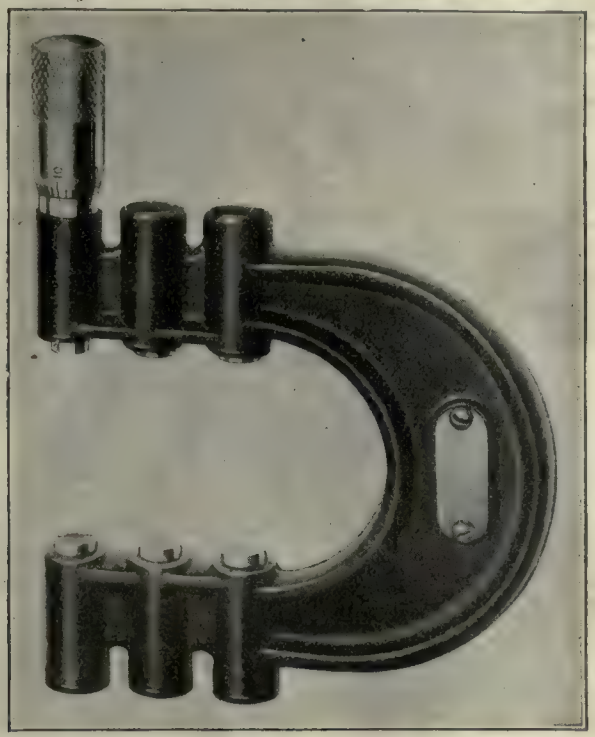


FIG. 1. "SCUSA" MICROMETER ADJUSTABLE SNAP GAGE

the opposite side, Fig. 2, are ground and lapped to have a tight friction fit in the frame and are provided with a device which includes the adjusting screw *B* and the lock screw *A*, giving an adjustment in both directions. The adjustment is made thus: Take two screwdrivers, one to fit *A* and the other *B*. Loosen *A* about

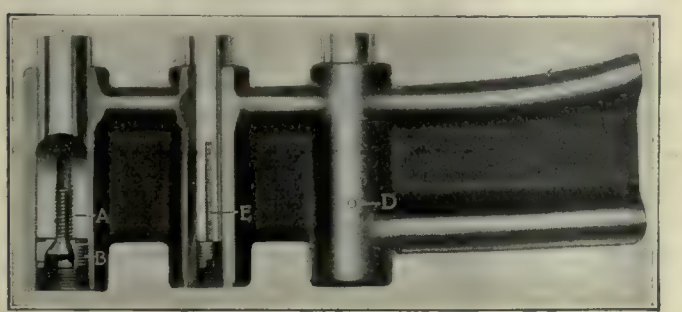


FIG. 2. CONSTRUCTION OF ADJUSTABLE PINS

one full turn. With the other screwdriver move *B* the required amount. Then tighten *A*. This tightening of *A* results in its taper head bringing the plug *C* to bear against *B* and also expanding *B* to make it a tight fit in the seat. The keyseat *E*, in connection with the pin *D*, prevents rotation of *C*.

Erratum

On page 917, the title in the middle of the left-hand column should read Horstmann Indicating Caliper and the title in the middle of the right-hand column, Bush Wiggler Attachment. Corresponding corrections have been made in our Condensed Clipping Index.

Edward Paul Reichhelm

Edward Paul Reichhelm, 24-26 John St., New York, died at his home in Bayonne, N. J., on Sunday, May 4, in his seventy-sixth year.

Mr. Reichhelm was the founder and president of E. P. Reichhelm & Co., Inc., New York, the American Gas Furnace Co., Elizabeth, N. J., and the American Swiss File and Tool Co., Elizabethport, N. J.

He came to this country with his parents at the age of five years, and after passing through the regular courses in school and academy, he studied mechanical



EDWARD PAUL REICHHELM

engineering in the evening school of Cooper Institute, while being engaged during the day as mechanic's apprentice with A. & F. Brown, machinists.

At the outbreak of the Civil War he enlisted in September, 1861, in the Third Missouri Infantry Regiment and became sergeant-major, advanced to the post of lieutenant in the Fifty-first U. S. Regiment and became regimental adjutant, captain, and subsequently major.

He established himself in the business of tools and supplies at 65 Nassau St., New York, in 1876, and organized the American Gas Furnace Co. in 1887. In the year 1900 he also organized the American Swiss File and Tool Co., in Elizabethport, N. J.

He was a member of the Loyal Legion, the Masonic Order, Cooper Union Alumni Association and the George H. Thomas Post No. 29, G. A. R. He fathered commission government in the State of New Jersey, and was president of the Park Commission of Bayonne, N. J.

The three business organizations established by him and built up from modest beginnings to their present high standing are a monument to his fine executive ability, indomitable energy and persistent purpose of acchievement in mechanical and industrial progress.

Salvaging Small Tools in the Machine Shop

By J. B. GRAY

While the salvaging of broken drills, cutters, and other such small tools is by no means a new thing, it required the high prices of raw material and the difficulty of obtaining new tools at any cost, brought about by war conditions, to teach us the possibilities in this direction. Once started, many apparently formidable obstacles proved to be insignificant, and a department installed as an emergency measure has now become a recognized auxiliary.

OF THE many economies the war has taught us, not the least important is the overhauling of our pile of scrapped tools, gages, jigs and cutters. I have had some experience with the scrap pile myself during and since the war, and have been able to reclaim at small expense many a tool that appeared to be hopelessly out of commission, including dies, gages, jigs, small tools, and even bench vises.

Many of these salvaged tools are in use now, and it would seem that a work which has proved to be so satisfactory while the war was in progress should not be lightly cast aside. More than once, some of our production departments have been kept running with salvaged tools, when it would otherwise have been necessary to shut down.

Every manufacturing plant of any size soon accumulates a scrap pile of worn-out and broken cutters, drills, reamers, counterbores, and the like, and I have found that a worth-while percentage of these can be reclaimed and put back in service.

The Man in Charge Should Be a Practical Toolmaker

The man in charge of this work must be first a thoroughly practical and resourceful toolmaker. He should know something of tool design to the end that his work when finished will be properly "balanced"; that is, where a new part is introduced, it must not be so large as to weaken the rest of the tool, nor must it be so light as to be too weak itself. A knowledge of carbon and high-speed steels is also necessary for the reason that if a part or a cutter must be replaced with a material different from the original, the salvage man should know exactly what material to use. Another qualification is that he should be an accurate and rapid draftsman, to enable him to get his ideas on paper actually "while you wait," to the end that his men and machines may not be idle. He must thoroughly understand packhardening, cyaniding, the heat-treatment of machinery steel and the various low grades of alloy steels in general as well as the hardening and tempering of high-carbon and high-speed steel. Unless he thoroughly understands this part many failures will result, not only in wasted time but in the possible shutdown of production machinery.

At one time we had considerable trouble with drills breaking about an inch or so below the shank and all we could use the shanks for was to make small centers for lathes and other purposes. When the drill happened to be of high-speed steel, we would anneal the stub, shank and all, drill a hole in the center 2 in. deep, then drive in a piece of hardened drill-rod and grind it with the toolpost grinding device. We found, however, that breakage could be materially reduced by drawing the drill to a dark straw color for a distance of from 1½ to 2 in. below the shank. In larger drills there would be many with the tangs twisted off, and many large reamers and counterbores in the same condition.

After proving to the "old man" that they could not be "saddled," or "tongued in" and welded satisfactorily because the lightness of metal beside the slot would permit the weld to open up, and also they would run "out" so much that we could not spare the stock from the shank to grind them true, we salvaged them in this way: The drill was chucked at the straight part, just below the shank, and the shank run in the steadyrest. The damaged tang was then faced off, the shank recentered and turned down to the next smaller size. An ordinary drill socket or sleeve was then shrunk on, the sleeve of course being the size of the original taper. It was driven down against a shoulder left on the large end of the old shank. The final operation is to drill for a drive pin between the end of the drill-socket and the shoulder. Reamers and counterbores are treated the same way. It will be found cheaper to use stock sleeves than to make them.

In the case of large boring heads, however, say No. 5 or 6 Morse shanks, it is preferable to turn the old shank down parallel, bore a piece of stock to drive on, and turn a new shank. We have salvaged large boring-head shanks in this way, the heads carrying six to eight stellite cutters, and used for boring large cylinders for motor trucks. They have been back on the job for months and are still working satisfactorily.

The Recutting Method

Side-milling cutters up to 6 in. x ¾ in. are usually made solid, and in order to provide sufficient chip clearance we thought the distance from the cutting edge to the bottom of the side teeth should not be less than $\frac{3}{16}$ in. The way we recut these teeth is to take a fairly coarse grinding wheel and dress it to shape by hand (a diamond makes the wheel too smooth and it burns the work too readily). We then bolt a stud to the grinding-machine table, place the cutter on it, and index with a finger, also bolted to the table. A boy should recut eight cutters in this way on both sides in 10 hours, using a No. 1½ Cincinnati tool-grinding, or other similar machine.

After being recut once or twice, it will be found that the web must be thinned if the cutter is to be recut again, and the best way to do this is to anneal the entire cutter and face it down in the lathe; it doesn't pay to attempt to grind it.

Spiral cutters also can be very handily recut on the tool-grinding machine; simply run the job on centers, index from the head, and swivel the head same as you would to mill a spiral, only turn the head to the angle instead of swiveling the table as in milling. A left-hand spiral can be as readily recut as a right-hand one.

Broken end mills can nearly always be saved; small ones can be annealed and filed, then ground to the next

size smaller, while the larger ones can be cut off with an elastic wheel, and the end teeth recut in the same way as described for recutting a side cutter.

A tool that seems altogether hopeless may often be used for something else. For example, reamer bodies can be made into arbors, mandrels, various sorts of machine handles, tap wrenches, handles for small die-stocks, etc. Drill shanks make good centers, either male or female. Mandrels that are beyond repair can be annealed and made into lathe centers, or if they are machine-steel, may be made into stock for plug gages. We often make such plug gages and packharden them.

Foreign Selling Agencies

BY ROBERT ALTER

This article contains some comments and advice regarding foreign selling agents by a man especially qualified to write on the subject. He has long been foreign manager and vice president of the American Tool Works Co., Cincinnati, Ohio; is honorary vice president of the National Foreign Trade Council, and president of the Foreign Trade Association of Cincinnati.

IF OUR foreign customers and business friends in other countries could have had the opportunity of attending the impressive meetings of the National Foreign Trade Convention and the Mississippi Valley Association, their trade tendencies would gravitate toward us as never before: (1) Because they would realize how fully we Americans appreciate their patronage and coöperation; (2) how sincerely we sympathize with them in the many difficulties that have surrounded them, due to the unsettled conditions brought about by the war; (3) how much better we understand them from not only a business but a social standpoint; (4) how willing we are to give them the best we have at the lowest possible prices and on terms that are as good from an economical standpoint as any other country in the world.

True, the war has brought much additional money to the United States of America, but we realize that this additional money has really come, to a large extent, from our friends and business associates in the countries with which we have been coöperating during the war. Conditions have brought about high prices due to many causes, and for this reason the volume of money in America is greater than would have been the case had prices been able to stay normal on a pre-war basis.

While this additional money is here, yet the attitude of every fair-minded business man is that this surplus should be used not only in developing the trade relationships between this country and others, but also to help those industrial organizations in other lands which have in the past given such good service to the Americans in pushing their trade and also to those who contemplated specializing in the sale of American products. This money can be used to advantage in this way through several channels, such as buying foreign securities, extending longer credits and making substantial loans, not only to foreign countries, but to foreign industrial enterprises.

The new American merchant marine will most certainly be operated to the advantage of our foreign customers not only in giving the lowest possible cost in ocean transportation, but also in establishing definite reliable sailing schedules, so that delivery of orders placed in America may be accomplished at definite reliable periods.

Much is being said about the operation of the Webb-Pomerene Bill, which allows combination and price regulation for American manufacturers in foreign trade. There is a lurking danger in the publicity being given to activities along these lines. Americans wishing to operate under this new legislation should not and will not do so in the spirit of animosity toward dealers in similar lines in foreign countries.

The foreign dealer and customer may be seriously concerned over the passage of this bill in feeling that the services of the dealers and the patronage of the customers has not been fully appreciated by us Americans. This is an erroneous idea. The true American never forgets a service rendered, and we Americans who have had the opportunity of realizing from personal contact the efforts that have been expended by foreign dealers in pushing our goods in their respective countries will use our influence to maintain their confidence and to educate the newcomer in American foreign trade to respect the foreign dealer who has been loyal to us, who has been the sole medium for making our foreign trade up to the present time.

As interest in organizing purely American selling organizations for foreign trade is keener at this time than ever before in the history of the country, such organizations are liable to spring into being at any time and in any number. It is well, therefore, to point out for the benefit of our old reliable representatives in foreign countries of foreign nationality that they should not feel in their hearts a spirit of antagonism toward these new American selling organizations, because they will find them good neighbors and well worth cultivating, especially in a social way.

It should be pointed out to foreign dealers that the old attitude of considering a competitor as your enemy is fast disappearing. The fallacy of this attitude has been demonstrated in America, and the evolution from this deplorable attitude has been brought about largely by the social intercourse in the American club and the now prevalent practice of conferences between competitors to bring about conditions which will help them all.

The foreign dealer, therefore, should not draw back from any American selling organization which may appear in his country, but it would be well to bring about a meeting whereby a better understanding of each other, their aims and difficulties can be had.

The new American selling organizations can be of great assistance even to the old established firms in foreign countries, not only in placing them in touch with American lines which they might care to represent, but also to prevent useless losses and suicidal price cutting.

Furthermore, these American organizations can give information to our foreign friends about American markets desiring material of all kinds from their countries. Therefore, let us all work together to help each other in reciprocal trade between our respective countries and in this way the most admirable relationship will be established.

Sapolio for Grinding and Lapping

BY R. B. FRANK

A good material to use for grinding or lapping in surfaces, where a good joint is required, is pulverized sapolio and water. The shaft or other part is set in place and the mixture liberally poured on while the part is in motion. In this way a true surface may be made and after the grinding is finished all particles of grit can be washed away. If emery is used the grinding is done faster, but the particles of emery cannot be entirely removed, and they are continually cutting.



Sparks from the

Exporting Opportunities in South America

Chile, Peru and Ecuador Offer Good Opportunities for Doing Splendid Export Business in Construction Materials

The requirements for construction materials and machinery in Chile, Peru and Ecuador are set forth in detail in a book of 200 pages just published by the Bureau of Foreign and Domestic Commerce, Department of Commerce. It is a report made by W. W. Ewing, trade commissioner of the Bureau, who was sent to study these markets at first hand for the Government.

It appears that there is much construction and building work going on in Chile, where the public works department has considerable work in hand. As an instance, there were studies for railway work nearly completed at the time the report was made amounting to over $12,000,000. During 1917, 35 projects with an estimated cost of over a million dollars were finished. Of these, five were for water supplies, six for repairs to wharves, three for repairs to jetties, four for wharves and sea walls, and twelve for sewers.

There was also begun 13 additional projects in 1917 and the public works department had under inspection the execution of 25 contracts of a total value of $887,538. There was also a considerable amount of irrigation work under way.

The author of the reports states that American manufactures are generally as good as those of Europe, and in some cases better. Some of the articles of American make that enjoy a preference in Chile are door locks, padlocks, hinges, iron and wire nails, tacks, lumber for construction and cabinet work, turpentine, varnishes, enamels, and many other articles that are not imported in large quantities.

There are certain basic paint materials, such as zinc and linseed oil, as well as marine paints, in which England has the preference.

The Chilean public is generally favorably impressed with American goods and considers them more up to date than the European articles.

During the past decade sanitation in Chile has made great progress. It is estimated that 15,000 fixtures, including enameled and porcelain bathtubs, water-closets, and lavatories are imported annually. There has also been a steady demand for heating installations, hot water being the system most favored.

There are many things requiring development—the railroads, the enormous hydraulic assets, the vast wealth in nitrate, the copper and other mines, the agriculture resources, and the great forests of the south.

With the development of its hydraulic power the central section of Chile may become a great manufacturing center. With the investment of capital, the application of American talent, and the use of Chilean labor, good returns may be had.

War Has Enriched the Peruvians

The time is ripe in Peru for the sale of construction materials, and there are possibilities of making some good contracts. The country has entered upon a period of prosperity. The government is progressive. The war has enriched the Peruvians who, a little uncertain how to invest their gains, are in many instances buying up lands and old houses and are preparing to rebuild with modern structures possessing all sanitary conveniences.

The financial condition of the Peruvian government has been greatly improved, the income having increased more than 30 per cent., the result being that work has been commenced on several new public buildings and it is expected that work on others will soon follow.

Impetus is being added to this activity by the fact that on July 28, 1921, the centennial of the independence of Peru will be celebrated, and it is proposed to have finished by that time the Judicial Palace, the Legislative Palace, the Archibishops' Palace, the model jail, the Prefecture, an orphan asylum, and a hospital for women.

* * *

Cutting Steel Under Water

It is stated that a French company has for some months past used an oxy-acetylene blowpipe of special construction to effect the cutting of steel under water. The apparatus consists of a cutting blowpipe based on the same principles as the ordinary one, but supplemented with a small diving-bell, to which compressed air is admitted to expel the water. The pressures of the oxygen and acetylene required are much higher than those usually employed; the pressure of compressed air depending upon the depth at which the blowpipe is worked. At the trials now being carried out, ships' plates have been cut at a depth of 27 ft. under water. The application to marine purposes of this system of cutting plates has obvious advantages. By its aid the salvaging of torpedoed vessels may be facilitated, and rapid repairs to lock gates can be effected. The electric arc can be manipulated in the same manner, but requires special electrodes and extra illumination.

Engineering Society of Western Massachusetts

A dinner and organization meeting of the Engineering Society of Western Massachusetts was held at the Hotel Kimball, Springfield, Mass., on Wednesday evening, Apr. 16. The following officers were elected: Charles L. Newcomb, president; C. C. Chesney, vice president; George E. Williamson, vice president, and Winfield E. Holmes, secretary and treasurer.

The constitution and by-laws provide for four grades of members, an entrance fee of five dollars and annual dues of the same amount.

The speakers included Prof. L. P. Breckenridge, William Spencer Murray, and Dr. George Otis Smith. Over 300 persons attended the dinner and nearly 1100 applications for membership were presented.

* * *

Will Manufacture Low-Priced Automobiles in France

A determined effort is being made to manufacture low-priced automobiles in France, and it may be expected that every protection will be afforded this industry. The important munition plant at Citroen has been transformed into a factory designed to develop a 10-hp., 4-cylinder machine, consuming 2 gal. of gasoline per 62 mi. Its chassis weighs 882 lb. and the machine is supposed to develop a speed of 40 mi. an hour. The importance of this industry will be realized from the fact that material for the construction of the first 30,000 chassis is now being worked, and that the machines are beginning to appear on the market.

The price of these cars will be $1400 to $1700, according to the type; that is, torpedo shape (for three or four passengers), sedan, etc. All equipment and accessories are included in the above-mentioned prices. The plan of the organization of this factory is based on American methods.

* * *

Tractors Shipped From Canada

Figures compiled by Dominion authorities show that more than 8000 tractors were shipped into Canada by United States manufacturers during December and January. During the year 1918, 21,691 American-built tractors were exported to Canada, 12,805 in 1917 and 3693 in 1916. There is no import duty on tractors, and it is believed there will be none for the remainder of the year. Canadian tractor makers, however, are insisting on the replacement of the import duty, as but a few hundred tractors were made in Canada during 1918, chiefly because of American competition.

World's Industrial Forge

By E.C.Porter
News Editor

Tractor Imports to France To Stop July 1

Agricultural tractor imports into France will be prohibited on July 1, if French makers are in a position to meet national requirements, is the official statement made by Minister of Ravitaillement Boret.

At the present time not only are tractor imports permitted, but the government is buying American machines and selling them to groups of French farmers. In addition to this, as has already been said, the ministry of agriculture is offering a subsidy equal to half the cost of the machine to purchasers of tractors who give the necessary guarantees that the tractors will be kept at work.

It is doubtful if the French makers will be in a position to meet requirements by the date indicated. The biggest producers at the present time are Renault, De Dion-Bouton, and Latil, but others who are rapidly getting into production are Peugeot, Schneider, Paris General Omnibus Co., Delahaye and Gnome & Rhône.

* * *

Machine Tool Convention Speakers

The speakers at the convention of the National Machine Tool Builders Association, held at Atlantic City, N. J., May 12-13 were Mark Sullivan, of Collier's Weekly, on "Personal Experience at the Peace Conference," and Chas. F. Lang, president of the Lakewood Engineering Co., Cleveland, Ohio, on "Coöperation."

Full details of the meeting will be published next week.

* * *

Definitions of Diesel and Semi-Diesel Engines

In its issue of Mar. 21, *Engineering* (London) published an account of a meeting of the Diesel Engine Users' Association, and announced that, as a result of papers and discussion, the association has approved and is now circulating among its members the following definitions of Diesel and semi-Diesel engines.

A Diesel engine is a prime mover actuated by the gases resulting from the combustion of a liquid or pulverized fuel injected in a fine state of subdivision into the engine cylinder at or about the conclusion of a compression stroke. The heat generated by the compression to a high temperature of air within the cylinder is the sole means of igniting the charge. The combustion of the charge proceeds at, or approximately at, constant pressure.

A semi-Diesel engine is a prime mover actuated by the gases resulting from the combustion of a hydrocarbon oil. A charge of oil is injected in the form of a spray into a combustion space open to the cylinder of the engine at or about the time of maximum compression in the cylinder. The heat derived from an uncooled portion of the combustion chamber, together with the heat generated by the compression of air to a moderate temperature, ignites the charge. The combustion of the charge takes place at, or approximately at, constant volume.

* * *

Compelled To Seek Material From America

At the annual meeting of the Scottish Tube Co., Ltd., in Glasgow, the chairman said that in order to keep the works going they were compelled to seek supplies of material from America, where the works were able to supply suitable steel for tube-making at a considerably lower price than home makers.

* * *

New Cuban Engineering Society

There was established in Havana on the evening of Feb. 21 the Association of Members of American National Engineering Societies in Cuba. This organization restricts its membership to persons who are members of the following American national engineering societies: The American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the American Society of Agricultural Engineers, the American Society of Refrigerating Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Architects, the American Iron and Steel Institute, and the American Chemical Society.

There will be four regular meetings each year, one of which will be the annual meeting, occurring on the second Friday of December. The headquarters of the society are located at No. 17 Empedrado, Havana.

The officers for the coming year are Luther Wagoner, president; George H. Nolan, vice president; T. Carlile Ulbricht, secretary, and Wallace R. Lee, treasurer.

* * *

Statistics Given at the International Conference in New York

The last reports from England give the number of men totally blinded in the war as 1415; Belgium reports only 28, Canada 120, and the United States (according to Major Henderson, of Fort McHenry) 75.

Government Will Dispose of Surplus Materials

Committee Representing the Trade and Technical Papers Hold Conference With Director of Sales in Washington

The general policies of the War Department in the disposal of surplus property were enunciated by C. W. Hare, Director of Sales, to a committee representing the trade and technical papers of the country, at a recent meeting in his office in the Munitions Building, Washington.

Those present were: Mason Britton, chairman, McGraw-Hill Co., New York; A. C. Pearson, president of the Associated Business Papers, Inc.; V. E. Carroll, chairman of the New York Editorial Conference; A. I. Findlay, editor of *Iron Age*, New York; David Beecroft, editorial director of the Class Journal Co.; Jesse H. Neal, executive secretary of the Associated Business Papers, Inc., New York.

In addition to C. W. Hare, there were present from his department, E. C. Morse, Assistant Director of Sales; T. R. Elcock, Chief of the Sales Promotion Section; and L. G. Chapin, Assistant Chief Sales Promotion Section.

Mr. Hare stated that the War Department would dispose of its surplus materials by first consulting with the various branches of the Government to ascertain if any could be utilized in regular Government work. After the Government requirements have been satisfied, the producers of each particular commodity will be called into conference to advise with the Director of Sales as to the best method of getting the remaining amount of the commodity back into the usual channels of trade.

If, as has been the case in the disposal of copper, sulphur, lead, wool and lumber surplus stocks, the industry is able to contract with the Government to dispose of its surplus within a reasonable length of time, paying the Government the current market prices, it would be the policy of the Government to make such an arrangement.

Should both of the methods mentioned fail, the surplus property will be offered to the general public through auction sales, or by sealed bids, or in any other manner which will enable the Government to obtain the best prices.

A Sales Promotion Section has been established under the supervision of T. R. Elcock, Jr., to collect all information pertaining to the disposition of surplus property and to see that appropriate information reaches interested industries through the proper trade and technical papers.

Business Items

Ogden R. Adams, Rochester, N. Y., has moved his showroom and office to 244-246 St. Paul St., Rochester, N. Y. The new location affords much larger office and showroom space.

The Neptune Meter Co., of New York, has acquired a building from the Russell Motor Car Co., of Toronto, Ontario, Can., in which it intends to manufacture Trident Water Meters for Canadian trade.

Oliver Machinery Co., of Grand Rapids, Mich., has opened a new office at Chicago, Ill., owing to the increase of business and manufacture. It is located at 810 Railway Exchange Bldg., Jackson and Michigan Blvds. Inquiries for pattern-shop equipment, woodworking machinery, engine lathes, as well as equipment for industrial and vocational schools, in the Chicago district, should be addressed to the new office.

Paul W. Koch & Co. has been organized to take over the charter of the Electrical Sales Engineers, Inc. and to combine that company with Koch and Sandidge. The new officers are as follows: President, Paul W. Koch; vice president, R. A. Alderman; secretary, M. E. Gaffney; treasurer, M. S. Koch. The new company will act as Chicago district representative of the Condit Electrical Manufacturing Co., South Boston, Mass., the Esterline Co., Indianapolis, Ind., and Lewis and Roth Corporation, Philadelphia, Penn.

The Black & Decker Manufacturing Co., Baltimore, Md., has recently established a New York office in the Equitable Building, which will be in charge of G. H. Lundane. Mr. Lundane was formerly connected with the Thomas B. Jeffery Co., Kenosha, Wis., and the Findeisen & Kropf Manufacturing Co., Chicago, Ill. The Black & Decker Manufacturing Co. has branches in New York, Philadelphia, Atlanta, San Francisco, Chicago, Detroit, Columbus, Buffalo and Boston, the general office being located at Baltimore. It also has connections in England, France, Norway, Sweden and Japan.

* * *

Speakers and Subjects at the Pittsburgh Convention

The speakers at the joint convention of the National Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association being held in Pittsburgh this week are George N. Peek and Samuel P. Bush of the Industrial Board, U. S. Department of Commerce. Some of the subjects of other speakers are "Employment Relations from a Manufacturer's Viewpoint," Stephen C. Mason; "Business Outlook," H. L. Humphrey; "The Steel Situation," S. E. Hackett; "Price Guarantees," Severir P. Ker; "Combination and the Manufacturer," James A. Emery.

Trade Currents

Cleveland Letter

The turn of the month has brought marked improvement into the machinery and machine-tool market in northern Ohio. The last week has been significant in the development of more inquiries and more orders than was noticeable in any similar period during the entire month of April. This improvement, however, is not general, but is taken as an indication of what may be expected by the trade here for the immediate future. While the demand is still quite general, there seems to be a greater interest in radial drilling machines, lathes, automatic screw machines, and milling machines, with automatic screw machines perhaps heading the list.

In one quarter the last week's business is reported to be 100 per cent. greater than any week during April. In other quarters there are more inquiries than for many weeks past, which is taken as a good sign. The only drawback to good business, in the opinion of some leaders in the industry, is the disposition on the part of purchasers to refrain from quick closing of their orders.

The chief factor that the trade in this section will have to contend with during the immediate future, leading distributors and manufacturers point out, is the surplus of Government-owned machinery on the market. This is hitting manufacturers more than dealers. In this territory several large distributing interests have taken over plants where Government machinery had been used; in some instances only a few months, and as the average asking price of these items is 50 per cent. below that necessarily asked for new equipment, it is naturally finding a readier outlet, especially as much of the machinery offered is in excellent condition.

Chicago Letter

Trade among machine-tool dealers in Chicago continues excellent, with no indication of an immediate let-up. Shops needing tools to fill definite requirements are placing orders freely and, while some larger buyers are holding in the apparent hope of lower prices, actual sales are in sufficient volume to indicate that May is going to be at least as good as April. A conservative estimate would place present sales in this district at $250,000 a week.

The wide range covered by present activity is indicated by the following representative sales made in the last week: One No. 4 Kempsmith milling machine; one 30 in. x 24 ft. W. & S. lathe; two 7-ft. boring mills; one 72-in. boring mill; one 52-in. boring mill; one 18-ft. x 36-in. lathe; eight power presses, various sizes; seven engine lathes, ranging in size from 14-in. to 18-in. swing; several multiple-spindle drilling, milling and shaping machines; an extra large Duplex horizontal boring, milling and drilling machine.

Personals

PAUL H. SCHATZMANN, of Joseph T. Ryerson & Son, Chicago, Ill., sailed for Rio de Janeiro to take care of its South American interests.

MARCEL E. CARTIER, of Joseph T Ryerson & Son, Chicago, Ill., sailed for France after a few weeks' visit in this country. He will continue to look after the company's foreign interests.

JOHN H. ROMANN, of Joseph T. Ryerson & Son, Chicago, Ill., recently sailed for France to look after its interests in France, Belgium, Holland, Switzerland, Italy, Spain and Portugal.

PETER A. FRASSE Co., New York, has announced the appointment of C. W. Jacoby as manager of the Philadelphia office and warehouse. Mr. Jacoby succeeds W. F. Moore who has recently resigned.

LIEUT. LAMBERT G. NEFF who has been with the Aviation Corps since the beginning of the war, has been released and has returned to the S. A. Potter Tool and Machine Works, 79 E. 130th St., New York.

A. L. G. GENTLES, of Joseph T. Ryerson & Son, Chicago, Ill., will establish headquarters in London, to take care of its interests in Great Britain and Scandinavia. He will sail about the end of May.

HALE D. JUDSON, city engineer of St. Joseph, Mo., has resigned to accept a position with the engineering department of the Missouri State Highway Commission. Mr. Judson has been city engineer since December, 1918.

T. J. HUDSON has been appointed acting manager of the Chicago Pneumatic Tool sales division, succeeding F. H. Waldron, who returns to Minneapolis, Minn., as district manager of sales for the Minneapolis territory.

LIEUT. R. A. FISHER, U. S. N. R. F., for the last 18 months connected with the flying corps, has joined the sales and engineering force of the J. R. Stone Tool and Supply Co., Detroit, Mich. Lieutenant Fisher, before entering the service, was connected with the Curtis Aircraft Corp. and the Continental Motors Corp., Detroit and Muskegon, Mich.

* * *

Reconstruction Information Offered to Industry

The reconstruction research division of the National Defense Council is now ready to give the business world whatever information relative to reconstruction it has been able to compile. The division has charge of all the Federal official bodies and has access to information relative to foreign reconstruction activities and also data relative to domestic business, which has been gathered during the war by the various war-administration boards. Manufacturers who are desirous of obtaining any of this information can do so by applying to the committee.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Centering Gage, Precision for Pattern Work

Syracuse Sander Manufacturing Co., Inc., Syracuse, N. Y.

"American Machinist," April 24, 1919



For the use of patternmakers in locating centers and lines on plain or irregular surfaces, opposite the centers and lines obtained when work is laid out as on the cope or parting of pattern. In use, a centering point is pressed into the center on the pattern which is then placed on the base. This centering point fits in a hole in the base and the scribe in the arm is in alignment with the center of this hole, so that when the arm is lowered a center is marked on the upper side of the pattern directly opposite the one on the lower side, this method being said to obtain accuracy and great saving of time. By placing the scribe horizontally in the arm the device may also be used as a surface gage on small patterns. Overall height, 16 in.; weight, 7 lb.; vertical capacity, 12 in.; distance from center hole in base to column, 6 in.; centering points furnished, 6.

Boring Head, Offset

Detroit Pattern Works, Manufacturers; Great Lakes Sales Co., 924 Dime Bank Bldg., Detroit, Mich., Sales Agents

"American Machinist," April 24, 1919

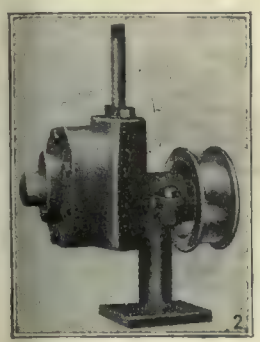


The body is made from solid steel 4 in. in diameter and 2⅛ in. long, the total overall length of the tool being 3½ in. Lead screw, ⅞ in. in diameter, 20 pitch, and graduated on the head to indicate movements of 0.001 in. Will hold round stock from ⅛ to ⅝ in. and square or hexagonal stock from ¼ to ½ in. The slide has a travel slightly over 2 in. and the back of the body is bored to fit a No. 4 Morse taper shank.

Pump, Gear, Style Y

Matson Machine Co., 2 Beacon St., Concord, N. H.

"American Machinist," April 24, 1919

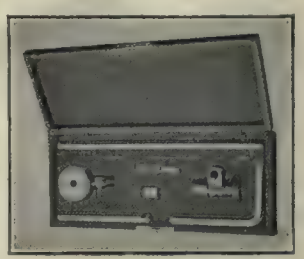


A one-way pump equipped with valves that cause the liquid to flow in one direction regardless of the direction in which the machine is running. It has an adjustable base that can be set to suit any angle; this construction allowing the base to be fastened to a surface at any angle and still have the body of the pump upright. The pump is built in ¾- and ⅝-in. pipe sizes, and the holes in the base can be placed according to the requirements of customers.

Indicator, Dial Test

Cornell Tool Co., Manufacturers. F. E. Conley Co., 502 Book Bldg., Detroit, Mich, Sales Agents.

"American Machinist," April 24, 1919



Made in two sizes; No. 1 for toolroom use and No. 2 for use in production work. The feature of the indicator is that the dial works on a universal joint in such a manner as to enable the operator to always have the dial facing him, thus eliminating the use of a mirror. A number of attachments are furnished, one enabling the dial to be used as a height gage, another indicating the bores of holes down to ⅝ in. in diameter and to a depth of 8 in. A feature is that the indications on the dial are wide apart, enabling accurate readings to be taken. The No. 1 machine will indicate distances up to 0.135 in., while the No. 2 will indicate distances up to 0.235 in.

Marking Tool

Helios Metal Co., Inc., 437 11th Ave., New York City

"American Machinist," April 24, 1919



Instead of having an individual tool for each number or letter, small wheels carrying stamps, numbers or letters are made up, these being held in a holder as shown. One side of the wheel is stamped to show the number or letter on the corresponding projection, while the other side carries a number of impressions into which a locating pin drops, operated by the spring shown on the body. While holding the tool by the sides, the wheel can be easily turned so that the desired figure is ready for use, and while stamping, the spring is pinched between the fingers, holding the wheel rigidly in the desired position. The tool is put up in a set containing one holder and four wheels, one wheel carrying the numbers 0 to 9, while the other three carry a set of letters.

Stand for Taps and Drills

J. M. Waterston Co., 77 Woodward Ave., Detroit, Mich.

"American Machinist," April 24, 1919



Intended to aid the stock-keeper in picking out the proper size of drill or tap. Each stand holding up to and including ⅜—24 taps has openings of the proper size to accommodate the body drill, tap drill and two taps; the stands from ¼—20 to ⅝—11 have openings for the body drill, counterbore, tap drill, and taper, plug and bottoming taps. The stands are made in 16 sizes with wooden tray to hold the whole set.

Grinding Machine, Piston Ring

Bristol Machine Tool Co., Bristol, Conn.

"American Machinist," April 24, 1919



Chuck, 8-in. steel rotary magnetic; size of grinding wheel, 12 x ¾ in.; maximum distance from center of wheel to face of chuck, 9½ in.; vertical feed of wheel, 5 in.; largest swing of dry machine, 17 in.; largest swing of wet machine, 15½ in.; height of chuck from floor, 42½ in.; speed of grinding wheel, 1900 r.p.m.; speed of chuck, 180 r.p.m.; number of strokes per minute of grinding wheel across face of chuck, 4.8, 9.6, 14.4 or 19.2 per minute; revolutions of countershaft, 400; tight and loose pulleys on countershaft, 8 x 3 in.; floor space, 42 x 26 in.; overall height, 63 in.; net weight, 1300 lb.

Vise Jaws, Fiber

Henry Frey, 337 Gould Ave., N. S., Pittsburgh, Penn.

"American Machinist," April 24, 1919



Each jaw is made in two pieces, a pocket of galvanized iron fitting over the jaw with a fiber inset that can easily be removed and replaced in case of wear or in case it is desired to insert a face of some soft material, such as leather, for very delicate work.

Patented Aug. 20, 1918

Exhibitors at the Railway Supply Convention

There has been a great demand for exhibit space at the mechanical conventions which are to be held in Atlantic City, June 18-25. The Railway Supply Manufacturers' Association has furnished the following list of exhibitors to whom space has been assigned thus far. The president of the association is E. H. Walker, of the Standard Coupler Co., and the secretary is J. D. Conway, Oliver Building, Pittsburgh, Penn.

Exhibitors at the Railway Supply Conventions:

Acme Machine Tool Co., Cincinnati, Ohio.
American Tool Works Co., Cincinnati, Ohio.
E. C. Atkins & Co., Inc., Indianapolis, Ind.
R. & L. Baker Co., Cleveland, Ohio.
Chas. H. Besly & Co., Chicago, Ill.
Blevney Machine Co., Greenfield, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cincinnati Bickford Tool Co., Cincinnati, Ohio.
Cincinnati Grinder Co., Cincinnati, Ohio.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Clark Trucktractor Co., Chicago, Ill.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Davis Machine Tool Co., Rochester, N. Y.
Elwell-Parker Electric Co., N. Y.
Gould & Eberhardt, Newark, N. J.
Heald Machine Co., Worcester, Mass.
Hyatt Roller Bearing Co., N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Keller Pneumatic Tool Co., Grand Haven, Mich.
Landis Machine Co., Waynesboro, Penn.
R. K. Le Blond Machine Tool Co., Cincinnati, Ohio.
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.
Lucas Machine Tool Co., Cleveland, Ohio.
Ludlum Steel Co., Watervliet, N. Y.
Newton Machine Tool Works Inc., Philadelphia, Penn.
Niles-Bement-Pond Co., N. Y.
Oakley Machine Tool Co., Cincinnati, Ohio.
Oesterlein Machine Co., Cincinnati, Ohio.
Rich Tool Co., Chicago, Ill.
Rivet Cutting Gun Co., Cincinnati, Ohio.
Ryerson & Son, Jos. T., Chicago, Ill.
Simonds Manufacturing Co., Fitchburg, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Watson-Stillman Co., Aldene, N. J.
Wilmarth & Norman Co., Grand Rapids, Mich.

Trade Catalogs

Reid No. 2 Surface Grinder. Reid Bros. Co., Beverly, Mass. A single-sheet circular illustrating and describing the No. 2 surface grinder.

Reid Universal Angle Fixture. Reid Bros. Co., Beverly, Mass. A single-sheet circular describing a universal angle fixture manufactured by this company.

Oliver No. 483 Universal Motor Drive for Double-Spindle Shapers. Oliver Machinery Co., Grand Rapids, Mich. A 4-page circular describing a new universal motor drive manufactured by this company.

Reversible Ratchet Wrenches. Lowell Wrench Co., Worcester, Mass. Catalog M; pp. 20; 6 x 9 in. This booklet gives descriptions, prices and specifications of the various drills, vises and wrenches manufactured by this company.

Jones Spur-Gear Speed Reducers. W. A. Jones Foundry and Machine Co., Chicago, Ill. Folder, illustrated, showing some of the advantages of the Jones spur-gear speed reducers as compared with other forms of transmission used, to obtain the same reductions in speed.

Commercial Gear Cutting. The Fellows Gear Shaper Co., Springfield, Vt. Booklet, Sixth Edition. Pp. 92; 6 x 9 in.; illustrated. This has been slightly revised and enlarged from the previous edition and contains some new material, dealing more particularly with the commercial production of spur, helical and internal gears.

Armco Iron Rods. Page Steel and Wire Co., 30 Church St., New York. Catalog; pp. 60; 4 x 6¾ in. This is a handbook on welding and welding materials, including a description of Armco welding rods, their analysis, manufacture and typical applications. Many useful tables of measure, temperature conversion, heat colors and metric conversion are given.

Machine Tools and Metal-Working Machinery. (Used Machinery.) Graves Machinery Exchange, 50 Church St., New York. Catalog; pp. 16; 7 x 10 in. It presents a number of half-tone illustrations and gives a description of a large assortment of used machine tools and metal-working machiery such as planing machines, boring machines, boring mills both vertical and horizontal, lathes, grinding, milling, drilling, slotting and shaping machines, gear-cutting machine motors, etc. Any one interested in used machinery may receive a copy of this catalog upon request.

New Publications

Labor Turnover, Loyalty and Output. By Fred H. Colvin. One hundred and fifty-two 5 x 7-in. pages; bound in cloth. McGraw-Hill Book Co., 239 W. 39th St., New York. Hill Publishing Co., 6 and 8 Bouverie St., London, E. C. Price, $1.50.

A discussion of the cause and cure of labor turnover with chapters on industrial democracy, labor representation in management, and other means of arousing and maintaining the interest and loyalty of the worker. The principal cause of the so-called labor unrest arises from the fact that the average employed workman knows little or nothing about the completed product of his particular line of industry beyond the few necessary movements required to produce the very minor portion of it that falls to his lot. The author sets forth the desirability and even the necessity of instructing and educating the worker to the point of comprehending the whole product, to enable him to see his part of it in proper perspective.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A manufacturing firm in Norway wishes to purchase machinery to be used in an automobile factory. Drilling machines, milling machines, lathes, motors, frames, axles, and starter equipment are required. Quotations should be given f.o.b. New York. Payment, cash against documents. References. No. 29266.

Exclusive representation is desired by a company in India for the sale of hardware, mill and railway stores, machinery, electrical goods, bicycles, motor cycles, motors, dynamos, electrical lighting sets, pumps, oil engines, lathes, bleaching, dyeing, and finishing machines, weaving and spinning machines, rice hullers, flour mills, elevators, etc. It is requested that triplicate sets of catalogs, price lists, and samples where necessary, be forwarded. References. No. 29263.

A company in India desires to purchase and secure an agency for the sale of steel and iron in bars, sheets, tubes, plates, etc.; builders' and engineers' hardware; caustic soda and petroleum and lubricating oils. References. No. 29268.

An agency is desired by a man in Switzerland for the sale of motors, auto trucks, agricultural machinery, and farm tractors. Correspondence may be in English. Reference. No. 29280.

A man in France desires to be placed in touch with leading metallurgical firms manufacturing such articles as iron, steel and copper pipes in general, accessories, and everything concerning the pipe trade for high-pressure and steam hydraulics. Correspondence should be in French. References. No. 29282.

The manager of a mines association in China wishes to receive catalogs covering railway supplies, machine tools, and mining machinery. No. 29289.

Forthcoming Meetings

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

The American Supply and Machinery Manufacturers' Association and the National Supply and Machinery Dealers' Association will hold a joint convention at Pittsburgh, Penn.; headquarters, William Penn Hotel.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Association of Manufacturers will hold its convention at the Waldorf Astoria Hotel, New York City, on May 19, 20, 21.

New England Foundrymen's Association will hold its May meeting at Hartford, Conn., on Wednesday, May 21. Fred S. Stockwell, 205 Broadway, Cambridgeport, Mass., is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Dividing Head, Semi-Universal

Whiting & Comstock, 32 Union Place, Hartford, Conn.

"American Machinist," April 24, 1919



The centers will swing work up to 8 in. in diameter and the head is shown tipped up slightly with a collet in place in the spindle. The device is intended for either manufacturing or toolroom needs, the head swiveling 180 deg. in a horizontal plane, 90 deg. each side of the center line, and from 30 deg. above the center line to 10 deg. below. The spindles are hardened and ground to size, and all parts subject to wear are heat-treated. The parts are made interchangeable so as to facilitate repairs in case of breakage. A keyway is cut in the under side of the base and open-ended holes are provided for fastening to the machine table. Standard equipment includes headstock, tailstock, head center, ¾-in. collet, four binder bolts and index plate with 24 divisions.

Steel, Cast Tool

Kinite Co., Milwaukee, Wis.

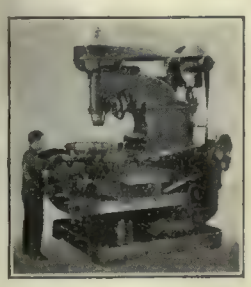
"American Machinist," April 24, 1919

Kinite tool steel can be cast to suit the shape of tool or die desired and is said to possess the unusual quality of not changing shape or size during hardening. The steel is cast in specially prepared molds and it is stated that it does not elongate under tensile stress or decrease in cross-section area, retaining its shape and size until the breaking point is reached. The steel contains no tungsten, is said to be very uniform and close-grained, has high heat-resisting qualities, and does not scale in the fire. It is stated to be particularly desirable for punches and dies, and that a large percentage of the labor usually involved in die construction is obviated by the manner in which it is cast. Kinite can be annealed and rehardened many times, without losing its properties and is annealed and hardened at a temperature of about 1840 deg. F.

Milling Machine, Vertical, Model D-1

Becker Milling Machine Co., Hyde Park, Mass.

"American Machinist," May 1, 1919

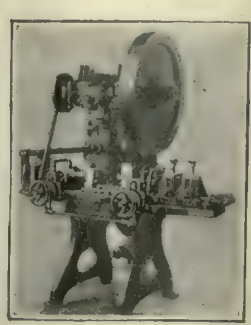


Longitudinal feed of table, 79 in.; cross-feed of table, 20 in.; vertical feed of knee, 20 in.; vertical power feed of spindle, 13 in.; working surface of table, 96 x 20 in.; over-all working surface, 110 x 20 in.; maximum distance between spindle and main table, 22 in.; maximum distance between spindle and rotary table, 13 in.; maximum distance from center of spindle to frame, 25½ in.; T-slots in table, three, ⅝ in. wide; length of saddle, 96 in.; width of face of column, 24 in.; feeds, from 0.003 to 0.46 in. per spindle revolution, three changes being obtained by gearing and a wide range through friction pulleys; main spindle bearing, 9⅞ in. long, 4 in. in diameter; end of spindle nose, 4¼ in. in diameter with No. 14 B. & S. taper hole; speeds, 14, 7 with open belt, 45 to 260 r.p.m., and 7 with back gears, 9 to 51 r.p.m.

Roll Feeds for Press Work

Acme Machine Works, 4125 Ravenswood Ave., Chicago, Ill.

"American Machinist," May 1, 1919

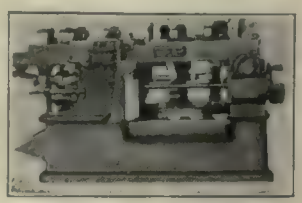


Believed to be the only roll feed on the market which is built in connection with a straightening device and which has a scrap cutter. The drive is also stated to be a new feature. The roll feeds are mounted on their own bolster plates and are made to fit any make or size of press. The feed rolls are fitted with the Acme drive which has from five to seven pawls, each having a toggle grip action. With this driving device the pawls take hold the instant the direction of rotation of the driving housing is reversed, thus assuring accurate and noiseless feeding and an extremely fine adjustment at high speed. An automatic feed cut-out can be furnished in cases where the stock has to be fed up against a stop-pin.

Screw Machine, 3½-In. Automatic Four-Spindle

Cone Automatic Machine Co., Windsor, Vt.

"American Machinist," April 24, 1919



Similar to the one described on page 741, Vol. 47, except that it will handle work from 1½ to 3½ in. in diameter, with a length up to 7 in. On the smaller machine cutting off is possible on one spindle only, whereas on the new machine, cutting-off operations can be carried on simultaneously on two spindles, a feature that is desirable on certain classes of work. The machine is of double-bed construction, one bed placed over the other and separated by spacers. The upper bed carries much of the mechanism which makes for accessibility, it being possible to remove the entire camshaft by simply removing the bearing cap. Capacity, work from 1½ to 3½ in. in diameter and up to 7 in. long; floor space, 11 ft. x 5 ft. 6 in.; height, 5 ft. 6 in.; weight, 15,000 lb.

Planing Machine, Toolroom Open-Side "Coulter"

Automatic Machine Co., Bridgeport, Conn.

"American Machinist," April 24, 1919

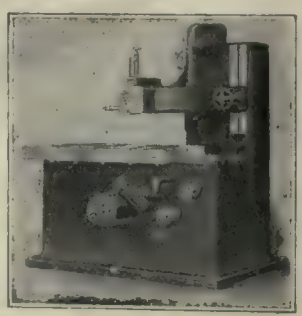
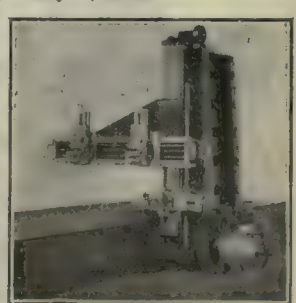


Table travel, 0 to 24 in.; table to crossrail (when up), 16 in.; crossrail traverse, 20 in.; vertical tool travel, 6 in.; length of table, 46¾ in.; width of table, 17½ in.; thickness of table, 3½ in.; distance between pockets, 32⅝ in.; three T-slots for bolts, ⅝ in.; height from table to floor, 36 in.; length of bed supporting table, 53 in.; center to center of ways, 11 in.; length of saddle on crossrail, 14 in.; diameter of swivel head, 10 in.; speed changes for each stroke, 4; horizontal feeds up to ⅛ in.; vertical feeds, ¼ in.; high-speed gear ratio, 6 to 1; low-speed ratio, 24 to 1; revolutions of countershaft, 350; single driving pulley, 20 in. x 3 in.; weight, net, 4600 lb.; weight, crated, 5200 lb.; weight, boxed for export, 6100 lb.; dimensions boxed for export, 50 in. wide, 76 in. high, 68 in. long.

Planing Machine, Open-Side 48-In.

Liberty Machine Tool Co., Hamilton, Ohio

"American Machinist," May 1, 1919



The crossrail is triangular in shape and is bolted and doweled to a triangular brace that extends to the rear of the column. The power-elevating device is located on top of the column and is operated by a lever-controlled saw-tooth clutch. The side head is mounted on the column and can be moved below the top of the table when not in use. The feed is said to be a decided improvement over the old-style arrangement and has the following advantages: (1) The operator can control or change the feed on the cross-heads at any time without stopping the machine or disturbing the feeds on either right- or left-side heads or vice versa. (2) All parts are well protected, yet accessible. (3) All operating handles and knobs are conveniently located. (4) The amount of feed is indicated by a dial enabling operator to set feed to proper amount to suit requirements.

Boring Machine, Gas-Engine-Cylinder

Defiance Machine Works, Defiance, Ohio

"American Machinist," May 1, 1919



A new vertical gas-engine-cylinder boring machine equipped with a circular indexing jig, the speed and feed mechanisms of which are somewhat similar to those incorporated in other machines built by this concern, but the rotating-jig fixture, together with the arrangement of the spindles, is said to be a new method of boring gas-engine cylinders. This method allows the machine to produce constantly and saves the time ordinarily lost in loading and reloading the fixture. The machine is a single-purpose tool and is built in three sizes, taking 36, 48 and 60 in. between the housings. The machine can be fitted with either two or three spindles or with two or three groups of spindles. When fitted with three groups of spindles it will rough-bore, semi-finish and ream gas-engine cylinders.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$30.75
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	26.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural sahpes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ½-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	New York				Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	Current	One Month Ago	One Year Ago	Current	One Near Ago	Current	One Year Ago
*No. 28 black	4.35	5.50	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 1/8, 5/32, 3/16 No. 8, 7/32 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14.00
9/32		1/4 by 19 in. long	12.00
No. 12		5/16 by 19 in. long	10.00
5/16, No. 14 and 11/32		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/16	33.00
Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.		3/32	30.00
		1/8	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	1/4 to 1½	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	1/4 to 1½	39½%	24½%
1/2	51½%	39%			
3/4 to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
1/8 to 3 in. steel butt welded	47%	31%	46½%	31 %	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.25	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	4.60	5.25	7.00
Spelter	6.27½	6.55	7.00
ST. LOUIS			
Lead	4.85	5.00	6.80
Spelter	5.92½	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	22.50	22.50	31.50–33	23.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	23.00	34.00	22.00	31.00
Brass sheets	20.00	23.75–28	30.75	23.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	30.00	41.00	31.00	40.00
Solder (half and half) (case lots)	45.00	46.50–41	62.00	43.00	41.25	39.00	55.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

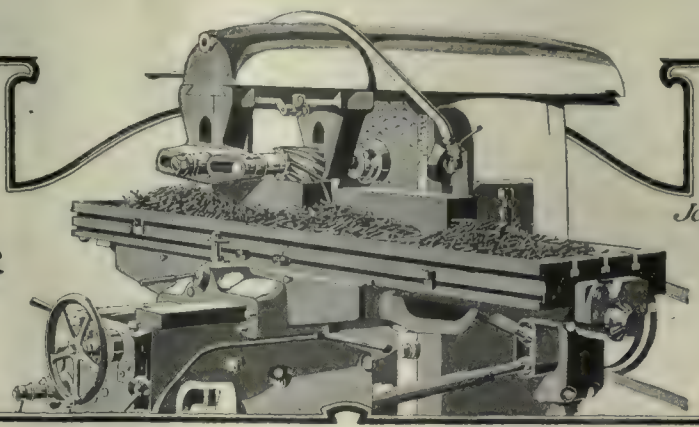
BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

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THE NEW CINCINNATI No. 5 HIGH POWER MILLING MACHINE



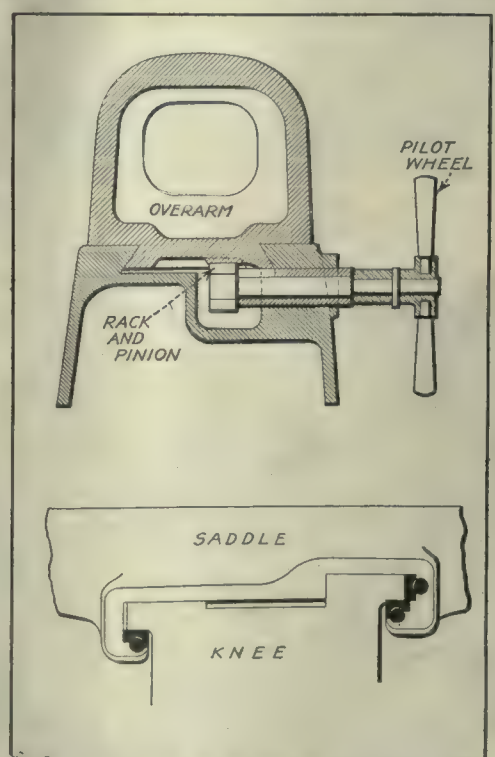
By John H. Van Deventer
Editor in Chief,
American Machinist

This new product of the Cincinnati Milling Machine Co. marks an advance in the continual struggle for supremacy between the machine tool and the cutting tool. Its massive construction, new features of design, operating conveniences and adequate powering enable this machine, when equipped with modern high-power cutters, to resolve production problems into terms of jigging and chip disposal. Although this article is the first description of this milling machine, it has been subjected to a very thorough test, and some three hundred machines of this type and size have been distributed during the last two years.

IT MAY not be amiss to apply a very apt comparison to introduce the machine described in this article, and so I will briefly sketch the historic struggle between artillery and infantry. When cannon was first invented, infantry (if we can call it such) literally took to the woods. But before long came the "fire arms" which enabled the infantrymen to pick off the early cannoneers because these shoulder arms, although crude, had better range. Later on, in Napoleon's time, cannon was so improved that artillery gained the ascendancy, and nearly won him the world. Then came the breech-loading rifle which once again turned the tables; while the present war with its wonderful development of long-range guns put artillery once more in the van.

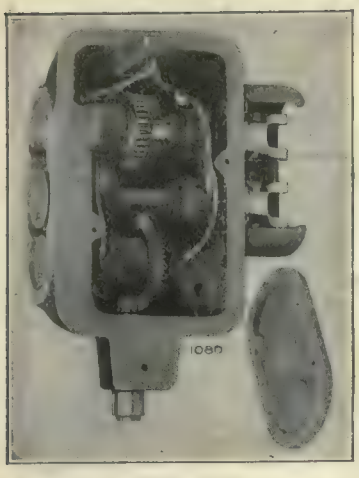
Now this same game of see-saw has been going on for years between the machine tool and the cutting tool. One would have said eight years ago in reading the article entitled "Milling Cutters, Their Efficiency," in the *American Machinist*, that a milling cutter had at last scored a final decision. A glimpse of this new "number five" at work assures one, however, that the miller can now claim a draw with the cutter. This fact causes two different factors to limit production; namely, jigging and chip disposal. In other words, the cutting time on the average job has now been reduced to a point that makes the ability of the operator to load and unload his fixture the limiting factor.

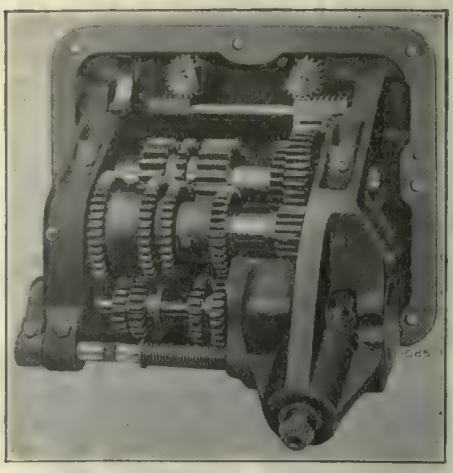
The logical way to describe a machine is to first tell how it is constructed and then what it will do; but in this case I think it will be more interesting to tell some of the things that this machine does and then show how it was built to do them. Performance tests which extend only over a short period of time, and which are beyond the limits of application to practical use, are of course of little practical value. Tests, such as the following, however, are both useful and convincing in demonstrating the rigidity, driving power and strength of a machine tool.



FIGS. 1 AND 2. CROSS-SECTIONS THROUGH OVERARM, KNEE AND SADDLE

With braces on the overarm and using a 4½-in. diameter spiral mill of 6-in. face, having 10 teeth with 15-deg. undercut, the cutter running at 60 r.p.m., the following roughing cuts were taken over a block of machinery steel 5 in. wide and approximately 24 in. long, having a tensile strength of between 55,000 and 65,000 lb. The cutter ran at a speed of 60 r.p.m., which represents a surface speed of approximately 70 ft. per minute. The following table shows the feeds and speeds that were obtained under these conditions:





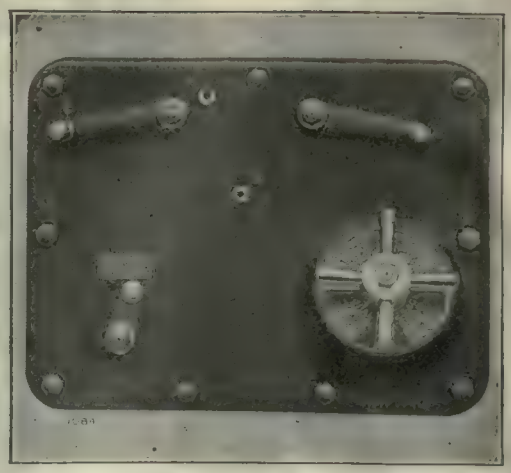


FIG. 5. SPEED CHANGER FOR FEED DRIVE. FIGS. 6a AND b. FRONT AND REVERSE SIDES OF SPINDLE SPEED CHANGE UNIT

Depth of Cut, Inches	Width of Cut, Inches	Feed, Inches per Min.	Cu.In. of Metal Removed per Min.
¼	5	30	18.75
¼	5	30	37.5
¾	5	30	56.25
½	5	11¼	29.375
½	5	19	47.5

Neither distress nor excessive vibration was noticeable at any of these cuts, although the last one required a net horsepower input of 80 hp., or four times the normal maximum powering of this machine. A cut ⅛ in. deep was taken on the same steel block at a cutting speed of 340 ft. per min., with feeds first at 19 in. per min. and then at 30 in. per min.; a straight-edge applied to the surface after this cut held tissue paper at four points. For the ordinary run of work and with the average size of milling cutter close to the column, overarm braces are not required. A roughing cut without braces on the same block and with the same cutter was taken at ¼ in. depth and 30 in. per min. feed, followed by a finishing cut at 30 in. per min. The resulting surface was as accurate and smooth as would be required in first-class commercial work.

Perhaps the most interesting test performed on this machine was that of milling, simultaneously, two slots 1½ in. wide and 1½ in. deep in one cut from the solid in the same grade of machinery steel. Two cutters were mounted on the arbor, each cutter, 1½-in. face by 8-in. diameter, having 18 teeth staggered right and left, each tooth taking ¾ of the full width of cut. The feed on this cut was 9¼ in. per min. These remarkable performances are made possible by general massiveness of construction combined with two principal features of design: namely, an overarm of rectangular cross-section with V-shaped guides, and square gibbing and narrow guides for the column, knee and saddle bearings. Both of these features may be observed in the illustration forming the title-piece of this article.

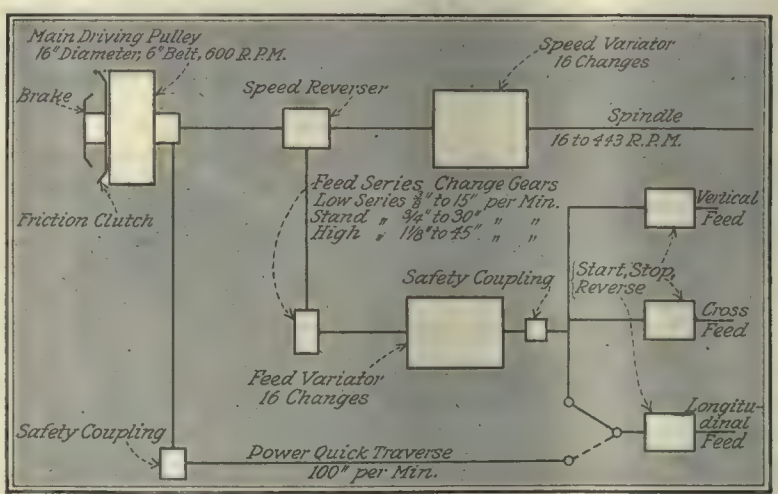
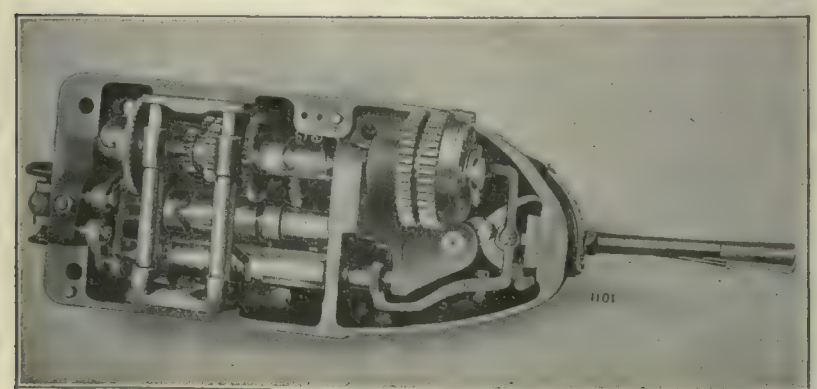


FIG. 3. DIAGRAMMATIC REPRESENTATION OF DRIVING MECHANISM





FIGS. 7a AND b. FRONT AND REVERSE SIDES OF FEED CHANGE UNIT CONTROLLING LONGITUDINAL TRAVERSE AND VERTICAL FEEDS

A cross-section through the overarm showing the V-guides and also the rack-and-pinion mechanism for moving the overarm lengthwise is presented in Fig. 1. This adjustment feature is an operating convenience which enables one not only to move the overarm easily but also to set it readily to a line by means of a pilot wheel. The knee bearing on the column and the saddle bearing on the knee have heavy square guides which are provided with thick taper gibs that are adjusted lengthwise, as shown in Fig. 2. The combination of the square guides on the column and V-guides on the overarm form a particularly rigid and ready means of attaching the various complementary mechanisms for vertical milling, rack cutting, slotting, etc. The offset knee-guide construction, shown in Fig. 2, permits the builders to make this miller in the universal type without raising the table surface more than 1½ in. over the standard table of the plain machine.

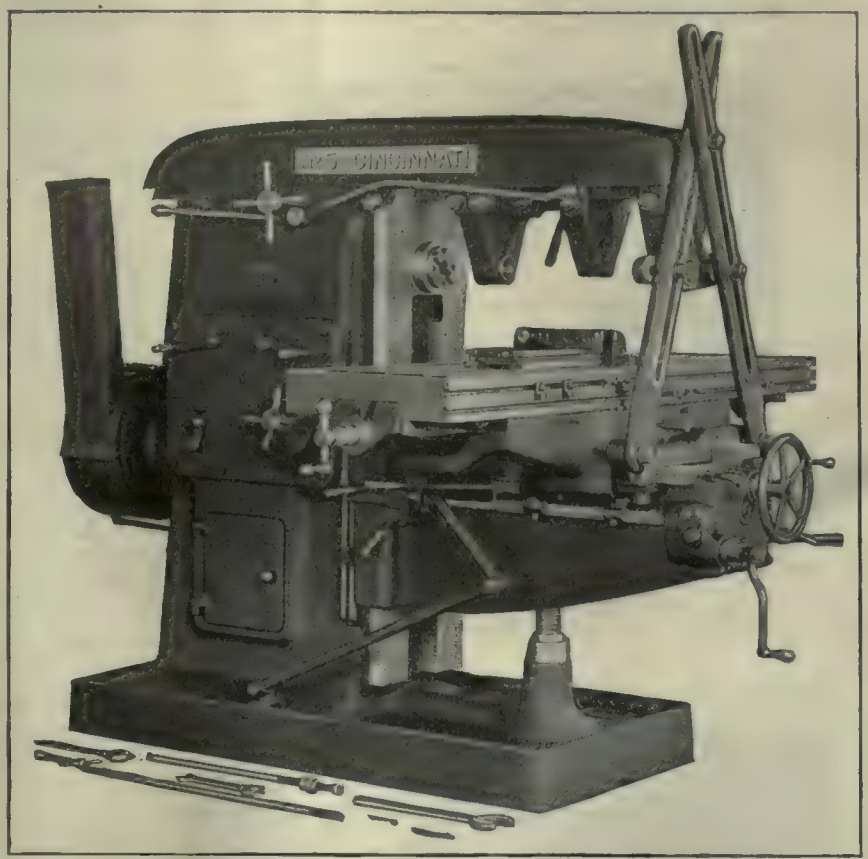


FIG. 4. THE NEW NO. 5 PLAIN MACHINE. NOTICE THE WIDE SADDLE BEARINGS, LARGE BASE, PILOT WHEEL FOR MOVING OVERARM, DUPLEX CONTROL, AND BELT GUARDS

A diagrammatic representation of the drive mechanism is shown in Fig. 3. The driving pulley, built as a unit with the oil pump, friction clutch and brake, follows the lines of automobile construction by being "full floating." In other words, it is mounted on ball bearings on an independent bracket which relieves the main shaft from belt pull. The powerful friction clutch starts and stops the machine and the brake is automatically brought into action by the starting and stopping lever so that the spindle comes to an immediate stop. All of the gears and shafts used in transmitting power and feeds are hardened steel. All of the speed changes are accomplished by means of selective sliding gears, eliminating tumblers. A spindle-reversing mechanism provides for running the spindle either right or left handed.

The speed changes, which vary from 16 to 443 r.p.m., are made by means of the drive box shown in Fig. 5. Sixteen speed changes are obtained by means of the four positions of the pilot wheel in combination with the two positions of each of the large swinging levers. The spindle reverse is controlled by the small swinging lever shown in the same illustration.

The feed-changing mechanism is of particular interest. Before mentioning this, however, it is well to call attention to the feed bracket on the column shown in Fig. 6. This connects the drive with the feed-change mechanism and the power quick traverse. The normal range of feeds on this machine is from ¾ in. to 30 in. per min. Occasionally a slower feed than ¾ in. is required and also a faster feed than 30 in., and to provide for such contingencies the ratio between the feed drive and speed drive may be changed by substituting other gears at *A* and *B*. In this way a slow series of feeds of from ⅜ in. to 15 in. per min. or a fast series of from 1½ to 45 in. per min. may be obtained through change gears. A universal-joint shaft leads from the feed bracket just mentioned to the feed box proper, shown in Fig. 7. The design of this feed box is of particular interest. It contains the complete mechanism for the sixteen feed changes which are made by a single lever through sliding gears. The feed changes are made while the machine is running, the operator moving a lever up and down or from side to side or diagonally, going direct from one feed to any other. This is accomplished by means of the mechanism shown inside the box which discloses two rotating camshafts. The lower shaft is actuated by the horizontal movement of the hand-control lever, the upper shaft by its vertical movement. The combination of the movements of these two camshafts, caused by any movement of the single hand-control lever, causes a corresponding movement of the selective sliding gears and results in obtaining a given feed ratio.

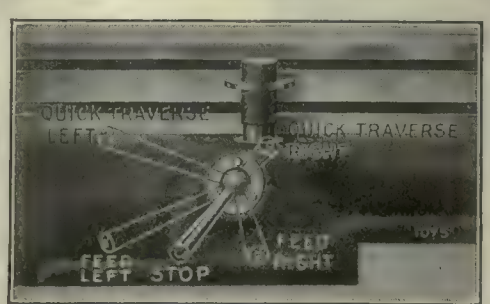


FIG. 8. FEED-CONTROL LEVER. ITS FOUR POSITIONS SHOWN IN OUTLINE CONTROL ALL TABLE MOVEMENTS

The spur gear that is seen protruding from the case in Fig. 7 transmits the feed power from the feed-change

mechanism to the feed reversers and feed screws. A safety device is incorporated at this point. It consists of a number of steel balls held in spherical recesses by spring pressure and which slip at a predetermined load. They may be seen around the circumference of the flange of the protruding gear in Fig. 7.

A quick traverse of 100 in. per min. is provided for longitudinal movement of the table in both directions. For vertical movement of the knee and cross-movement of the saddle the maximum feed of the feed box (usually 30 in. per min.) is used as quick traverse, 100 in. per min. being too rapid for these shorter move ments.

It is evident that a machine which reaches the limit in fast cutting puts the production rate up to the ability of the operator to load and unload his table. Realizing the importance of relieving the operator manually as much as possible on quantity-production work, the designers of the Cincinnati No. 5 have worked out an ingenious system of table dogging which, when applied by the user, practically converts the machine into an automatic miller. This arrangement is extremely simple and is an extension of the application of the usual dogs which are found on every miller for the purpose of limiting the table travel. The feed-control mechanism shown in Fig. 8 has been arranged so that table dogs, in addition to merely throwing out the feed, will, when required, reverse the table movement, throw from quick traverse to feed in either direction and vice versa. There is no more "red tape" in the set-up for this automatic control of the table than there is in setting a pair of planer dogs. A surprising number of combinations or cycles are possible when these dogs are used, this being indicated in Fig. 15.

One of the most convenient operating features of this new machine is the duplex control. Starting and stopping action, feeds in all three directions and quick traverse are controllable from the rear as well as from the front of the table. This is of particular importance on the universal machine. This machine is absolutely similar in design to the plain machine except for the addition of the universal feature which provides the swiveling of the table 50 deg. to either side of its normal position. The universal machine, which is illustrated in Fig. 9, is provided with a power quick traverse but not with intermittent feed. The power quick traverse on this machine is hand-operated and is designed so that the operator has to hold the lever in position in using the quick movement. When he lets it go the quick traverse is automatically disengaged and the table comes to a stop.

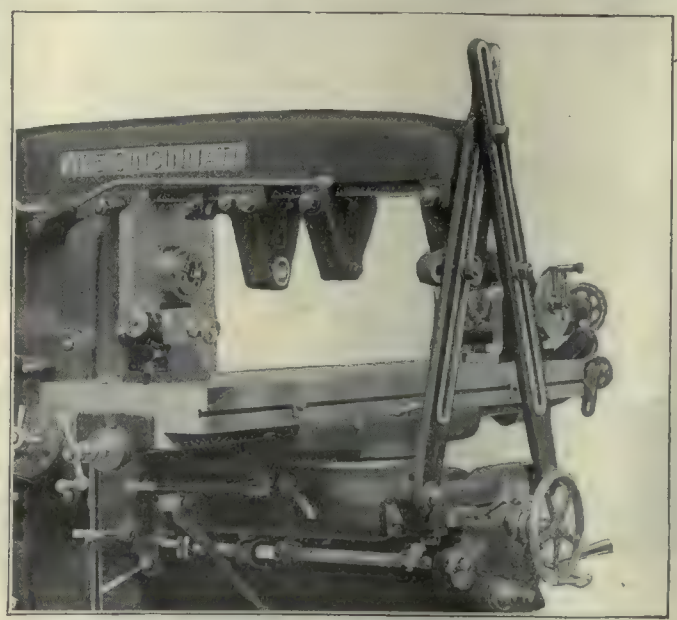


FIG. 9. THE CINCINNATI NO. 5 HIGH-POWER UNIVERSAL. THE OFFSET KNEE-GUIDE CONSTRUCTION PERMITS OF COMPACT AND RIGID DESIGN

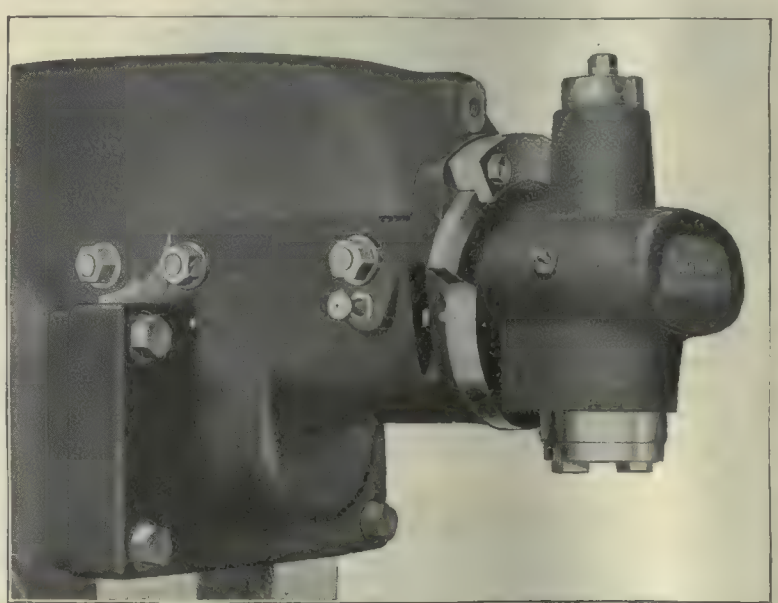


FIG. 10. THE COMPLEMENT WHICH CONVERTS THIS MACHINE INTO A VERTICAL MILLER

The table width on the universal is 20 in., and on the plain machine is 21 in. Both of these wide tables give ample opportunity for the convenient attachment of jigs and facilitate the work of clamping.

The spindle bearings, the spindle drive gears and shafts, and all other rotating parts in the column are lubricated by a positive pump delivering oil into a reservoir at the top of the machine, from which independent pipes lead to individual bearings. There are, in addition to this automatic lubrication, six oiling stations which take care of all remaining bearings in the saddle, the knee, feed box and table.

Coolant is circulated by means of a centrifugal pump connected with a reservoir in the base of the machine. The table design incorporates screened openings which return the lubricant rapidly to the reservoir.

The word "attachment" to my mind indicates a sort of mechanical "afterthought." When a machine "attachment" is properly designed it is in reality not an "attachment" but a *complement*, which in use becomes an integral part of the machine and completes it for a given purpose. The complementary mechanisms designed for this No. 5 high-power machine convert the machine into a vertical miller, a rack miller, slotter, spiral miller and a circular miller. They are shown in Figs. 10 to 14, inclusive. As an indication of the rigidity and power of these complementary mechanisms I might mention a performance of the machine con-

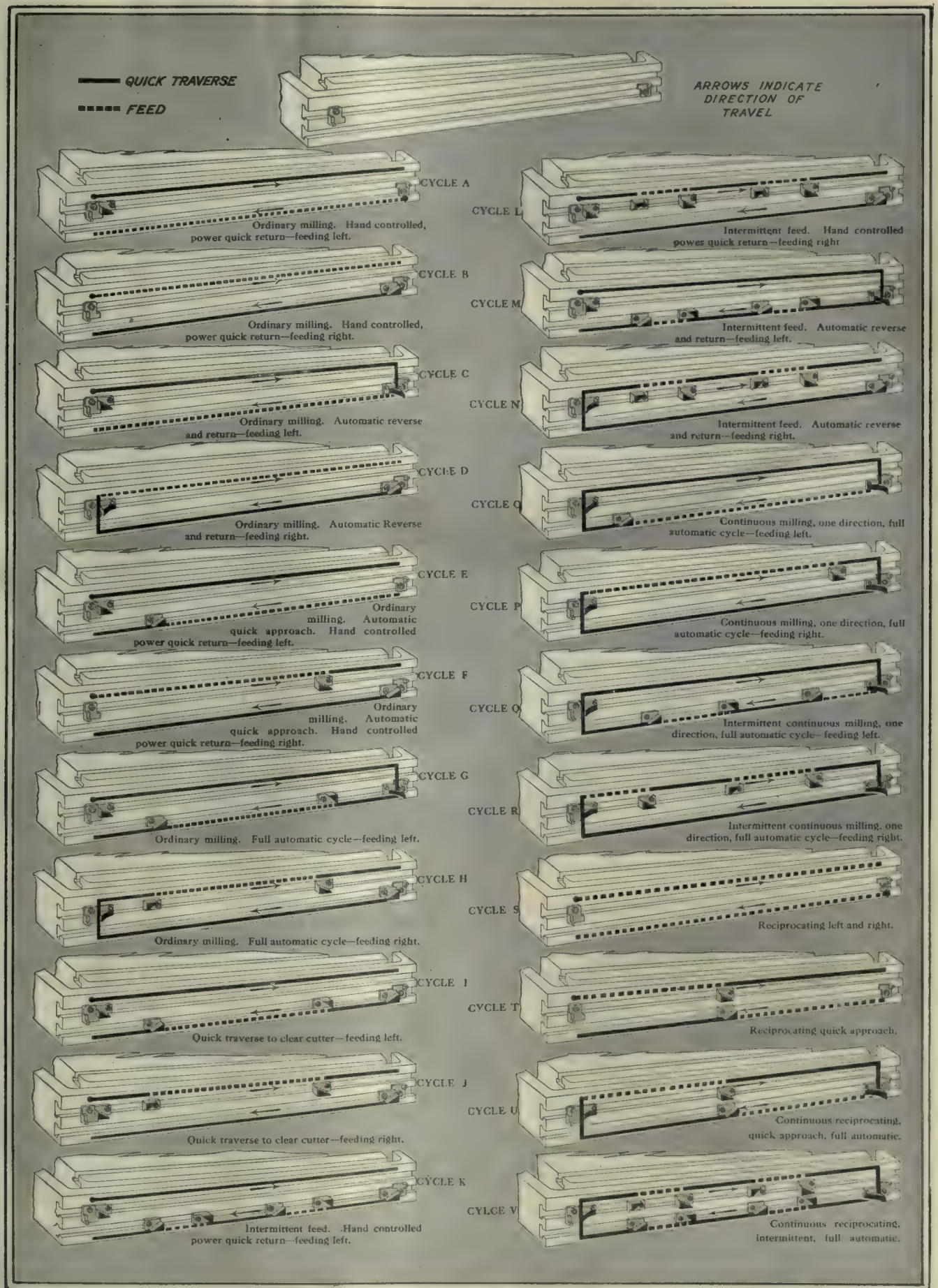


FIG. 15. DIAGRAMS ILLUSTRATING THE APPLICATION OF THE INTERMITTENT-FEED FEATURE AND SHOWING TABLE DOGGING FOR VARIOUS CLASSES OF WORK

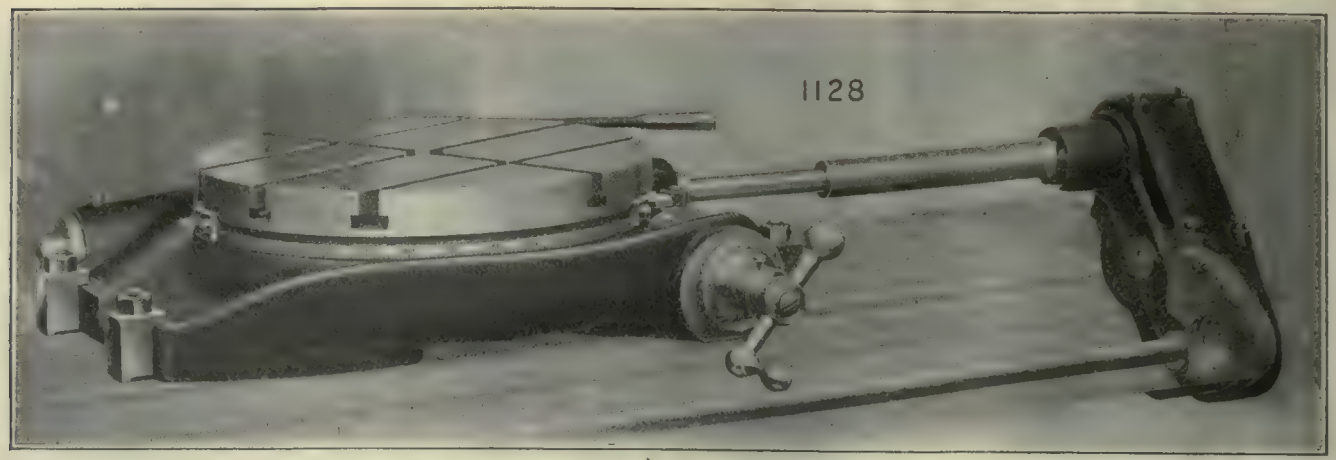
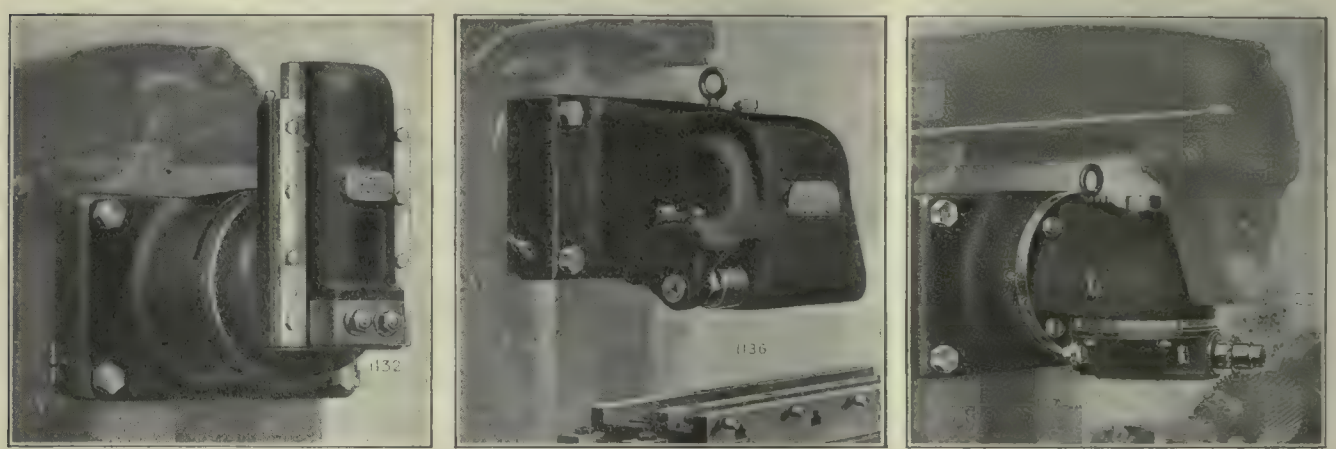


FIG. 11. THE CINCINNATI NO. 5 EQUIPPED FOR CIRCULAR MILLING

verted into a vertical miller. Using a 12-in. Cincinnati high-power inserted-tooth face-mill, a cast-iron block of medium hardness 12 in. wide was milled with a ¼-in. depth of cut at 11¾ in. feed per min. A straight-edge test at the close of this accomplishment indicated straightness of surface within 0.001 on a 24 in. length and 12 in. width.

Usually a machine tool can be easily classified either as a quantity-production machine or as a general-purpose machine. With its brute strength, rigidity, flexibility and range of complementary mechanisms, it is hard to say whether this new Cincinnati No. 5 will find its maximum field of service in the production department or the toolroom. There is no doubt, however, but that it is destined to render valuable service to both.



FIGS. 12, 13 AND 14. COMPLEMENTARY MECHANISMS FOR SLOTTING, RACK CUTTING AND SPIRAL MILLING

Does Technical Writing Pay?

By G. R. Smith
Pittsfield, Mass.

Some months ago the question as to whether or not technical writing "paid" was discussed at some length in the columns of the *American Machinist*.

My answer to this question would be, unhesitatingly, yes; not only is there an adequate financial return for the small allotment of time devoted to it, but there is infinitely greater reward in the satisfaction of having performed a service for the benefit of mankind.

One never knows where the seed sown broadcast in the columns of the technical journal is to fall upon fallow soil. Take, for instance, the journal we are pleased to call "ours"—the *American Machinist* itself. It has a circulation in this country alone of nearly thirty thousand copies weekly, and in addition it goes to every quarter of the civilized globe.

Your contribution to its columns is read by thousands of your fellow countrymen in the United States, and also by engineers and mechanics in all parts of Europe, Africa and Asia. It is quite possible that while your words are holding the interest of the English factory-manager in his London club, the native mechanic in India, and the mining engineer in the Transvaal (this depends somewhat on how interestingly you write, you know), the same words are perhaps being puzzled out by a machine-shop foreman in Greenland or a husky, dusky apprentice in the Solomon Islands.

I have personally received queries concerning articles appearing under my signature, not only from Belgium and other countries in nearby Europe, but from faraway Australia, and even from the Falkland Islands on the extreme southern coast of South America. I have on one occasion paid out more money in postage than the amount of the check received in payment for the article, but the satisfaction derived from the knowledge that I have been able to help a fellow-mechanic far outweighs the value of any monetary consideration.

If by writing your experiences to your favorite technical journal you can contribute a trifle to the sum total of mechanical knowledge in the world; if you can do something that is going to help your brother on the next bench, in the shop on the next street, or on the other side of the world your work is justified.



XII. Gas Torches Used For Welding

To the welder it is important that he should know the construction of his torch as well as its use. This article describes the common makes and illustrates them in detail. Several tables of valuable data are also given for the use of the practical man.

THE gas torches used for welding in the United States may be divided into two general types, known as medium-pressure and low-pressure torches. Each type is made in a number of sizes, and each size is usually provided with a number of interchangeable tips for producing flames of different size.

The medium pressure torches are also known as positive-pressure torches, and to avoid misunderstanding, they will be referred to as positive-pressure torches hereafter. In these torches, using acetylene and oxygen for welding, the acetylene pressure will range from 1 to 14 lb. and the oxygen pressure from 1 to 24 lb. per square inch, the pressure employed depending on the thickness of the metal being welded, the make of torch, and the tips used. The pressures given may even be exceeded in some exceptional cases.

A sectional view of a typical positive-pressure welding head is shown in Fig. 108. The oxygen enters at *A* and the acetylene enters at *B*. The oxygen goes to the small chamber *C* and thence out through the center hole. The acetylene goes to the chamber *D* and also out through the center hole, the two gases starting to mix at the point *E*, and as they pass out through the channel *F* to the end of the tip, they are thoroughly mixed. In this illustration, the removable tip is indicated by *G*. This make of tip has a conical seat and is held in place by means of the lock collar *H*. Made in this way, there are no threads on the tip itself, although the practice varies in different makes.

The low-presure torch is also known as the injector type. In this type of torch, the acetylene, or other gas, is supplied under a pressure of a few ounces up to 1 lb., but the oxygen may have a pressure of from 5 to 30 lb. per square inch, according to the size of tip being used. In some cases the oxygen pressure may be either higher or lower than the figures given. A sectional view of a typical low-pressure torch is shown in Fig. 109. In this torch the acetylene, or other gas, enters at *A* and the oxygen at *B*. The acetylene goes to the chamber *C* from which it is sucked by the oxygen pouring out through the nozzle at *D*, and it is carried along with the oxygen into the mixing chamber

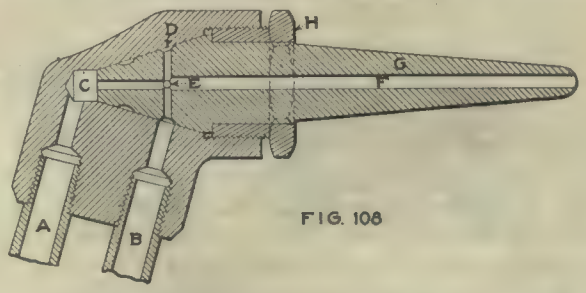


FIG. 108

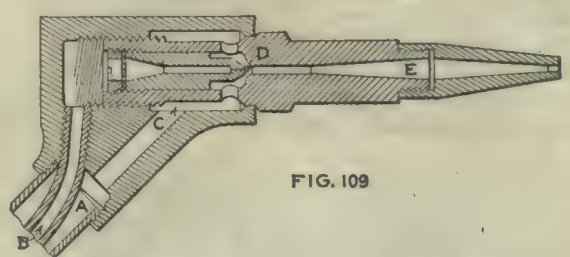


FIG. 109

FIGS. 108 AND 109. A TYPICAL POSITIVE-PRESSURE WELDING TORCH AND A LOW-PRESSURE OR INJECTOR TYPE OF WELDING TORCH

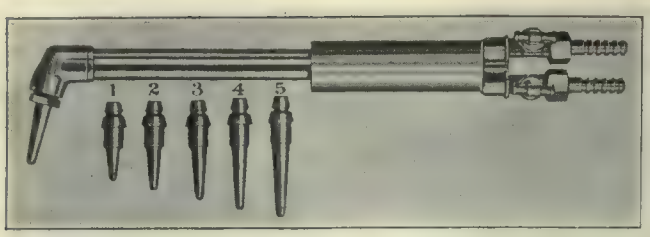


FIG. 110. THE DAVIS-BOURNONVILLE STYLE C POSITIVE-PRESSURE WELDING TORCH

E in the tip of the torch. From this chamber the gases issue thoroughly mixed and ready for combustion.

As they qualify for classification as either positive-pressure or low-pressure types of torches, the various makes of each type differ principally in form, the general principles of action remaining the same. A few examples of the different makes of positive-pressure torches will be shown first, and these will be followed by others of the low-pressure or injector type.

A standard form of a positive-pressure welding torch, made by the Davis-Bournonville Co., is shown in Fig. 110 and in detail in Fig. 111. A number of torches used for various purposes are shown in Fig. 112. In this illustration, *A* is a small lead-burning torch. *B* is a midget torch used for welding very light sheet metal for manufacturing purposes, such as the seams of cook-

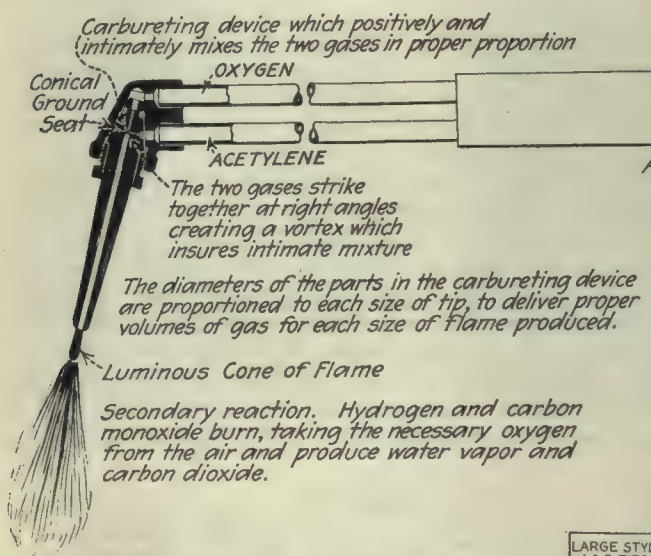


FIG. 111. DETAILS OF THE DAVIS-BOURNONVILLE WELDING TORCH

ing utensils, aluminum ware, etc. It weighs about 8 oz., is 10 in. long, and may be used on sheets up to $\frac{1}{8}$ in. thick. *C* is a small-size torch for metal from $\frac{1}{32}$ to $\frac{5}{16}$ in. thick, weighs 18 oz., is 14 in. long and uses oxygen pressures, with different tips, of from 2 to 10 lb. *D* is a manufacturer's torch, intended for use on boilers, steel barrels, metallic caskets, tanks, cylinders, etc. The head is set at right angles to the body, which has been found best for this work. It weighs 24 oz., is 18 in. long and uses oxygen at 2 to 10 lb. pressure, according to the tips employed. *E* is a large torch for heavy welding. It weighs 2 lb., is 20 in. long, and uses oxygen at 12 to 20 lb. pressure. It is used on metal from $\frac{1}{4}$ in. thick up. *F* is a water-cooled torch, used for heavy welding where the tips have a tendency to become overheated. It is 36 in. long and weighs about $3\frac{1}{2}$ lb. Four lines of hose are needed with it, two for water and two for gas. *G* is used for welding with oxygen and hydrogen. *H* is for use on a welding machine. *I* is a water-cooled torch for a

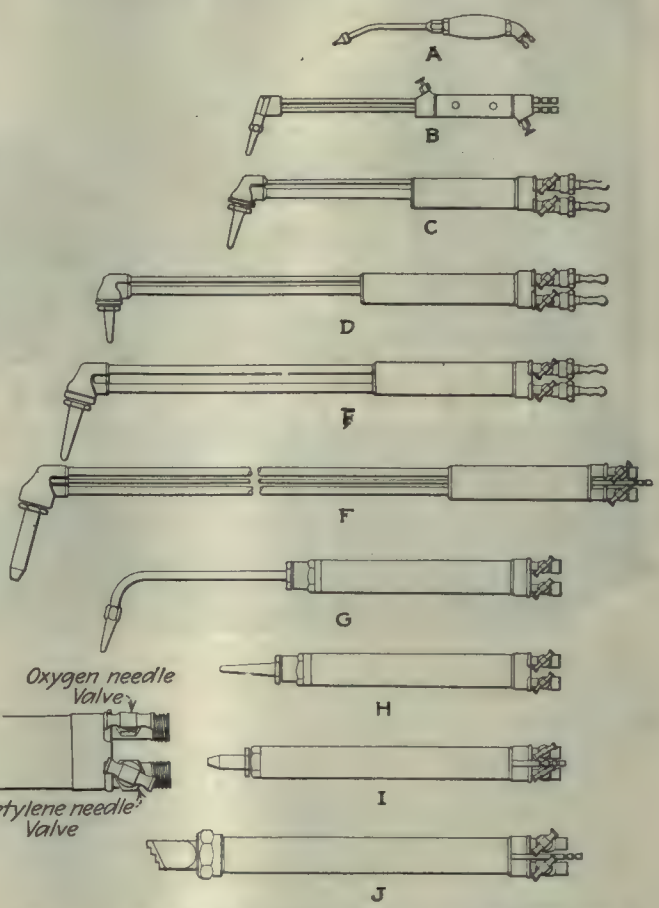


FIG. 112. VARIOUS MODELS OF DAVIS-BOURNONVILLE WELDING TORCHES

welding machine. *J* is water-cooled, for machine use, and has a multiple-jet nozzle or tip. All of the torches mentioned are furnished with five interchangeable tips for different thicknesses of metal. These tips, however, do not fit torches of different size; that is, the tips for

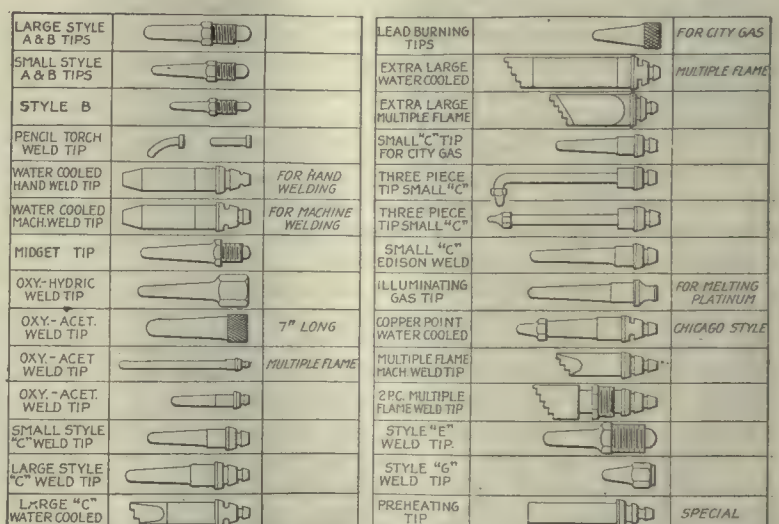


FIG. 113. DIFFERENT KINDS OF TIPS USED WITH DAVIS-BOURNONVILLE WELDING TORCHES

large torches will not fit small ones, nor vice versa. All the torches named are intended for oxygen and acetylene, except where mentioned otherwise. A number of different tips designed to be used with the torches illustrated, are shown in Fig. 113.

The approximate pressures of oxygen and acetylene as used in the Davis torches, are given in Table IX. The tips referred to in compiling this table, are known as styles Nos. 99 and 100, and are used with style *C* torches. These pressures serve only as approximate guides and are not to be taken literally in practice.

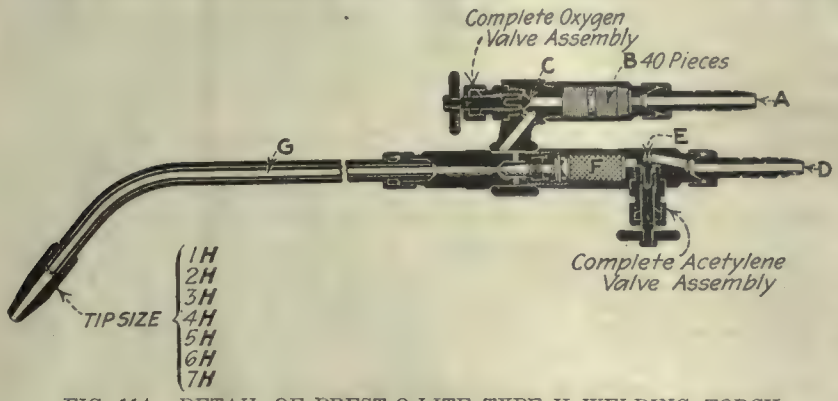


FIG. 114. DETAIL OF PREST-O-LITE TYPE H WELDING TORCH

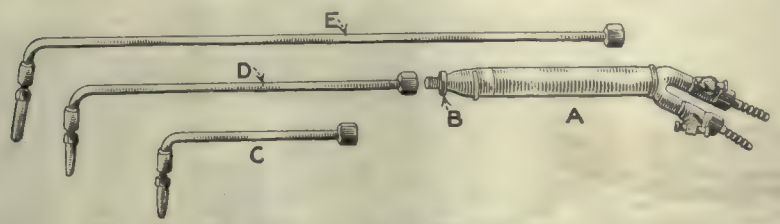


FIG. 115. TORCHES MADE BY THE GENERAL WELDING AND EQUIPMENT CO.

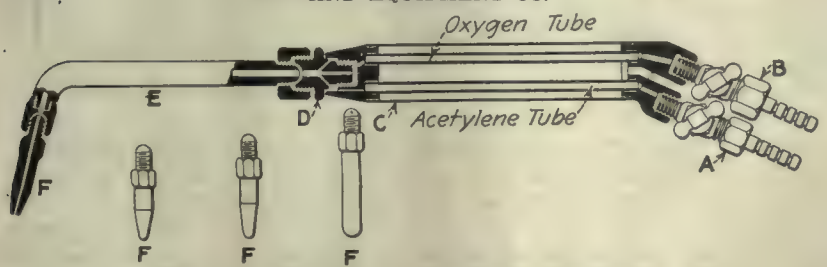


FIG. 116. DETAILS OF TORCH SHOWN IN FIG. 115

TABLE IX. APPROXIMATE GAS PRESSURES FOR DAVIS-BOURNONVILLE STYLE C WELDING TORCH, WITH NOS. 99 AND 100 TIPS

Tip No.	Thickness of Metal Inches	Acetylene Pressure Lbs.	Oxygen Pressure Lbs.
00	Very Light	1	1
0		1	2
1	1/32–1/16	1	2
2	1/16–3/32	2	4
3	3/32–1/8	3	6
4	1/8–3/16	4	8
5	1/4–5/16	5	10
6	5/16–3/8	6	12
7	7/16–1/2	6	14
8	1/2–5/8	6	16
9	5/8–3/4	6	18
10	3/4–Up	6	20
11	Extra Heavy	8	22
12		8	24

The torch shown in detail in Fig. 114 is made by the Prest-O-Lite Co., Indianapolis, Ind., but is handled by the Oxweld Acetylene Co. This torch is fitted with a long stem through which the gases pass and are thoroughly mixed before issuing from the nozzle.

The stem is fitted to the mixing chamber by means of a union nut, which permits the operator to point the welding tip in any direction, without changing his method of holding the torch. This is particularly advantageous for vertical and overhead welding. Both oxygen and acetylene inlets on the torch are fitted with fine-adjustment control valves. The one on the oxygen supply is so placed that the operator while working can make any slight necessary adjustment with the forefinger of the hand that grips the torch. The handle of the torch is fitted with anti-fireback chambers for both gases, filled with a special material through which it is impossible for a flame to pass.

The torch is easy to dismantle, as all parts are screwed together on metal-to-metal seats and no packing or solder is used at any joint.

For extra heavy work, a special stem 22 in. long is furnished, and for close work a 5½-in. stem may be had in addition to the regular size. The regular stem has seven tips, the largest four being of copper which will stand up against the intense heat radiated from the work better than any other metal. The smaller tips are of a special alloy. A similar torch is also made for very light work which weighs only 3 oz. complete.

In the detailed view given of the torch, *A* is the hose nipple through which the oxygen passes. At *B* is a set of 40 strainer cloths for the oxygen filter chamber; *C* is the oxygen needle valve; *D* is the acetylene hose nipple; *E* is the acetylene needle valve; *F* is the acetylene filter-chamber cartridge; *G* is the stem. The seven tips are indicated from 1*H* to 7*H*, and their openings can be determined from Table X.

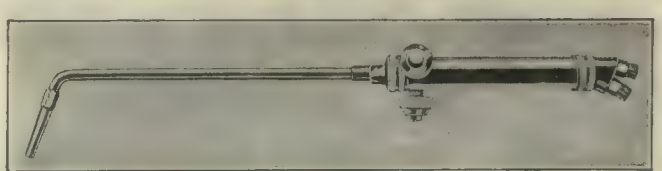


FIG. 117. THE IMPERIAL TYPE B WELDING TORCH

This table is especially valuable in that the nozzle openings are shown in regular twist-drill sizes, furnishing an easy method of comparison. The two tips given at the bottom of the table are extras, used for heavy work. The figures quoted in the table are based on straight

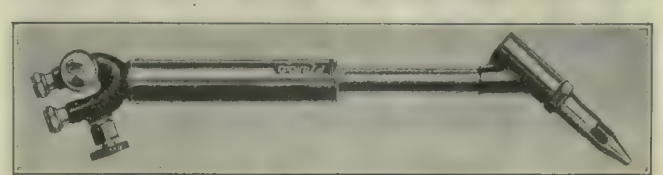


FIG. 118. THE OXWELD LOW-PRESSURE WELDING TORCH

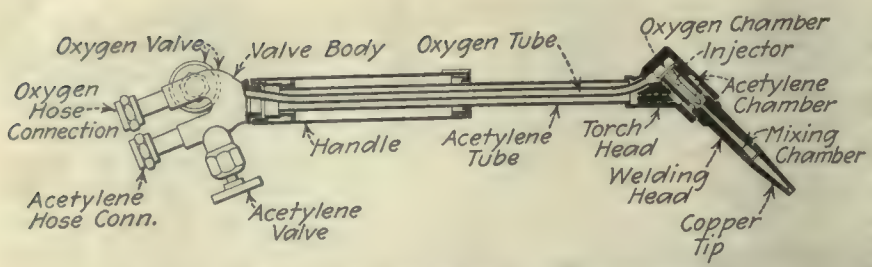


FIG. 119. DETAILS OF THE OXWELD WELDING TORCH

work on steel plate, beveled when over $\frac{1}{8}$ in. in thickness and welded without preheating.

A welding torch made by the General Welding and Equipment Co., Boston, Mass., is shown in Fig. 115. Each torch is furnished with nine tips, affording a range equal to all ordinary welding jobs. In addition, stems of different lengths may be had. In the illustration, *A* is the body of the torch; *B* is the mixing chamber; *C* is a short stem, the use of which makes the entire torch 16 in. long; *D* is a medium stem, making the torch 22 in. long; *E* is a long stem, making the total length of the torch 30 in.

TABLE X. APPROXIMATE WELDING RESULTS WITH TYPE H, PREST-O-LITE TORCH

Tip No.	Tip Drill Size	Gas consumption Cu. Ft. per hour		Thickness of Metal	Blow-pipe pressures Lbs. per sq. in.		Lineal feet welded per hour
		Oxygen	Acetylene		Oxygen	Acetylene	
1H	69	3 to 4	3 to 4	$\frac{1}{32}$ to $\frac{3}{64}$ in.	2 to 3	2 to 3	30 to 35
2H	60	6 to 8½	6 to 8	$\frac{1}{16}$ to $\frac{3}{32}$ in.	2 to 3	2 to 3	24 to 32
3H	55	10 to 12½	10 to 12	$\frac{1}{8}$ to $\frac{5}{32}$ in	3 to 4	3 to 4	12 to 16
4H	52	12 to 21	12 to 20	$\frac{3}{16}$ to $\frac{7}{32}$ in.	4 to 6	4 to 5	9 to 12
5H	49	18 to 28	18 to 26	$\frac{1}{4}$ to $\frac{5}{16}$ in	5 to 7	5 to 6	6 to 8
6H	44	24 to 40	24 to 38	$\frac{3}{8}$ to $\frac{7}{16}$ in.	8 to 11	8 to 9	4½ to 6
7H	35	35 to 54	35 to 50	$\frac{1}{2}$ in. and up	10 to 15	10 to 14	2 to 3
*7J	35	35 to 54	35 to 50	$\frac{1}{2}$ in. and up	9 to 13	9 to 12	Not used on plates
*8J	31	40 to 60	40 to 55	$\frac{1}{2}$ in. and up	9 to 14	9 to 13	Not used on plates

Details of this torch are shown in Fig. 116. Here the acetylene inlet is shown at *A* and the oxygen inlet at *B*. The body of the torch is indicated by *C*, and *D* is the mixing chamber; *E* is the stem, and *F* various shapes of tips.

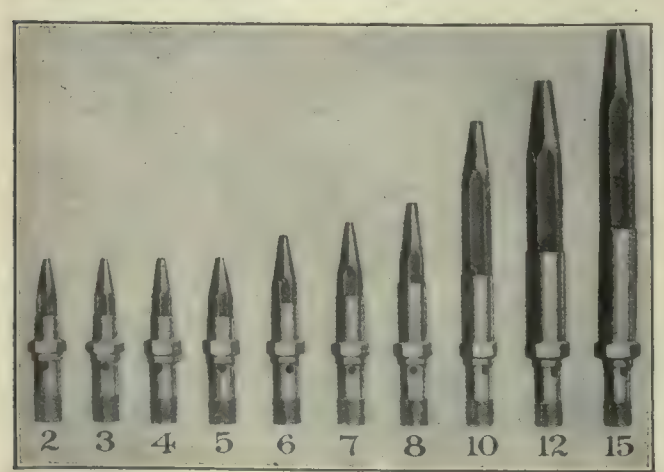


FIG. 120. A SET OF OXWELD WELDING TIPS

Another long-stemmed torch is shown in Fig. 117. This is made by the Imperial Brass Manufacturing Co., Chicago, and differs but little from the one just shown. The gas valves, however, are placed at the forward end of the body. Like most of the other torches, these may be used not only for oxy-acetylene, but also for oxy-hydrogen welding work, special tips and regulators being made for the purpose. For oxy-acetylene, the gas pressures are approximately the same as for other makes of torches. For oxy-hydrogen, the pressures used for various thicknesses of metal and different tips are given in Table XI. However, neither the size of the nozzle holes nor the amount of gas used per hour are given. This firm also makes a three-way torch which in outward appearance does not differ from the one

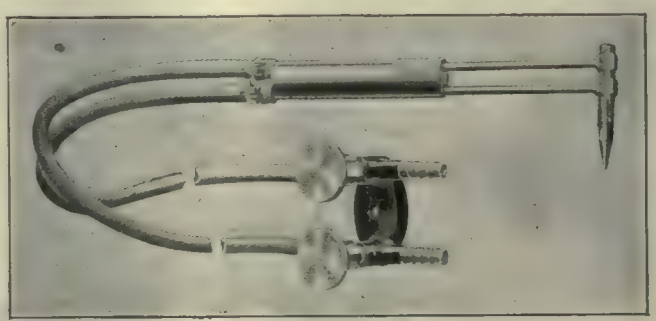


FIG. 121. THE OXWELD WELDING TORCH MODEL G

shown. It is intended to use a combination of acetylene, oxygen and hydrogen. The method used is to couple the acetylene and hydrogen hose by means of a Y mixing valve from which the two gases are conducted by a single hose to the torch, the oxygen hose being coupled in the usual way. This concern does not recommend the welding of steel above $\frac{1}{4}$ in., or cast iron above $\frac{3}{4}$ in. in thickness with oxy-hydrogen. For light sheet steel, and especially aluminum, oxy-hydrogen has some advantages, provided the hydrogen can be obtained at reasonable rates. The combination of oxygen-acetylene-hydrogen, however, has a claimed temperature of about 5000 deg. F., which is about half-way between that of oxy-hydrogen and oxy-acetylene. It is also claimed that this flame possesses all the advantages of both the double combinations. The same tips are used as for oxy-acetylene, and only a small percentage of acetylene is needed to give a cone-shaped flame of far greater

TABLE XI. PRESSURES OF GAS USED IN IMPERIAL OXY-HYDROGEN WELDING TORCHES

Welding Tip No.	Thickness of Metal to be Welded, In.	— Pressures, Lb. — Oxygen	Hydrogen
1H	1/64 to 1/32	10	10
2H	1/32 to 1/16	12	12
3H	1/16 to 1/4	15	15
4H	1/4 to 1/2	20	20
5H	1/2 in. and up	25	25

visibility than that of the oxy-hydrogen flame. The low visibility and long flame of the oxy-hydrogen flame are always a handicap in welding to any operator used to employing the oxy-acetylene torch. The approximate pressures employed when using the Imperial three-way outfit are shown in Table XII.

It should always be borne in mind, when consulting



FIG. 122. THE OXWELD SHEET-METAL WELDING TORCH

a table where only pressures are given, that these pressures do *not* signify the *amount* of gas used, and that such pressures apply only to the particular make of torch mentioned. It might be possible for two different torches to use gases at exactly the same pressures as far as the gages indicated, and yet have one of these torches use several times the amount of gases used by the other. In order to make it possible for

TABLE XII. PRESSURES OF GAS USED IN IMPERIAL THREE-WAY WELDING TORCHES

OXYGEN, ACETYLENE AND HYDROGEN

Oxygen, Welding Tip, No.	Thickness of Metal, to be Welded, In.	Pressures, Lb. Oxygen.	Acetylene.	Hydrogen
1T	1/32	3	2	2
2T	1/16	5	3	3
3T	3/32	6	4	4
4T	1/8	7	5	5
5T	3/16	8	6	6
6T	1/4	9	7	7
7T	3/8	10	10	10
8T	1/2	12	12	12
9T	3/4	14	14	14
10T	1 in. and over	18	15	15

a user to estimate the *amount* of either oxygen or acetylene his outfit is consuming, three methods of estimating are given here. These methods are taken from the Prest-O-Lite instruction book. Other methods have previously been given in the descriptions of the different gases and their production. The Prest-O-Lite methods are:

Method 1. — Weigh your acetylene cylinders before starting work. Weigh again after the job is completed. Note the difference in weight in ounces, and multiply by 0.9; result equals the cu.ft. of acetylene used. When using Prest-O-Lite torches multiply the acetylene used in cu.ft. by 1.1; the result equals the cu.ft. of oxygen used.

Method 2. — Take readings of oxygen cylinder pressure gage in atmospheres before and after.

For 100-cu.ft. cylinders the difference of readings in atmospheres multiplied by 0.83 equals the oxygen consumption in cu.ft.

For 200-cu.ft. cylinders the difference in readings in atmospheres multiplied by 1.67 equals the consumption of oxygen in cu.ft.

For 250-cu.ft. cylinders the difference in readings in atmospheres multiplied by 2.08 equals the consumption of oxygen in cu.ft.

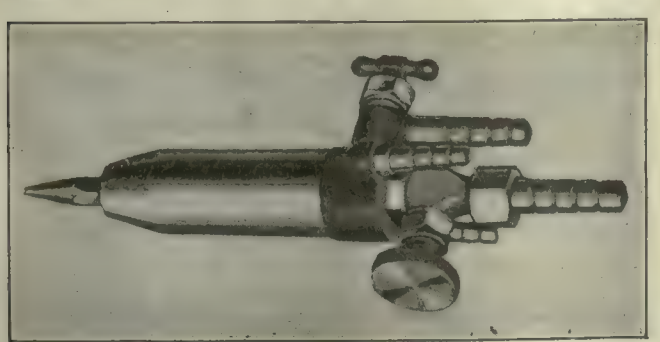


FIG. 123. THE OXWELD WATER-COOLED SINGLE-JET WELDING TORCH, TYPE W-8

When using Prest-O-Lite torches, multiply the oxygen used in cu.ft. by 0.91; the result equals the acetylene consumption in cu.ft.

Method 3. — Measure drill size of orifice in torch tip, using standard drills for measuring.

Area of orifice in sq.in. multiplied by 83 equals the acetylene consumption in cu.ft. per minute.

Area of orifice in sq.in. multiplied by 91 equals the oxygen consumption in cu.ft. per minute.

Note the minutes the torch is in use and use the above figures to estimate gas consumption.

Remember, the acetylene consumption cannot be accurately estimated from the pressure gage readings.

TABLE XIII. AREAS OF DRILLS FROM 1 TO 80 SIZE IN SQ.IN. AND SQ.MM. MANUFACTURERS STANDARD

No.	Size of Drill in In.	Area in Sq.In.	Area in Sq.Mm.	No.	Size of Drill in In.	Area in Sq.In.	Area in Sq.Mm.
1	0.2280	0.04083	26.35	41	0.0960	0.007238	4.670
2	0.2210	0.03836	24.77	42	0.0935	0.006860	4.426
3	0.2130	0.03563	22.99	43	0.0890	0.006221	4.014
4	0.2090	0.03431	22.14	44	0.0860	0.005809	3.748
5	0.2055	0.03316	21.39	45	0.0820	0.005281	3.406
6	0.2040	0.03269	21.09	46	0.0810	0.005153	3.325
7	0.2010	0.03173	20.47	47	0.0785	0.004831	3.117
8	0.1990	0.03110	20.06	48	0.0760	0.004536	2.926
9	0.1960	0.03017	19.46	49	0.0730	0.004185	2.700
10	0.1935	0.02940	18.97	50	0.0700	0.003848	2.483
11	0.1910	0.02865	18.48	51	0.0670	0.003526	2.275
12	0.1890	0.02806	18.10	52	0.0635	0.003167	2.043
13	0.1850	0.02688	17.34	53	0.0595	0.002781	1.795
14	0.1820	0.02602	16.79	54	0.0550	0.002376	1.533
15	0.1800	0.02545	16.42	55	0.0520	0.002124	1.370
16	0.1770	0.02461	15.88	56	0.0465	0.001693	1.092
17	0.1730	0.02351	15.17	57	0.0430	0.001452	0.9368
18	0.1695	0.02256	14.56	58	0.0420	0.001385	0.8936
19	0.1660	0.02164	13.96	59	0.0410	0.001320	0.8510
20	0.1610	0.02036	13.14	60	0.0400	0.001257	0.8116
21	0.1590	0.01986	12.81	61	0.0390	0.001195	0.7710
22	0.1570	0.01936	12.49	62	0.0380	0.001134	0.7316
23	0.1540	0.01863	12.02	63	0.0370	0.001075	0.6936
24	0.1520	0.01815	11.71	64	0.0360	0.001018	0.6568
25	0.1495	0.01755	11.32	65	0.0350	0.000962	0.6207
26	0.1470	0.01697	10.95	66	0.0330	0.000855	0.5516
27	0.1440	0.01629	10.51	67	0.0320	0.000804	0.5187
28	0.1405	0.01550	10.00	68	0.0310	0.000754	0.4865
29	0.1360	0.01453	9.374	69	0.0292	0.000669	0.4316
30	0.1285	0.01296	8.361	70	0.0280	0.000615	0.3968
31	0.1200	0.01131	7.297	71	0.0260	0.000531	0.3426
32	0.1160	0.01057	6.819	72	0.0250	0.000491	0.3168
33	0.1130	0.01003	6.471	73	0.0240	0.000452	0.2916
34	0.1110	0.009677	6.243	74	0.0225	0.000398	0.2565
35	0.1100	0.009503	6.131	75	0.0210	0.000346	0.2232
36	0.1065	0.008908	5.747	76	0.0200	0.000314	0.2026
37	0.1040	0.008495	5.481	77	0.0180	0.000254	0.1639
38	0.1015	0.008092	5.221	78	0.0160	0.000201	0.1297
39	0.0995	0.007775	5.016	79	0.0145	0.000164	0.1058
40	0.0980	0.007543	4.866	80	0.0135	0.000143	0.09226

In order to simplify the calculations in Method 3, the areas of the various orifices made with numbered drills are given in Table XIII. This table was calculated by K. H. Condit, associate editor of the *American Machinist*, for both square inches and for millimeters.

The Oxweld Low-Pressure Torch

The Oxweld low-pressure torch is of the true injector type. One of this make of torch is shown in Fig. 118 and in detail in Fig. 119. In this torch the acetylene is drawn into the combining tube by the injector action of the high-pressure oxygen jet, in the proper quantity to form what is known as a neutral flame; that is, one not having an excess of oxygen or acetylene. A torch of this type may be used with either a low- or positive-pressure acetylene system, although primarily designed for low-pressure acetylene, which means at a pressure of 1 lb. or less. Ten hard-drawn copper tips, shown in Fig. 120, are regularly supplied for this torch, and bodies may be had to hold the tips at 67½ or 90 deg., although the regular angle is 45 deg. The tips shown are numbered 2, 3, 4, 5, 6, 7, 8, 10, 12 and 15 and are intended for use on metal 1/16, 3/64, 3/32, 1/8, 3/16, 1/4, 3/8, 1/2, 5/8 and 3/4 in. thick and up, respectively.

A very light torch, weighing 9 oz. and known as

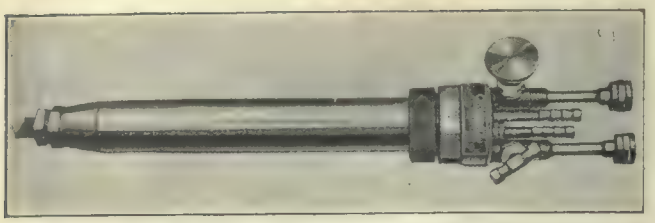


FIG. 124. THE OXWELD WATER-COOLED MULTIPLE-JET WELDING TORCH, TYPE W-5

model G, is shown in Fig. 121. This is intended for very light sheet metal, instruments, jewelry and the like. In order to secure a torch of minimum weight, the oxygen and acetylene regulating valves have been removed from the body of the torch and incorporated in a separate valve block which may be fastened in any convenient position near the operator.

Another very light torch is shown in Fig. 122. This is suitable for metals up to $\frac{1}{8}$ in. thick. In addition to the usual practice of placing needle valves in the rear body, there is also incorporated in the torch head a needle valve which gives minute control of the flame with each size of tip. Three sizes of interchangeable copper tips are supplied. It is 10 in. long and weighs 10 oz.

The Oxweld water-cooled machine torches are shown in Figs. 123 and 124. Fig. 123 is a single-jet, known as type W-8, and is adapted to work on cartridge cases, pistol magazines, or any light sheet-metal work that can be fed mechanically. Fig. 124 is known as type W-5, and is a multiple-jet torch suitable for welding metal up to $\frac{3}{32}$ in. thick, and is designed for continuous operations on tube stock or other mechanically handled work.

In Table XIV, which is taken from the Oxweld handbook, the various thicknesses of metal, the oxygen pressure, hourly gas consumption, consumption per foot and amount of wire used, are shown. In this table the acetylene is used at 1-lb. pressure.

The torch shown in Fig. 125 and in detail in Fig. 126 is made by the Messer Manufacturing Co., Philadelphia, Penn. It works on the injector principle and may be used with either low- or positive-pressure acetylene systems. This make is notable on account of the single valve in the torch itself, and the tips, which are bent, may be set at any angle radial with the torch body. The various sizes, tips and general range is practically the same as for the torches previously described.

TABLE XIV. APPROXIMATE DATA FOR USE WITH OXWELD WELDING TORCHES

Thickness of Metal In.	Size of Weld. Head	Oxygen Pressure Lb./Sq. In.	Per Hour				Per Linear Foot		
			Speed		Gas Consumption		Gas Consumption		Oxweld Iron Wire Cu. Ft.
			Best Condition Lin. Ft.	Shop Practice Lin. Ft.	Oxygen Cu. Ft.	Acetylene Cu. Ft.	Oxygen Cu. Ft.	Acetylene Cu. Ft.	
1/64 No. 28	Model G	5	30	26	3.5	3.3	0.14	0.13	
1/32 No. 22	2	9	26	22	4.5	4.2	0.20	0.19	0.005
1/16 No. 16	3	10	21	17	6.6	6.2	0.39	0.37	0.01
3/32 No. 13	4	11	17	14	8.7	8.3	0.62	0.59	0.02
1/8 No. 11	5	12	14	11½	10.8	10.2	0.94	0.89	0.04
5/32	6	14	11	9	15.0	14.2	1.67	1.58	0.06
1/4	7	16	9	7	19.2	18.3	2.74	2.62	0.15
3/8	8	19	6¼	4½	27.6	26.3	6.13	5.85	0.3
1/2	10	21	4½	3	36.0	34.3	12.0	11.4	0.6
3/4	12	25	2¾	1½	52.8	50.4	35.2	33.6	1.4
1	15	30	2	1	69.7	66.3	69.7	66.3	2.4

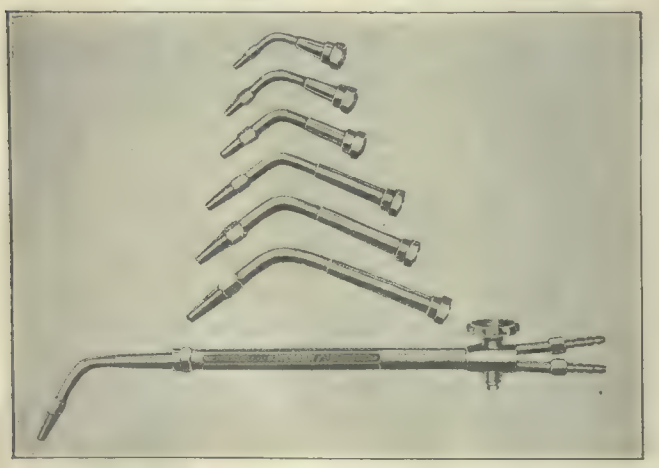


FIG. 125. THE MESSER WELDING TORCH AND TIPS

Description of the Oxy-Thermalene Welding Torch

An oxy-thermalene welding torch, and a set of tips, is shown in Fig. 127. Details of the head are shown in Fig. 128. One of these torches is about 17 in. long and weighs 24 oz. Referring to the detailed cut, the oxygen enters at *A* and the thermalene at *B*. The oxygen nozzle is at *C*. Screens are placed at *D*. One of the troubles with some torches is the fact that frequently a flashback will occur, reaching the oxygen nozzle in the gas chamber. Here a flame would be formed which would burn out the entire copper tip. In

TABLE XV. AMOUNT OF OXYGEN AND THERMALENE USED FOR WELDING

Tip No.	Thickness of Metal in Inches	Consumption of Thermalene, Ft.	Consumption of Oxygen with Thermalene, Ft.	Oxygen Pressure with Thermalene, Lb.
1	1/64 to 1/16	2.15	2.55	1.0
2	1/32 to 3/32	3.32	3.99	2½ to 3
3	3/32 to 1/8	5.51	6.52	3 to 3½
4	1/8 to 3/16	8.29	10.11	3½ to 4½
5	3/16 to 1/4	11.78	14.21	5 to 5½
6	1/4 to 5/16	16.48	20.10	6½ to 7½
7	5/16 to 3/8	21.40	27.51	10 to 11
8	3/8 to 1/2	25.00	35.01	11 to 12
9	1/2 to 3/4	33.60	54.21	15
10	3/4 to 1½	48.05	75.30	20 to 22
11	1½ to 1¾	70.35	101.62	25 to 28
12	1¾ to 2	91.10	159.20	25 to 30

the torch shown it is claimed this does not occur. It will be seen that the gas chamber is comparatively large, while the orifice leading from the gas chamber to the mixing chamber is restricted and elongated. This orifice is enlarged abruptly to the mixing chamber in the nozzle, so as to form sharp corners at *E*. The mixing chamber gradually contracts to the outer opening in the nozzle. As a result, if a flashback should occur, it will cause a whirl or eddy at the shoulder *E*, which in itself will prevent the flame from running back through the restricted channel. Moreover, such propagation of the flame into the mixing chamber will cause the gas in the chamber to be pressed back by the increased expansion and pressure, so that there will

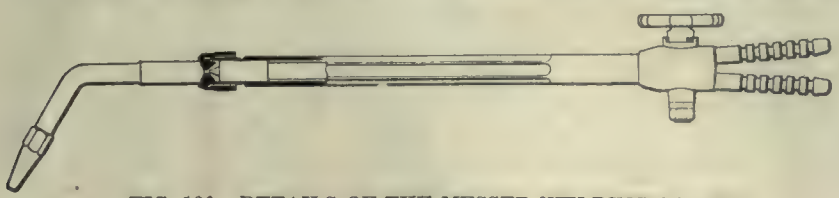


FIG. 126. DETAILS OF THE MESSER WELDING TORCH

be only burnt gas in the restricted channel and around the oxygen tip. The result is that the flame will die out in the restricted channel between the gas and mixing chambers, so that a cutting flame is never formed at the oxygen nozzle. It is necessary, however, that these

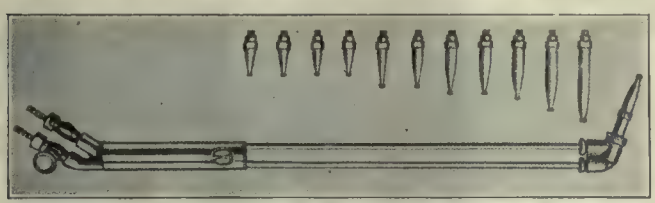


FIG. 127. A THERMALENE WELDING TORCH AND TIPS

parts should be properly proportioned to obtain the desired results.

For various welding purposes, 12 sizes of tips are made to be screwed into the torch bodies. These tips run from 2 to 4 in. in length, and the outlets vary from the size of a No. 80 to No. 33 drill. All have

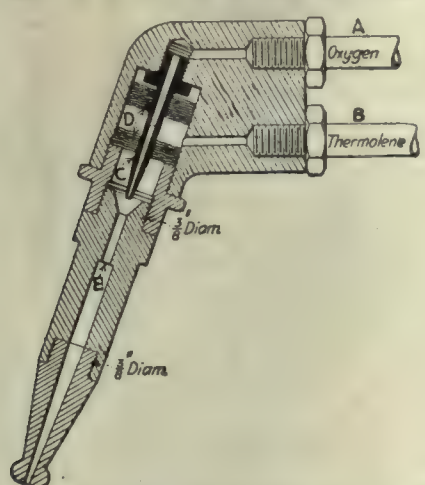


FIG. 128. DETAILS OF THE THERMALENE WELDING TORCH HEAD

$\frac{9}{16}$-in. wrench-holds on them for screwing into the torch bodies.

Table XV will furnish a good idea of the amount of thermalene and oxygen used per hour for different thicknesses of metal, the torch being fitted with the proper nozzle in each case.

Harry Tells His Uncle a Few Things

My dear Uncle:

It has been some little time since I had the opportunity to write you, and during that time much has happened. A few months ago everything was at the height of a feverish activity. Shops everywhere were running, days, nights and Sundays in frantic endeavor to furnish something—anything—to "swat the Hun." Machinists and toolmakers, the fellows with whom you and I are most intimately acquainted, were very important individuals indeed and some of them were exasperatingly conscious of their importance.

We had our troubles, of course; everybody has trouble, but ours were of a minor nature. Our toolmakers were mostly sensible fellows with families to keep their heads level, who did not really believe that the war would last forever, and that a good job before the war stood a pretty good chance of being a good job after the war, while some of the in-between jobs with their glittering financial accompaniment might prove to be will-o-the-wisps, exciting while the chase lasted, but with a bitter taste of the Dead Sea fruit for an aftermath.

Over at the Big Shop across the canal the trouble was acute. This shop is owned by a New York syndicate to which a dividend is no object so long as the stock market is active, and it has for some years been an exponent of system to the *n*th power. Its regular product is far from being munitions of war, and thus when it joined the procession of producers of war material it began at once to suffer from general debility of the system.

Cornered the Market in Toolmakers and Machinists

Operating at first on the "cost plus" basis it immediately cornered the market in toolmakers and machinists. One of our kids, not an apprentice, whose principal job was sweeping the floor and running a drilling machine on jigged work, went over and hired out as a first-class toolmaker at $4.50 per day of eight hours. This was quite early in the war; he probably got $9.00 or so later.

He first went up against the employment manager—or manageress, I forget which it was at the time—who gave him the once over, sized up his "noble brow," his "eagle eye" and his "aggressive chin," noted that these compared favorably with the large-sized chart hanging on the wall, and then passed him along to a youthful assistant who gave him a form to fill out.

On this form Tommy deposed that he was 20 years of age; male; white; born in U. S. A.; unmarried; had no children; was several feet and some inches high; and weighed 119 lb. in his stocking feet. Much of this was true. He further declared that he did not drink; did not use tobacco; smoked cigarettes occasionally (I have always suspected that his cigarettes were made of old rope); was strictly honest; and that his habits and deportment were excellent. Some of this was true. He might have added that he had never been in jail, though I do not recall that that question was asked—on the blank.

Passing to the second entrenchment, Tommy was given a blank on which he stated that he was an expert toolmaker, had served a regular apprenticeship with

the Gatchet Machine Co. and had worked for two years in the capacity of toolmaker with the Hookemsnivy Manufacturing Co. Also that he was perfectly familiar with the use of a micrometer, a dial indicator, and a sine bar, and that he had a kit of tools. None of this was true.

He further averred that he wanted $5.00 per day, which statement was unimpeachable, though quite conservative.

At this stage the prosecution rested. Tommy also rested—for two hours—at the expiration of which period he was notified by an important-appearing youth to come in for examination at 10 o'clock on the following morning.

At the appointed time Tommy presented himself before the "examining board." He had spent some time the previous evening "boning" for the examination with the help of a friend who had been through the mill, and he could read a micrometer as readily as the boy at the head of the Primer Class reads "See The Cow Jump." Indeed, I think he could read it better than his examiner, for when he was handed a plug gage plainly marked ⅝ in. he promptly read it "point six two five," which, I'll bet a cookie, wasn't right if the tenths were to be considered.

Tommy Demonstrates the Sine Bar

The youth in charge of the sine bar gave Tommy a few practical examples in the use of this tool and required him to demonstrate it, which he did, although his mathematics were not beyond criticism. After a few more unimportant questions, that could have been answered by any ordinarily intelligent boy after a couple of hours' study under a competent instructor, Tommy was on; his poor showing in trig had cost him 50c. per day, but he was a full-fledged certificated toolmaker without having had a single day's experience, and knowing practically nothing of the business.

This would have been a joke if it were an isolated case and his employer had to pay him, but unfortunately there were many thousands of him and the paymaster was the American people.

Now that the tide has turned the other way the market is flooded with young Tommies who are not toolmakers, may never be toolmakers—because before they can become such they must accomplish the practically impossible feat of unlearning many things they know, that are not so—yet they have been called, and are calling themselves, toolmakers; have worked for toolmakers' wages, and have never learned that they are not toolmakers. These young men are not going back to the level of unskilled labor without a struggle and there seems to be a disposition in some quarters to accept them as they are and build new machinery to fit them.

So long as the supply exceeds the demand, the natural law of selection will prevail and the general trend will be toward a level of greater skill, knowledge and efficiency. When, on the other hand, the demand is greater than the supply, the tendency is toward degeneration unless it be combated by efficient and well-thought-out methods.

Though it now appears as if the supply was going to exceed the demand, it is a very wise or a very ignorant man who will predicate what the condition will be a year hence. For this reason some measures should be adopted first to determine to what avocation each of our young men—and possibly our young women—is best adapted, and second to devise some means by which each individual may be best fitted to assume the duties of that avocation.

Years ago the principal determining factor was heredity. A boy wanted, and was expected, to follow in his father's footsteps. This was a sort of natural progress along the line of least resistance that produced results not wholly undesirable. We had (and have now) machinists, than whom there are none better in the world, whose fathers, and whose fathers' fathers were machinists before them.

Keeping the Trade in the Family

This tendency to "keep the trade in the family" may or may not have developed a natural genius, but it cannot be denied that the training of a boy whose father and grandfather were machinists was much more intensive and began at a much earlier age than that, for instance, of a boy whose father was a minister, and who never saw the inside of a shop until he was 15 years or so of age.

There were disadvantages also. We still have with us men who know things that are not so, just because "father said so," and who are conservative to the point of suspicion when anything new is discovered in their field, but even at the risk of being classed with the mossbacks and hardshells I hold to the opinion that this system brought forth better workmen than the present-day method of choosing a trade solely because it pays the best wages.

We cannot go back to the old way, even if that were to be desired, in less than three generations, and to continue in the present way is to gradually increase the troubles of the poor foreman who "can't get the kind of help he used to." Nature will provide a way, but it will very likely not be the best way, so it seems to be up to us to provide a means of assorting and educating the rising generation, as well as re-educating a portion of that already risen.

Harry, Sr.

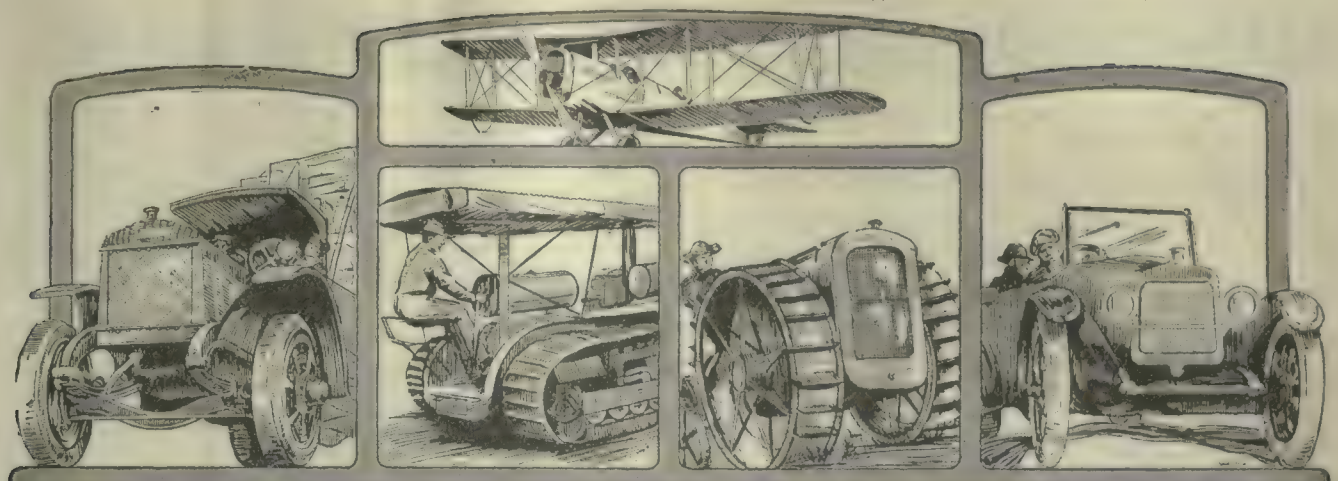
How Would You Prevent This Grinding Trouble?

By J. H. Hollinger

With reference to the above inquiry by John Vernon published on page 705 of *American Machinist*, if Mr. Vernon had given a little more information as to how he ground the piece it would have served as a guide to others in solving his problem.

Assuming that the work is to be done on a regular surface-grinding machine, the piece should be placed on true parallels (to provide clearance for the bracket depending from its under side), and sounded to find out if it bears solidly. It should be underlaid with paper at all points not in contact with the supporting surface so that there will be no distortion or springing either from wheel pressure in grinding or from pressure in whatever manner applied for holding the work in place.

The work may be held in the ordinary form of machine vise by means of suitable fingers or, by using special parallels, may be held on a magnetic chuck. A wheel of medium grain and rather soft texture should be used for the grinding operation, and its surface should be kept sharp to avoid the generation of undue heat which is usually the cause of warping.



Operations on the Liberty Motor Cylinders

II. Machining Operations

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit, Mich.

The manufacturing of steel cylinders in large quantities, especially in view of the extreme accuracy demanded, involved new problems which may have a bearing on automobile building of the future. The illustrations give a good general idea of the methods employed in the earlier operations and the data as to operations give complete information as to speeds, feeds, etc.

IN VIEW of the fact that the machining of Liberty motor cylinders in great quantities is now a thing of the past, it does not seem advisable to go into the extreme details of the manufacturing methods employed. On the other hand, as there seems likely to be an increase in the use of steel cylinders, it is felt that the experience gained should not be lost, but should be recorded in sufficient detail to enable others to profit by it as occasion may arise. With this in view, these articles have been prepared in the belief that they may prove beneficial to the industry as a whole, and that they contain many suggestions which can be modified and adopted for many other uses. This will be followed by articles outlining other essential parts of the motor. Beginning with a list of the operations, there follows a brief description of the main operations and the illustrations of the fixtures and machines used. This also gives the speeds, feeds and time required for each operation.

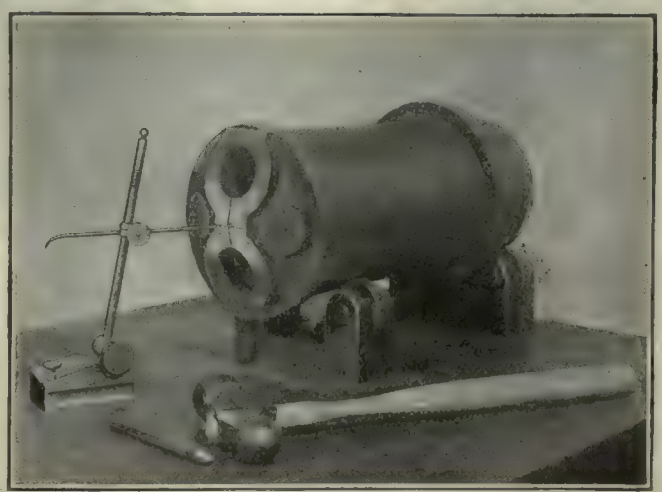


FIG. 1. CENTERING THE CYLINDER FORGING

One of the most important and vital parts of the Liberty motor is the steel cylinders. The forging of these was perfected by the engineers of the Ford Motor Co., and all the cylinders used were forged in their plant, as has been described in a previous article.

In the following machine operations at the Lincoln Motor Co. performed before welding the elbows and water jacket, the average production covering the period from Mar. 3, 1918, to Nov. 23, 1918, was 2.34 finished cylinders per man each day of nine hours. For the period from Nov. 18 to Nov. 23, the production was 3.26 perfect cylinders per man for a nine-hour day. When the rough forging went into the shop it weighed 47 lb. After the machining was completed, it weighed 11 lb., 6 oz. From the perfect cylinders alone, this shop produced 3,967,231 lb. of chips and turnings; imperfect cylinders not being computed. Each man in the first operation handled 1000 cylinders, weighing 47,000 lb. or 23½ tons per man each nine hours. The rough-boring operation removed 9 lb. from each cylinder or 4½ tons of borings per day. The operation of recentering was performed by one man. The cylinders at this period weighed 33 lb. 7 oz. each and were lifted on the drilling machine and lifted off again. The production was from 850 to 1000 per day, so that this man handled more than 33 tons of steel in nine hours.

CENTERING.—The centering was formerly done by scribing the point central with the outside of the dome. A large loss resulted because of the dome not being central with the body, and the bore would not

AUTOMOTIVE CONSTRUCTION

clean up So this was changed to locate the center by the body of the cylinder.

MACHINING OPERATIONS ON CYLINDER BARREL

Inspecting the rough stock.
Locating and countersinking the center in rough-boring (one helper).
Turning $6\frac{7}{32}$ in. diameter and $7\frac{7}{32}$ in. diameter for chucking surfaces (one helper).
Marking the finish line on the bottom end of the cylinder.
Rough-boring $4\frac{3}{4}$ in. diameter.
Rough-boring $4\frac{3}{4}$ in. (Acme turret lathe only, one helper to run four machines).
Roughing and finish-boring the face inside of the dome face to the finish line and recess.
Drilling the center.
Re-centering the open end.
Inspecting.
Re-centering the top of the cylinder, turning with the bore.
Rough-drilling the portholes to $2\frac{1}{4}$ in.
Rough-turning the outside diameter and finish-turning the bolt flange for the roller rest.
Rough-straddling the flange and rough-forming the water-jacket flange. Finish-turning the taper at the top and the diameter above the water-jacket flange, roughing a 1-in. radius below the taper, $\frac{1}{4}$-in. radius on the lower end, and finish-turning $5\frac{7}{16}$ in. and 5 15/64 in.
Finish-turning between ribs; finish-straddling the flange.
Turning the bottom rib, forming the top of the dome, and burring the ribs.
Finish-turning between the ribs and flange, turning the bottom radius, and recessing the water-jacket rib.
Inspecting.
Boring and turning the portholes.
Drilling and turning the spark plug holes.
Rough-facing the radius on the face of the cylinder.
Roughing the outline of the bolt flange.
Rough-milling the two parallel sides.
Finish-milling the two parallel sides.
Profiling the dome. (Girl price to be same as man price.)
Profiling the outline of the flange.
Chipping and filing the dome.
Washing.
Inspecting finished stock

The fixture shown in Fig. 1 was used, and the cylinder rolled so that quartering lines were scribed with a surface gage. The point was then marked with a prick punch. The center was then countersunk with a center drill on a 16-in. Leland-Gifford drill press at a rate of about 900 cylinders in nine hours by two men.

TURNING THE LOCATING SURFACES.—The cylinder is put on an 8-in. x 36-in. Lo-Swing lathe. The dome center is put on head center of lathe and two solid driving fingers engage the portholes. A cone center in the tailstock locates the open end. A cut is taken on the outside of the dome $6\frac{11}{32}$ in. in diameter and a cut $7\frac{7}{32}$ in. in diameter on the bolt flange. These points are used to locate future operations. The production was 300 pieces in nine hours for one man and helper; the cutting speed being 50 ft. per minute with a feed of 0.054 in. per revolution. The special tools used were two Lo-Swing tool blocks, a No. 5 Hoover insert point for center and a tailstock center. The gages on the operation were snapped tight.

MARKING THE FINISH LINES.—The cylinder is placed on a rolling fixture and adjusted so the top and bottom of the bolt flange will clean up, and that about $\frac{3}{32}$ in. stock is left on top of dome with finish material on bottom end of cylinder. A finish line is then scribed with a sharp instrument at the bottom of cylinder. This is prick punched and all future measurements taken from this line. Work of the previous operations is also inspected here. The capacity of this operation was about 600 in nine hours by two men.

ROUGH-BORING THE CYLINDER.—This work is performed on a Baker drill, as in Fig. 2. The fixture carries two chucking stations so that one can be emptied, cleaned, and reloaded while the other is in operative position The cylinder rests on two blocks between the bosses and the top of the dome. It is pushed in so that it rests against two fixed jaws, and the swinging clamp is then tightened. The fixture carries hardened bushings which are lubricated after each operation with a mixture of graphite and oil, to prevent the boring bar from binding under the stress of the work.

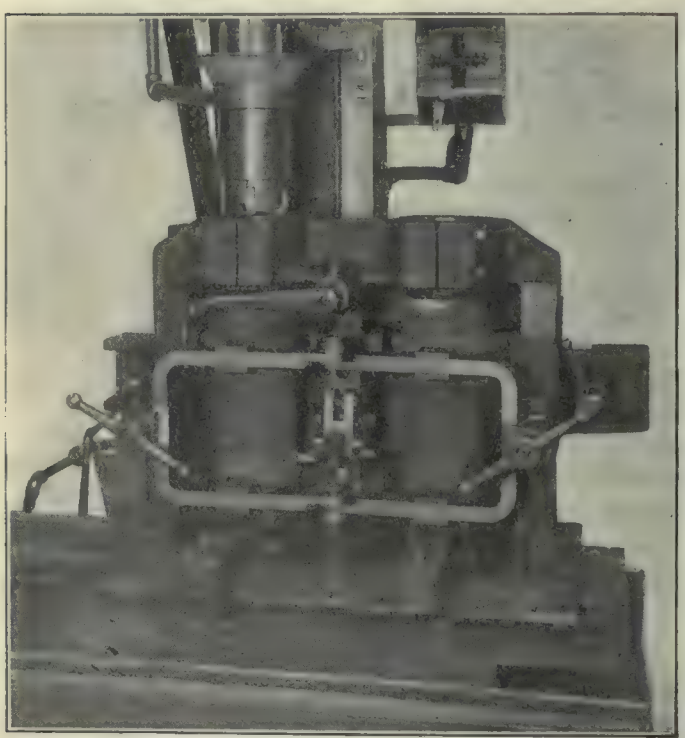


FIG. 2. ROUGH-BORING THE CYLINDERS

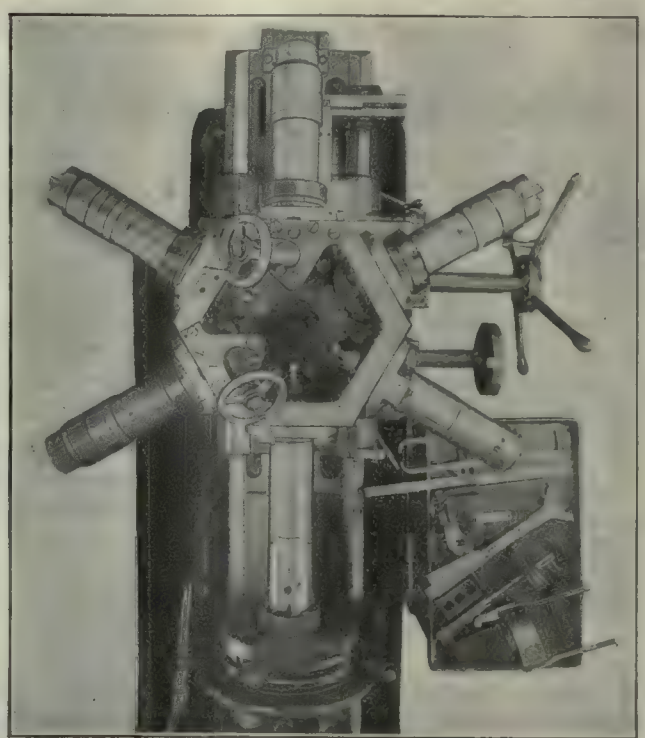


FIG. 3. BORING AND FACING THE DOME

AUTOMOTIVE CONSTRUCTION

The cutting speed is about 75 ft. per minute and the feed per revolution is 0.013 in. at the start but only 0.010 in. through the center increased to 0.013 in. for the remainder. Hand feed can be used for a part of the way at the top and bottom of the bore if preferred. The boring bar is ground on centers to micrometer dimensions, so that all four lips cut an equal amount. The capacity of one machine was about 75 pieces in nine hours, operated by one man.

BORING AND FACING THE OPEN END AND MACHINING THE INSIDE OF THE DOME.—The cylinder is placed in the chuck, and the port bosses are locked against the two bosses in the back of the chuck as a means for driving the cylinder. The outside finished locating rings of the cylinder rest on two fixed jaws which are bored to fit these spots. There is a swinging clamp for each of the said locating rings. These are clamped down firmly onto the cylinder. The machining operations are performed on a 3½-in. Acme flat-turret lathe, as illustrated in Fig. 3, which shows the tool layout. The recessing tools with handwheel adjustment, and some of the gages are shown.

First.—Feed the rough boring bar in part way before using power feed. This cuts the chamfer to 4⅞ in. in diameter.

Second.—Feed the finish-boring bar in part way, and then the balance by power feed. This should bore the cylinder to a diameter of 4.937 to 4.945 in. The open end is then faced back to the finished line, and the bore chamfered slightly.

Third.—Rough-machine the dome allowing not more than $\frac{1}{32}$ in. for finish.

Fourth.—Rough-machine the recess, feeding the special form tool down in a vertical position to within $\frac{1}{32}$ in. of the required diameter.

Fifth.—Finish-machine the dome to the correct depth in relation to the face of the open end.

Sixth.—Finish-machine the recess to a correct diameter, making certain that this cut blends with the finish cut of the dome. In this operation, care must be taken that the bore is kept central with the outside locating rings of the cylinder, and that it is reasonably smooth. The finish in the dome must also be smooth, and the radius correct when measured from the face of the open end. This also applies to the finish radius and angles.

RE-DRILLING THE CENTER.—A $\frac{3}{16}$-in. drill set for the correct depth is used for this operation. The object is to prevent the center reamer from breaking or from touching the bottom of the hole, causing it to run out of true. About 855 pieces were usually produced by one man in nine hours.

CHAMFERING THE OPEN END TRUE WITH THE BORE.—The cylinder is placed on an expanding pilot and turned on the pilot until the drivers are engaged. When the pilot is expanded, the cylinders are chucked. The chamfering tool is fed up against chamfer of the bore, until it is cut true and $5\frac{1}{16}$ in. in diameter. The feed was entirely by hand, the machine cutting speed being about 57 ft. per minute. This was satisfactorily performed on a 16-in. Reed lathe at a rate of 800 cylinders in nine hours. One man operated the machine.

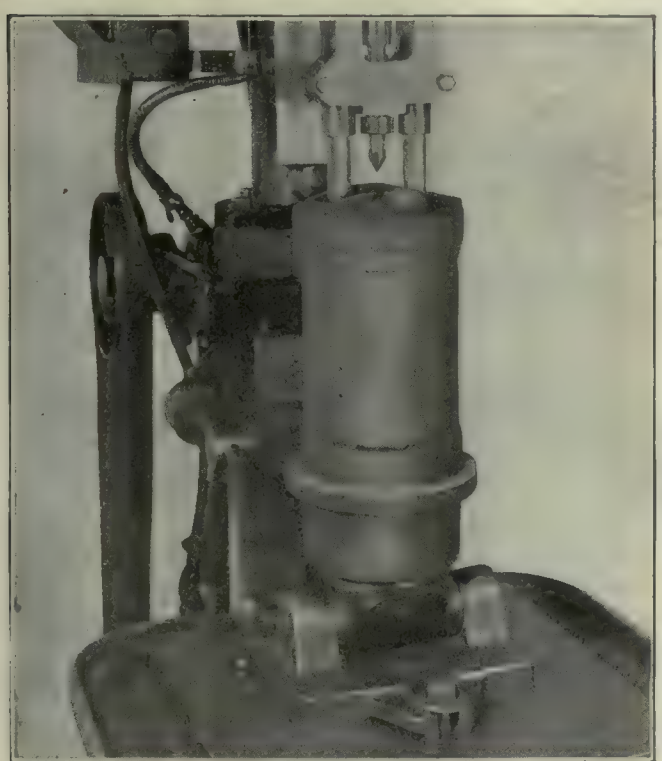


FIG. 4. RE-CENTERING TRUE WITH THE BORE

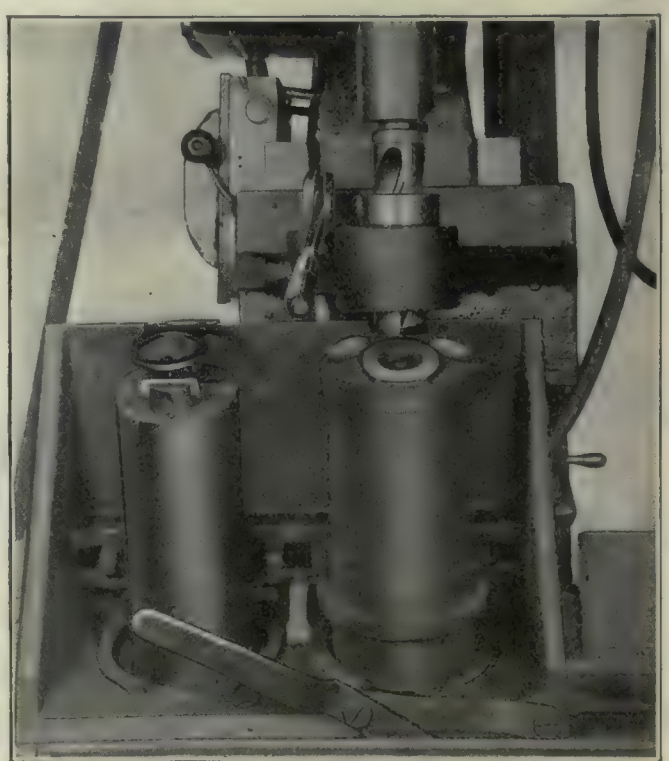


FIG. 5. ROUGH-BORING THE PORTHOLES

RE-CENTERING THE DOME TRUE WITH THE BORE.—For this operation a 16-in. Leland-Gifford drill is employed. The cylinder is placed on an expanding fixture shown in Fig. 4, and swung into a vertical position. Expanding plugs in the top of the fixture align the cylinder with the drill-press spindle, the lower end fitting closely over the locating points on the fixture. The center reamer on the drill-press spindle is then fed down until a perfect center is obtained; the cylinder is then removed, put on a solid pilot the full length of the bore, and with an indicator on the chamfered lower end, and one on the center of the upper end, the centering is checked for concentricity.

The reamer is a 60-deg. commercial center reamer. There is a special test fixture for centers, a guide for centering the fixture, and a holder for the centering reamer.

AUTOMOTIVE CONSTRUCTION

This machine produced 850 pieces in nine hours, one man doing the centering, and one man checking the work.

ROUGH-DRILLING THE PORTHOLES.—The portholes are rough-drilled to 2¼ in. in diameter on a Baker drill. The cylinder is held in a special fixture, Fig. 5, and turned until the bore-hole bosses lined with the gage as shown. The gage is removed, the first hole is drilled and, while this is being done, the other side of the fixture is being loaded in the same manner as the first. The fixture is then slid along; the hole in the second cylinder is drilled, while the first cylinder is turned on the fixture for drilling the other port. The cutting speed was approximately 59 ft. per minute, and 280 pieces in nine hours was the capacity of one machine.

the carriage moved along until the tool begins cutting; then the power feed is engaged. The first tool does the rough-turning below the bolt flange, and rough-faces the lower side of the flange. The second tool turns the outside diameter on the bolt flange. The third tool operated by the cam bar rough-turns one-half the length of the barrel above the bolt flange. The fourth tool, also operated by the cam bar, rough-turns the upper half of the barrel and the angle of the dome. The capacity of this machine was 85 pieces in nine hours, with a cutting speed of about 38 ft. per minute, the feed was 0.030 in. per revolution.

TURNING BETWEEN THE FLANGES AND REMOVING THE EXCESS MATERIAL.—This is performed on the same type of machine as the previous operation, and is handled in

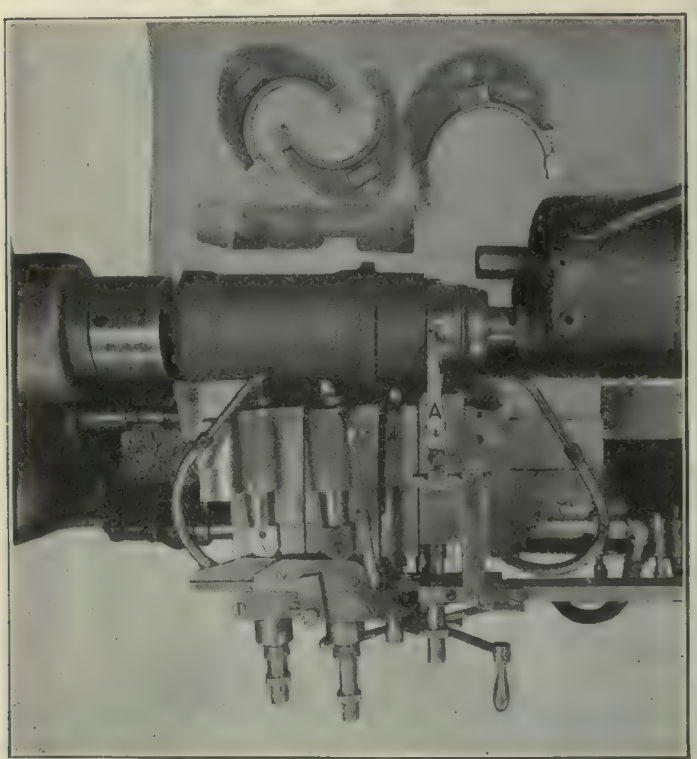


FIG. 6. TURNING THE LOWER END OF THE CYLINDER

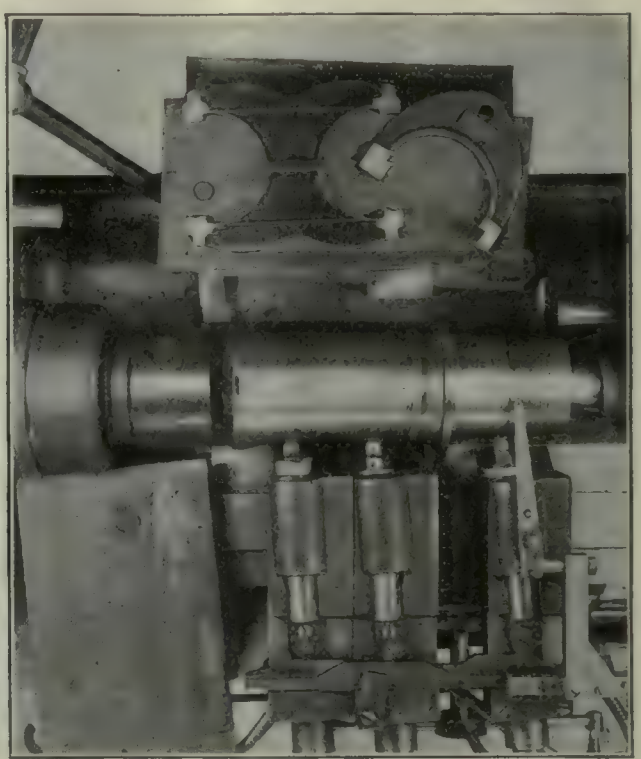


FIG. 7. FINISH-TURNING THE PILOT END

TURNING THE LOWER END AND FLANGE.—In this operation, the lower or pilot end of the cylinder below the flange is rough-turned; the lower side of the bolt flange is turned to the proper dimension from the lower end. The diameter of the flange is also turned to use for locating in future operations. The barrel of the cylinder is rough-turned about the bolt flange, and the angle formed at the top. This work was performed on an 8-in. x 36-in. Lo-Swing lathe. The center of the dome is located on the head center of the lathe, with driving fingers entering the portholes. The open end is supported on a cone center in the tailstock.

An indicator finger *A*, Fig. 6, which is fastened to the cam bar, is then located against the lower end of the cylinder. The cam bar is placed in a correct relation as shown by this indicator, so that the angle at the top of the cylinder will be turned in a correct relation to the lower end. When the cam bar has been so adjusted, the indicator is swung out of position, and

the same manner. The capacity on this operation was 120 pieces in nine hours with one operator. The cutting speed was about 38 ft. per minute with 0.090 in. feed per revolution.

FINISH-TURNING THE PILOT END OF THE CYLINDER.—This operation consists in turning the pilot end below the flange, and turning the barrel and the side of the dome to the blueprint dimensions. It is done on the same type of machine and handled in the same manner as the two preceding operations. Fig. 7 shows the tools and gages used.

The capacity per machine was 140 pieces in nine hours with a single operator; the cutting speed 68 ft. per minute with a feed of 0.030 in. per revolution.

FINISH-TURNING SIDES OF THE BOLT FLANGE.—This operation consists in finish-turning the lower end or pilot portion of the cylinder; facing bottom and top of bolt flange, forming the ¼-in. radius; finish-turning between the ribs, and rough-facing between the flanges.

AUTOMOTIVE CONSTRUCTION

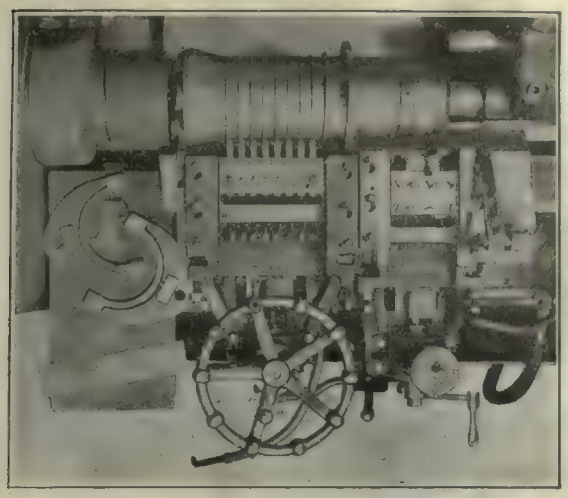


FIG. 8. TURNING THE RIBS

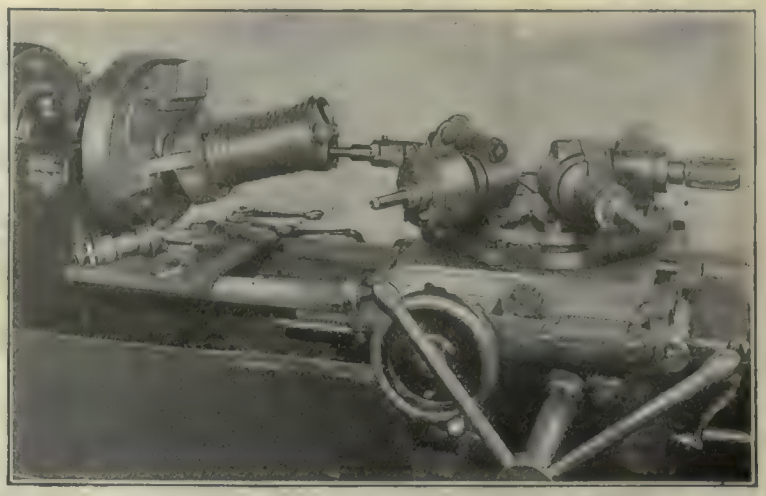


FIG. 9. BORING AND FACING THE PORTHOLES

This is performed on a Lo-Swing lathe as in Fig. 8. The production was 120 pieces in nine hours, operated by one man.

FORMING AND FACING THE WATER-JACKET FLANGE.—This is done on a 24-in. Lodge & Shipley lathe, and includes finish-forming and facing the water-jacket flange; finishing the 1-in. radius above the top rib; finishing the $\frac{3}{16}$-in. radius at the top of the dome, and filing the corners of the ribs. The cylinder is placed in the lathe, the dome center is located on the head center of the lathe with the driving fingers entering the portholes. The open end of the cylinder is supported on the cone tail center of the lathe. The tool is then adjusted to the correct relation by using a thickness gage between the forming tool and the water-jacket flange. Before removing piece the corners are filed. The capacity of this machine was 300 pieces in nine hours with one operator; the cutting speed about 68 ft. per minute, and hand feed used.

FINISHING THE DIAMETERS BETWEEN THE FLANGES.—In this operation, the water jacket flange is recessed and a $\frac{1}{4}$-in. radius finished on the bottom end of the pilot. It is performed on a 24-in. Lodge & Shipley lathe, very similar to the preceding operation. The capacity was 300 pieces in nine hours with one man; the surface speed about 68 ft. per minute, and hand feed used.

BORING AND FACING THE PORTHOLES.—This work is done on a 2$\frac{1}{4}$-in. Acme flat-turret as in Fig. 9. The cylinder is held on an expanding sleeve and is located by the plug which fits in the end of the fixture and in the rough-drilled port. A screw clamp is assembled to the cylinder bolt flange and fixture. The locating block is then removed and the expanding sleeve tightened within the cylinder. The first step is to rough-bore, counterbore, and face the port. In the next position of the turret, ream the hole $2\frac{7}{16}$ in. in diameter. The third position forms the outside of the boss and the next finishes the face counterbore. The cylinder is then indexed to bring the other porthole into position for machining. Cutting speed is 68 ft. per minute. The production was 90 pieces in nine hours for one man.

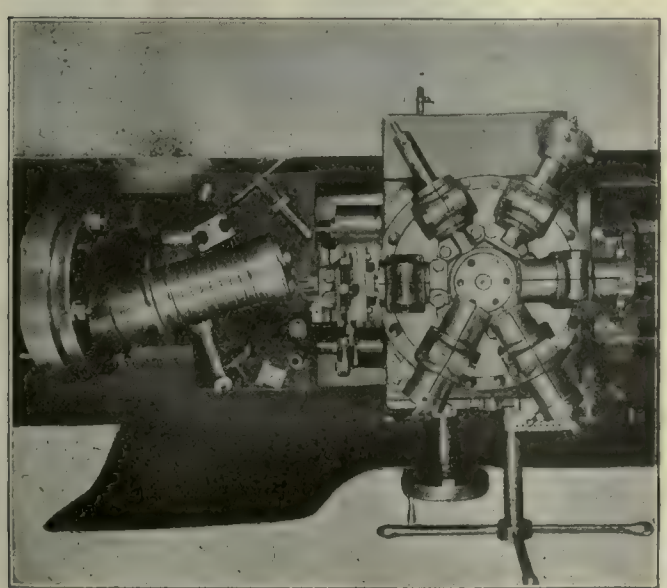


FIG. 10. UNDERCUTTING THE SPARK-PLUG HOLES

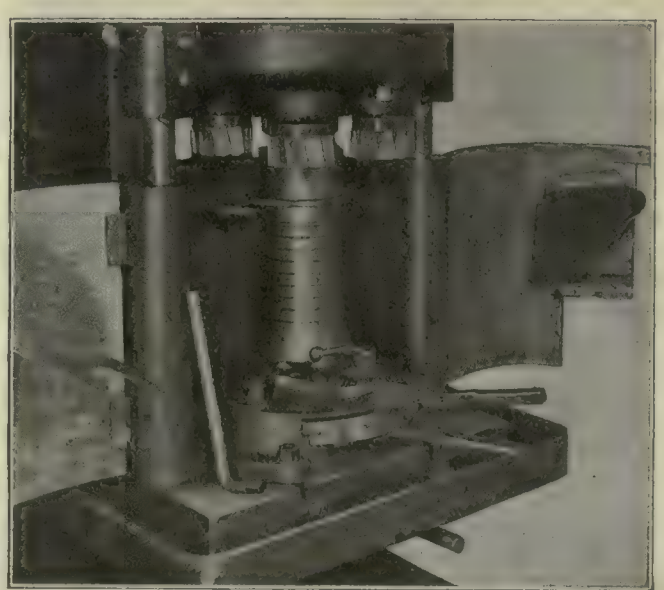


FIG. 11. ROUGHING THE BOLT FLANGE

AUTOMOTIVE CONSTRUCTION

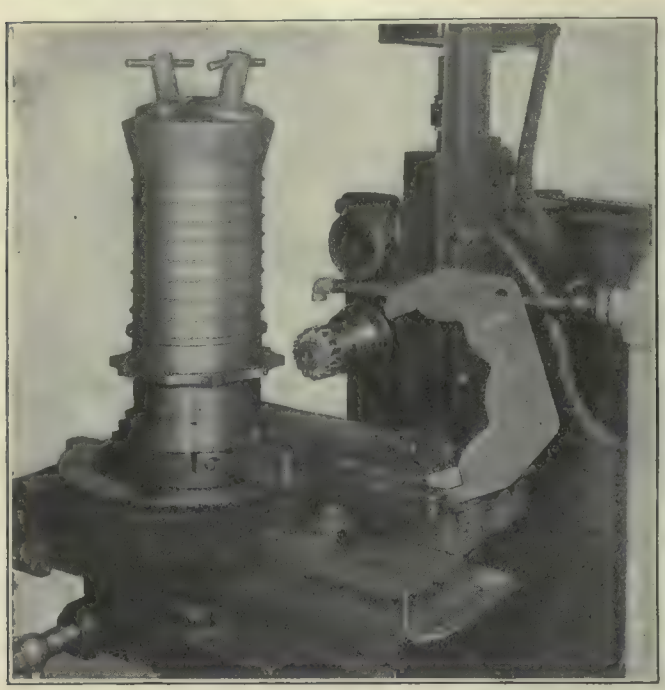


FIG 12. MILLING FLATS ON THE BOLT FLANGE

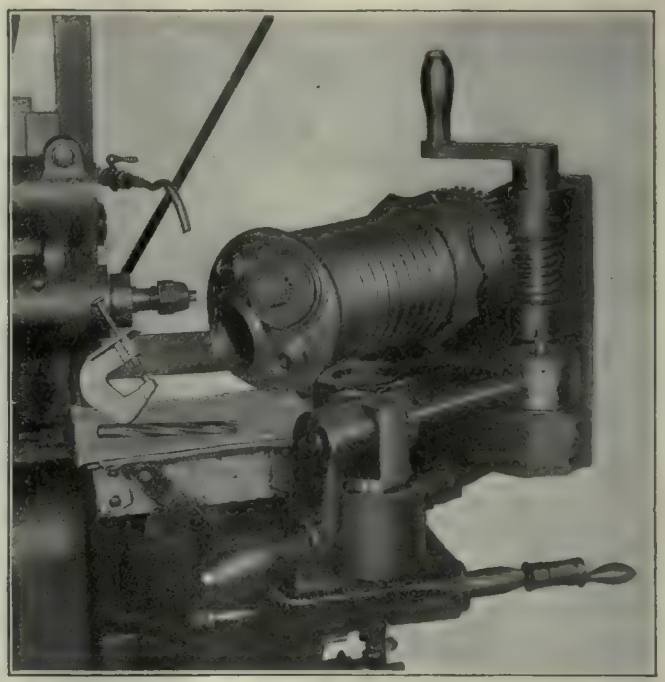


FIG. 13. FINISHING THE TOP OF THE CYLINDER

DRILLING, FORMING AND UNDERCUTTING THE SPARK-PLUG BOSSES.—This is done on a 2¼-in. Acme flat-turret lathe, as in Fig. 10. The cylinder is held on an expanding sleeve. A locating plug is used in the porthole in locating the piece. The machine is operated at a high speed to center and drill, then slowed down for the following operations. The production was 90 pieces in nine hours and was handled by one man; the cutting speed was about 73 ft. per minute.

ROUGHING THE RADIUS ON TOP OF THE DOME.—A Baker drill is used for this operation. The cylinder is placed on a pilot and located by a spark-plug hole. The fixture is capable of being slid to and from the working position and adjustable to four positions. When under the spindle of the press, it is supported sideways by a screw. About $\frac{1}{32}$ in. was left for the finished cut. Production was about 400 pieces in nine hours; the cutting speed, 75 ft. per minute, and feed 0.013 in. per revolution.

ROUGHING THE CONTOUR OF THE BOLT FLANGE.—This is done on a multiple-spindle attachment to a Baker drill, Fig. 11. The cylinder is placed, bottom up, on the fixture, locating by means of a porthole and clamping by a cam lever. Four cutters are used which cut out alternate spaces between the bolt positions. The fixture is then indexed to cut the intervening spaces. There is a central pilot on the spindle head which enters the bore of the cylinder and preserves the alignment. Power feed is used during the cut with an automatic trip of feed. The production of the machine was 450 pieces in nine hours with one operator; the cutting speed about 63 ft. per minute, and the down feed 0.032 in. per revolution.

ROUGH-MILLING THE PARALLEL SIDES OF THE FLANGE.—A Whitney hand miller is used, the cylinder being held upright on a pilot and located by a plug in the portholes. The fixture has a two-position index, and about $\frac{1}{32}$ in. is allowed for the finish cut as in Fig. 12. The capacity was 600 cylinders in nine hours for one man; the surface speed of cut, 188 ft. per minute.

FINISH-PROFILING THE RADIUS ON TOP OF THE CYLINDER.—This operation is also performed on a Whitney hand miller, Fig. 13. The cylinder is placed on the pilot and clamped by the plug in the porthole. To assure the cylinder always being on a line with the center of the spindle, the machine table is secured by dowel pins against any movement in either direction. The pro-

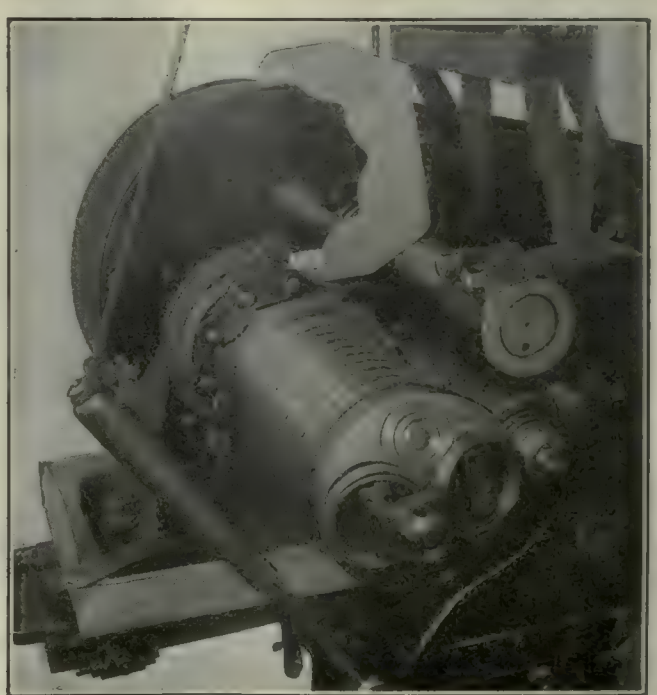


FIG. 14. FINISHING THE BOLT FLANGE

duction was 90 pieces in nine hours and a woman operator was used; the cutting speed about 110 ft. per minute.

FINISH-MACHINING THE CONTOUR OF THE FLANGE.—A Whitney hand miller is used, Fig. 14. The contour cam is carried on the fixture on the guide roller, held against the cam by weights. In starting the machine, the feed is let in slowly until the roller rests on the cam. The fixture is rotated by the power feed. The cylinder is located from the portholes. The cutter-size must be maintained to insure correctness of the work. The capacity was 65 pieces per machine. One woman operator attended three machines; the cutting speed was about 110 ft. per minute.

FINISH-MILLING THE PARALLEL SIDES OF THE BOLT FLANGE.—A similar hand miller is used. The operation is the same as for rough-milling, as previously described. The capacity of this machine was 900 pieces in nine hours.

CHIP AND FILE DOME.—The chipping was done with an air chisel while the cylinder was held on the fixture. Two men finished 750 cylinders in nine hours.

Johnson Starts to Reform His System

BY JOHN R. GODFREY

Have you "pink slipped" the interest out of the job in your shop? That's what Johnson found was one of the troubles in his. He's planning several ways to try and put it back. He knows he can never go back to the old shop methods, but he's trying to put himself in the other fellow's shoes and see how things look from his standpoint. It's a plan worth thinking about.

I DROPPED in to see Johnson the other day (he of the scientific Santa Claus experience) just to see whether he had really reformed or had blackslid, after calling down the management artists for the benefit of the assembled multitude. I wanted to see whether it was just gallery play to appease the wrath of the gods of the machine shop, or if it was an honest-to-goodness reformation.

Johnson was in his office, and as he had a sort of happy smile on his face I felt sure something pleasant had happened since I last saw him, because he wasn't happy a bit at that time.

"I'm darned glad to see you, Godfrey," he said, "and I'm equally glad you didn't come around butting in much sooner. It took me a lot of time and some hard thinking to get things back where the boys think I'm half-way human instead of wearing horns and a tail with spikes on the end. 'Twas some job, but 'twas worth it.

"This notion that you can play you're a little tin god and have some one else stand between you and the boys in the shop is all bunk, take it from me. It don't work! They don't want any benign heavenly smile when the old man comes around, but they do want to know the old codger is at least half human. And they do now.

"First thing I did was to sit down at home and do some tall thinking. I harked back to the little old shop where I served my time and where the boss was 'John' to all except the cubs. There wasn't a man in the shop who wouldn't work his head off on a rush job or who wasn't as happy in thinking up a new and better way to do a job as though it had meant dollars in his own pockets—which it didn't. So I set myself to thinking out what the difference was and why things had changed from the old-time coöperation to the state of armed neutrality and suspicion on both sides. And I believe I've found out a few things that make the difference.

"Then I called in one of the young firebrands from the shops and told him to do his worst. Promised him political and financial amnesty if he'd tell me just what he thought of me and the whole shebang and what he'd do if he was boss. And he told me good and plenty. Told me so many things that made me look so much like a piker and an 'iron duke' that I didn't know my own picture. And the great trouble was that most of it was true.

"I told him of the old shop and how we all worked nights and Sundays without a murmur if 'twould help the old man out, and never a thought of time and a half or double time. Thought I had him there, but he came back with a wallop that nearly floored me.

" 'Did your old boss sport a new horse and buggy the next week after such a job, Mr. Johnson?' he asked. 'Do you remember that rush job we did last winter? We worked nights for two months, straining our eyes and busting our backs. Got time and a half to be sure. And at Christmas we got a little old five-dollar gold piece, but you bought three new automobiles for Christmas for the family. The boys didn't exactly 'cotton' to the way the thing divided up.

ASSUMING MEN HAVE NO BRAINS

" 'But it isn't only the money Mr. Johnson, though that comes in mighty handy on rent day. There's another reason—you boys in the old shop remember it so pleasantly. You knew what was going on, you helped plan out the work and you took a real, live interest in it. If the old man had come out and loaded on you a dope sheet that had the ten commandments backed off the boards, that practically told you what an insignificant, hopeless idiot you were, and on that account, you must pick up the chuck wrench with your left hand, the work in your right, place the work in the chuck with the right hand, put the wrench on the chuck with the left hand and tighten it, and 47 other things that you knew already, I wonder if you'd have been wild about the job?

" 'Instead of that the old man came along with a sketch and said, "Hey, Bill, make one of these for

the Jackson grist mill. He's in a hurry as it's holding up your meal for griddle cakes next fall." Put it up to you and told you *why*. Of course you were interested—so would any good mechanic be interested. But how much interested would you be in the job I drew this morning?

"'Fourteen hundred rocker-arms for that old hay press, with every last detail laid out for me and a time given for almost every movement of my hands. This happens to be a case where I know the job from A to Izzard, while the young squirt up in the planning department never saw one of the animals in action. He's figured up the number of feet of holes to be drilled, the square inches of surface to be finished, and he's made a price that's a joke—not on me but on you. I can make 10 dollars a day and not half try—but I don't dare and you know it. I wouldn't follow his schedule within a hundred miles because as I said before, he never even shook hands with the job without fur-lined gloves on.

Doubling Shop Capacity

"'He's howling about production, but he's cutting it way down by prescribing methods which belong in college and not in a real machine shop. You're doing your little bit in keeping down production too by having a wage "dead line" that none of us dare pass, unless he's going to quit anyhow and don't care a cent what happens to the other boys after he's gone. If I made 10 dollars a day on that job you'd have heart-failure and the alleged planning expert would be up on the carpet in no time. And yet you forget that I'd be doubling your capacity to make these rocker-arms, for a mere five bucks a day in wages. No more machinery, or shop space, or overhead than before.'

"He told me a lot of other things which didn't set well but which were equally true, and while he didn't have a whole lot of helpful suggestions as to what should be done, he jolted me so that my thinker got real busy and I believe I've made a start in the right direction. I haven't fired the young squirt of a planner, but I've clipped his wings and he'll be quite a lad some of these days. Instead of doing his high-brow thinking all by his lonesome in the star chamber, he calls in the foreman of the department and at least one of the good workmen, to get their ideas as to how the piece should be made. This works two ways: It shows the shop men that the planner isn't such a jackass as he looks, and the planner has learned that the men on the job do have a few real brains which they know how to use when they have a chance. Then too I've cut out all gum-shoe work in the taking of time studies. But that's part of another story, as Kipling says.

"First thing I did was to try and put myself back in the old shop as a worker, and then out here in mine, and see what the difference was. Well, Godfrey, old man, it startled me. Back there we knew what was going on in the whole works. When the old man got that order for the engines for the ferry boat we were as tickled as though it was ours. He'd talked it over with us and together we'd planned out how we'd have the cylinders in the big lathe by blocking up the head and tail stocks. We'd plane the pedestals by mounting a head on the planer table and bolting the work to the floor, and we had more nifty little kinks than you can think of. Interested—say it was a liberal education for all of us and we knew it.

"But what happens out here. Lathe hand No. 17-21 draws a pink slip with a blueprint that tells him to turn 24 special studs. Tells him what tools to use, how to chuck it and dog it, and how many times to wink his left eye during the process.

"Does it tell him that these studs are to be used on that special ore crusher for South Africa and that much depends on their being done on time? It does not. It assumes it isn't any of his durned business and that he hasn't brains enough to know where South Africa is anyhow.

"Is he interested in his job? He is not, and neither would you or I be. We've 'pink slipped' the interest out of the job, old man, and by heck we've got to put it back.

"We can't go back to the old days for several reasons. We haven't the same kind of men, because we haven't trained 'em, and we haven't the time. But your Uncle Johnson has got several bees a-buzzing in his bonnet and when the hive is ready to swarm I'll send you a special invite. I am going to get back some of that old shop feeling if it takes a leg; I'm going to keep on putting myself in the other fellow's shoes until I find the answer. And if I can keep the dodgasted directors quiet till I get it swinging, I'll show 'em what production really is."

If Johnson can really see things from the viewpoint of his men, he's getting on the right track.

Use and Abuse of the "Belt Stick"

By R. B. Frank

The belt stick is a very useful article of furniture in the average machine shop in which there are always two or three—or more—according to the size of the shop.

They are made by the simple expedient of taking a narrow board from 6 to 8 ft. long, whittling down one end for a handle and putting a stud through near the other end, the stud projecting 5 or 6 in. and held by a couple of nuts so placed as to allow the board to be clamped between them. A hole 1 in. or so in diameter near the stud allows the stick to be hung upon a nail in a convenient place.

Certain places are assigned in which these sticks are to hang so that when one is needed in an emergency (it is always an emergency when one is needed), all that is necessary to get it is for the frantic machinist who needs it to rush to the place where one ought to be, find that it isn't there, and yell, "Boy! where'n blazes 'is that dambeltstick?"

Considerable time in the aggregate may be lost by this method, especially when, as is not infrequently the case, the boy also is misplaced, so the best method is to hang them up back of the upper cone of the lathe countershafts.

They are used, probably more frequently than for any other purpose, for running a tight belt into the upper step of the cone when it is necessary to speed the lathe for polishing or filing. If they are hung back of the cone with the stud pointing forward the belt can be run up easily by grasping the stick and giving it a twist.

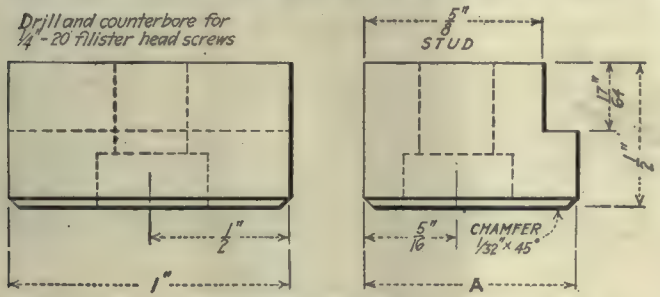
If needed for other purposes it is quite as likely to be found here as it would be in any other place.



Standard Tongue for Milling Fixtures

By C. H. Dengler

Many times it is desirable to use a milling fixture on more than one machine, and when the width of the slot in the tables is different trouble ensues. The usual way of milling the slot in the fixture the same width as



ADAPTING A FIXTURE TO DIFFERENT MACHINES

that in the machine and making a tongue to fit both, prevents interchangeability.

A good way to avoid this trouble is shown in the drawing. The slots in all fixtures are made $\frac{5}{8}$ in. wide and, by making the key of tongue as shown, may be used on any machine desired by choosing the required width of tongue.

Radius Link Designing

By Arthur R. Melloy

In turning the radius on a shell point by using a link to guide the cross-slide, several governing factors should be known:

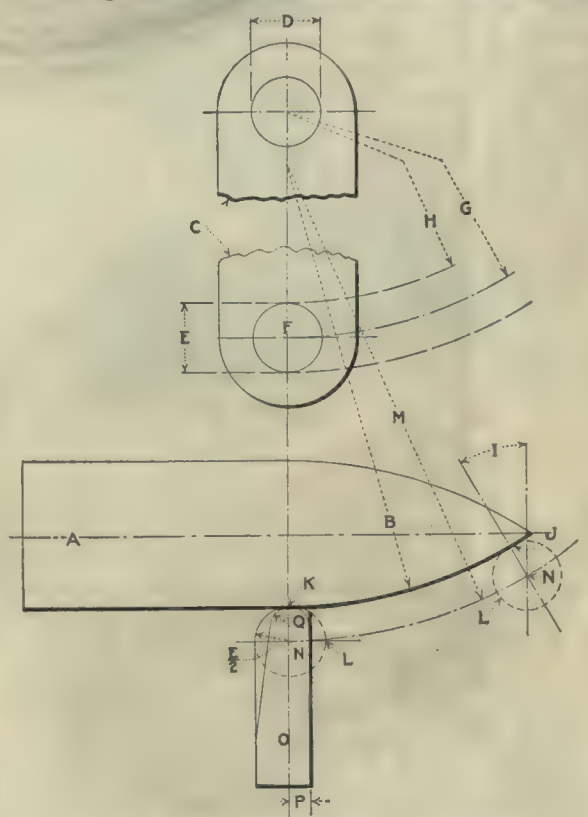
1. The center-to-center distance of the link should be the length of the radius to be cut on the shell plus the radius of the pin hole in the link end which controls the cross-slide.

2. The finishing tool must be ground to the same radius as the radius of the pin hole which connects the link end to the cross-slide.

3. A roughing tool may be used having a smaller radius than the finishing tool providing it bears a proper definite relation to the finishing tool.

In the figure let it be desired to cut a shell *A* of radius *B* using link *C*. Hole *D* has no bearing in the problem and for convenience may be made the same diameter as hole *E* which has a great deal to do with the final shape of the shell. The center *F* of hole *E* travels in an arc of a circle of radius *G*. *H* is the radius of the arc to which the inner part of hole *E* will run tangent when *F* travels the arc of radius *G*. For the present consider *L* as a roller of a diameter equal to the diameter *E* of the hole in the link and touching a finished shell at a point *K*.

As the roller travels along the shell, the point of contact *K* travels through an angle *I* to a point *J*. The center *N* of the roller travels the arc *N-N* of a circle of radius *M*. The point *N* is operated by the point *F* by means of the cross-slide and can only travel parallel to it and cannot pivot around it. Therefore if *N* and *F* travel in parallel arcs of circles, the radii of the cir-



RADIUS LINK SHELL-TURNING LAYOUT

cles must be equal; *M* is equal to *G*, and *H* is equal to *B* If any shape other than a circle is used in place of *L*, it is apparent that it would not be tangent to the finished shell at all points. Consequently the cutting edge of the finishing tool *O* must be the arc of a circle of radius $\frac{1}{2}E$. The length of radius *G* is equal to *M* because of the parallel motions, and *M* is equal to $B + \frac{1}{2}N$ or $B + \frac{1}{2}E$; therefore the center to center distance of the radius link must be equal to the radius of the shell plus the radius of the hole in the link end which operates the cross-slide.

If it is desired to use a roughing tool with a radius less than the radius of the finishing tool this may be done by establishing a size *P* for both roughing and finishing tools and then grinding the roughing tool to a smaller radius *Q*, remembering that by reducing the radius you leave a correspondingly larger amount of metal on the shell nose.

If the tools are designed as directed and a toolpost is used against the side of which the tools are lined up positively, the roughing and finishing tools may be interchanged indiscriminately without any fear of spoiling the work.

An Unusual Turning Operation

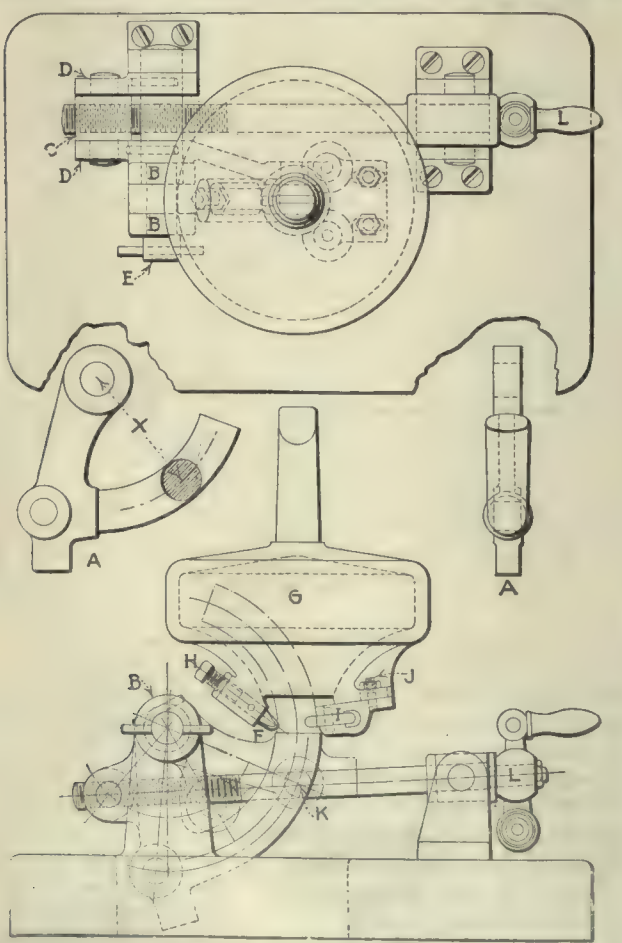
By Joseph N. Germain

At *A* in the drawing is shown a piece that we had contracted to furnish to a textile company. The arc, whose radius is *X*, has the large hole for a pivotal point. The tolerances allowed were as follows: ± 0.002 in. for the radius, and ± 0.001 in. for the distance between holes.

We made a simple pair of vise jaws to hold the pieces in the milling-machine vise so that the grip was upon the arc with the two bosses in the clear above the vise jaws. A straddle mill completed this operation.

The turning of the arc was a little more difficult, so we made up the device shown. It consists of a rectangular base on which are cast the two uprights *B*. The space between is the width of the large boss plus 0.002.

The nut *C* is made with trunnions turning in the double crank *D* which is rigidly held to the shaft by taper pins. The shaft is recessed where it enters the inner one of the uprights *B* to receive plug *E*. The cutting tool *F* is carried by the malleable casting *G* and is held in place by a setscrew. Adjustment of the tool is obtained by means of the screw and locknut *H*. The work is supported during the cut by the steadyrest *I* which consists of a pair of rollers and is adjustable by means of the screw *J*.



A UNIQUE TURNING DEVICE

To insert the work the cutter-head is raised above the highest point occupied by the work. The carrying lever is swung to bring the pin *K* to this point and the smaller hole in the work is put on *K* and the work rotated until the larger hole is in line with the holes in the uprights *B*. The pin *E* is then pushed into place. The work is swung back by turning the handle *L* until the pin *K* assumes the position shown in the figure.

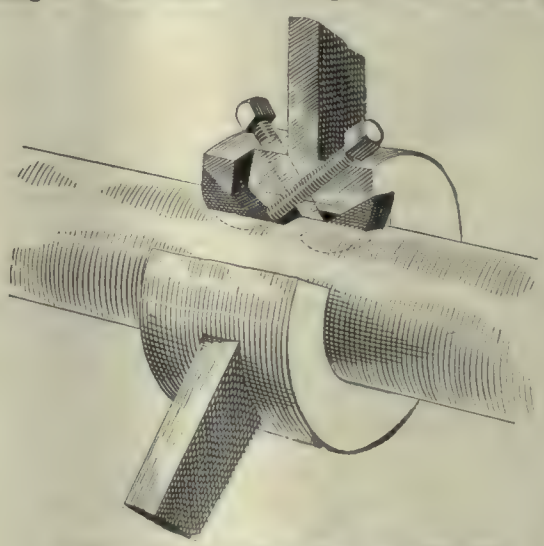
The cutter-head is then brought down to a point where the cutting edge of tool will be in the same horizontal plane with the center line of the pin *E* and at a distance from the center of the latter equal to the radius *X*. A stop collar on the spindle of the machine is adjusted so that the cutter-head will always be brought to the same point each time after it has been raised. The base is fastened to the table of the drilling machine.

We found it economical to handle the work twice, taking a roughing cut over all the pieces at the first setting, leaving about 0.008 in. to 0.010 in. for the finishing cut.

Keying a Hub Against Endwise Pressure

By P. G. Tismer

In making repairs to the clutch mechanism of some concrete hoists, it became necessary to key the hub of the clutch spider to the shaft in such a way as to prevent it from moving out of position endwise. This object had been secured in the original construction by pinning it to the shaft. The repairs were made necessary by the fact that the clutches would not hold in hoisting the load, and the changes involved the toggle joints in the clutch levers to secure greater power transmission through the clutch without slippage. Shortly after putting the new gear into service, the pins before mentioned began to shear off, and to stop this trouble the writer devised the method of holding that is shown in the sketch herewith.



KEYING TO PREVENT END MOVEMENT

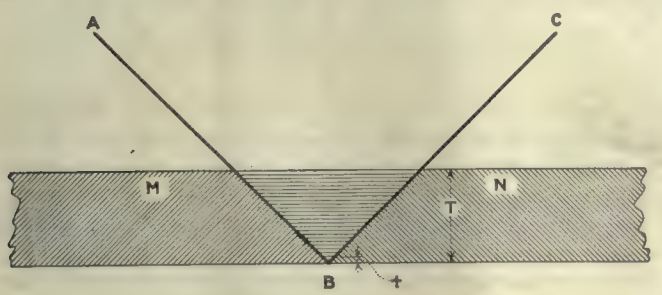
Two keyways were cut in the bore, their ends being cut out diagonally across the corner, one at each end as the sketch shows, and two Woodruff keys were sunk in the shaft. Setscrews set cornerwise in the hub bear upon the inner ends of the keys, holding them snugly in an angular position that effectively prevents the end movement of the hub. If it is feasible to put a setscrew in at right angles to the shaft, then only one keyway is needed, as one setscrew may bear upon the inner ends of both keys.

Maximum Thickness of Material Welded With Gas Torch or Electric Arc

By R. L. Browne

From a scientific point of view there is obviously a limit to the thickness of material that can be welded by a method of gradually building up without leaving strains in the body of the metal comprising the weld.

In making a weld in this manner the parts (M and N) to be united are V'd out (ABC) as shown in the



BUILT-UP WELD OF FLAT PLATES

figure, the included angle being about 90 deg. The weld is built up drop by drop and layer by layer, beginning at the bottom B.

As the thickness T ($T = \Sigma t$) of the weld increases, the rigidity of the welded zone, measured by the force R opposing a bending action, increases. Hence:

$$R \propto T$$

A constant force of contraction S, due to the natural shrinkage of each layer of metal comprising the weld as it is applied, is continuously exerted directly across the weld between M and N, tending to pull these parts toward each other and thereby warp or bend the welded zone. In fact this warping actually occurs from the starting of the welding operation and continues in a diminishing degree during the time that the relation $S > R$ maintains. This distortion relieves the shrinkage strains in the metal constituting the weld, thereby permitting a union to be made, which from an engineering standpoint is satisfactory.

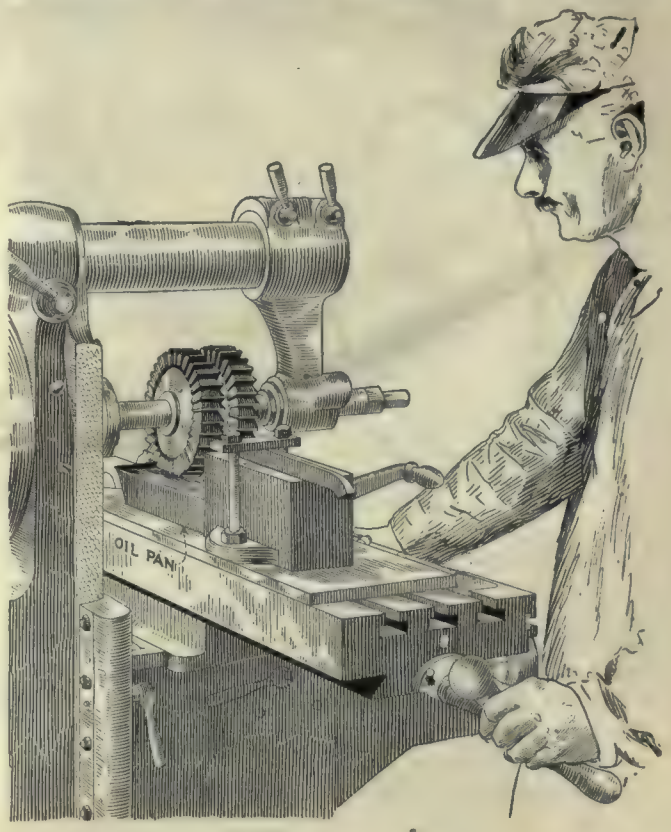
Inasmuch as the value of S remains constant for each added layer of metal throughout the entire welding operation, and R, which is a function of T, continues to increase with T, there is a transition point where the relation $S > R$ changes to $R > S$. From this point on, the force R resisting the shrinkage of metal added to the weld is greater than the force of contraction due to this shrinkage and the natural shrinkage of the metal is prevented. Strains are consequently established in the metal comprising the weld, which from an engineering standpoint is in an unstable condition, and a weld built up in this manner should not be attempted.

In other words, the maximum thickness T, which should be welded by a gradually built-up process is determined by the mathematical value corresponding to the change in relationship of $S > R$ to $R > S$, bearing in mind that R is a function of T. It is evident that this value will vary with different materials.

A Kink in Cutter Lubrication

By Adolph Moses

While passing through the shop I noticed this little cutter-lubricating kink. The work is strapped to a block bolted to the milling machine table which is fed



OILING A CUTTER

longitudinally to the cutter. A pan partly filled with oil is placed beneath the cutter and the latter, dipping into the oil, gets a good supply of it without wasting any. This was done on one of the old-style machines that had no pump and proved to be far more satisfactory than letting oil drip from a can.

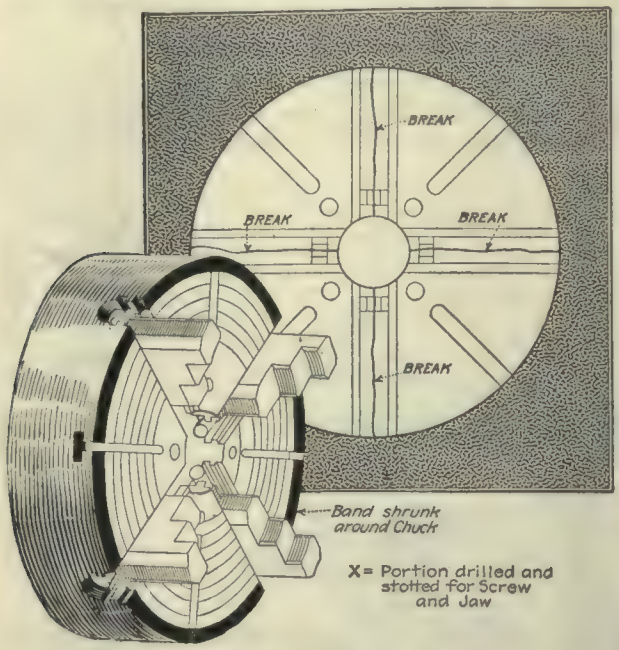
Repairing a Broken Lathe Chuck

By A. H. Yoch

A four-jawed chuck belonging to one of our heavy lathes had been broken into four pieces by the accidental movement of the lathe carriage, the break being along the jaw channels so that the chuck was practically separated into quarters. It was a most complete wreck and seemed impossible to repair, as to weld the parts together and then re-machine the chuck, as would be necessary to make the jaws fit and restore its accuracy, would cost more than a new one and would take a longer time than the chuck could be spared.

Because of the urgent need for the chuck, the following described method of repair was attempted, and somewhat to our surprise the result was very satisfactory, the repaired chuck being as good as new and

not even having the appearance of a repair job. The edges of the breaks were carefully cleaned of loose particles of metal and the parts brought together with the chuck lying face downward on a bench plate. A steel band of suitable size was made by bending and welding a piece of bar steel into a ring leaving the



A REPAIRED CHUCK

inside diameter small enough to finish. This band was then bored to a shrink fit over the outside of the chuck and shrunk into place. Then putting the chuck onto the lathe the band was turned and faced. Boring the holes for the wrench and slotting the band to allow the jaws to enter their channels completed the job and made the chuck practically as good as new.

Scaling Reduced Drawings

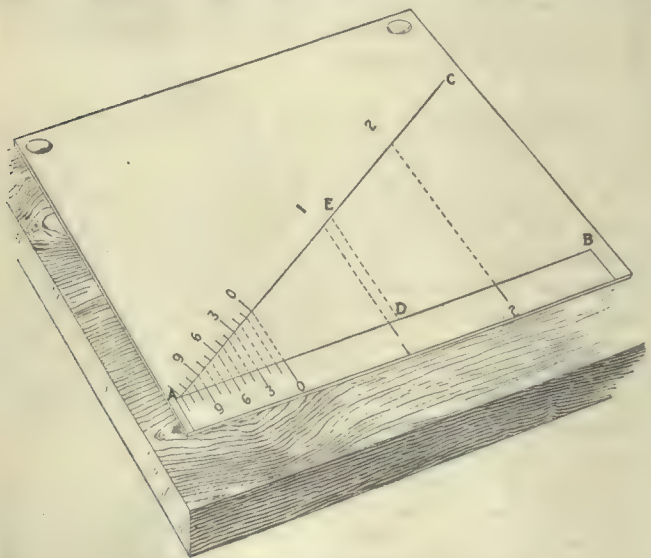
By B. A. Tyson

In making careful studies of line cuts of machine drawings in technical publications it frequently happens that many of the desired dimensions are not given and it usually always happens that the scale of reduction is such that none of the customary graduations on the draftsman's scale will fit. Usually one or more dimensions are given or may be learned from the description accompanying the cut. From one of these the ratio of reduction may be determined. By measuring with a full size scale and applying this ratio, the other dimensions may be computed.

For a complicated drawing this procedure involves considerable arithmetic or slide-rule work. For accurate and rapid work a scale may be made to fit the cut. This may be done in 15 minutes by the following application of the familiar method of dividing a line into a given number of parts.

Select on the cut one of the known dimensions, a long one if possible, and, as shown in accompanying sketch, lay off an equal distance *AD* on the line *AB*. Suppose this line represents 26 in. on the cut. From *A* draw *AC*, making any angle—say 30 degrees—with *AB*. Now lay off on *AC* the distance *AE* equal to 26 in., selecting the scale which will bring *E* as nearly as possible directly over *D*. Draw *ED*. Beginning at *A*, lay off on *AC* the graduations of the scale used in laying off *AE* as indicated, and project on *AB* the joints marked off by drawing lines parallel to *ED*. Now with a knife and straight edge, cut along line *AB* and the scale is complete.

If permanency is desired, a very presentable and durable article may be made by using a piece of thin white celluloid. Cut a strip about ½ in. wide and pin down with one edge facing the line *AB*. With a sharp knife held vertically, transfer the graduations of *AB* to the celluloid by cutting lines in its surface. Next rub india ink over the surface of the strip. By washing off the excess ink, each scratch made by the knife will retain the ink and will show up as a sharp black line. This home-made scale will compare favorably with one that costs real money.



AN EASILY MADE REDUCING SCALE

Eraser for Pencil Marks

By J. H. Moore

Instead of using an eraser to take out fine detail on pencil drawings I use a fountain-pen filler with a piece of cloth wrapped around the small end. The tube is filled with benzine, and when picking it up a slight pressure on the bulb moistens the cloth so that pencil marks may be wiped out with it without smudging adjacent lines.



ERASER FOR DRAFTSMEN'S USE

U.S. ARMY ORDNANCE NEWS

Gun-Boring Tools and Data

By FRED H. COLVIN
Principal Associate Editor *American Machinist*

The drilling of deep holes has been a difficult problem in many places. This article shows the tools and practice of one of the most successful gun shops, and the same facts are equally useful in any other kind of deep drilling and boring.

ONE of the things we have learned from the war is the art of deep boring, and the experience gained in this line can be utilized in other kinds of work. One of the shops which was most successful was the Tioga Steel and Iron Co., of which L. R. Layton is mechanical superintendent, their new gun plant in Philadelphia having made a splendid record in handling 4-in. guns for the navy. An outline drawing of this gun, with only a few main dimensions shown so as to give an idea of the work involved, is illustrated in Figs. 1 and 2, the first showing the jacket and the second the gun tube or liner.

As is usual in all work of this kind test pieces are cut from each end of the forging, these disks being sawed so as to give two bars from each disk, the ends of these bars squared and the bars turned to a standard

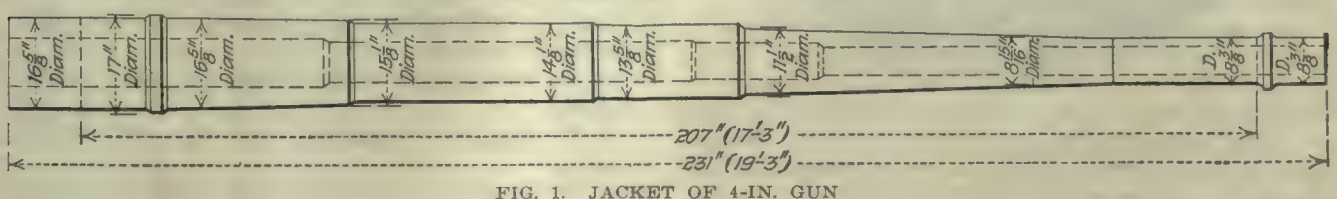


FIG. 1. JACKET OF 4-IN. GUN

section for the testing machine. This work took 4 hours, this being divided into 1 hour for cutting the disks from the forging, 1 hour and 15 min. for hacksawing the four bars and squaring the ends, and 1 hour and 45 min. for completely turning the four test pieces. This refers to the tube forging.

The disks from the ends of the jacket forgings were cut on a double-bladed Newton cold saw instead of in the lathe, as was the case with the tube, and the time was somewhat less in spite of the increased diameter of the forging. Test pieces were also made from these, as in the case of the tube.

The average weight of the jackets shown in Fig. 1 was 11,490 lb., this being reduced to 10,900 lb. after the end had been removed for making the test pieces. After the jackets were rough-turned and bored the average weight was 5114 lb., which shows that something over 2½ tons of metal was removed in these operations. It is interesting to note that it was unnecessary to make a special operation of removing scale before machining the gun, as heavy scale was not allowed to accumulate during the forging operation, and the light scale was loosened by green annealing. This also applied to the gun tube. Before any machine work was done, the forging was carefully examined to find the extent of all defects before laying out and centering for rough-turning. These defects were examined with the aid of a chipping hammer or, in the case of seams, drilling at various points along the seam with a portable electrical drilling machine, using a ⅜ to ½ in. diameter drill.

Both the turning and boring were done on Bridgeford 36-in. heavy pattern lathes, the time required for turning being 11 hours, using two tools at a cutting speed of 31 ft. per minute. The depth of cut was 9/16 in. and the feed per revolution 0.131, removing 210 lb. of metal per hour. The boring of the jacket was divided into four operations, these requiring 14 hours to complete. The feeds for these operations were as follows: Operation 1, 0.3 in.; operation 2, 0.6 in.; operation 3, 0.48 in., and operation 4, 0.4 in. The weight of metal removed was 170 lb. per hour, and the type of boring head is that shown in Fig. 3.

This boring bar has a number of very interesting details, three views of the body being shown at *A*. Four hard-steel wearing strips are provided, details of

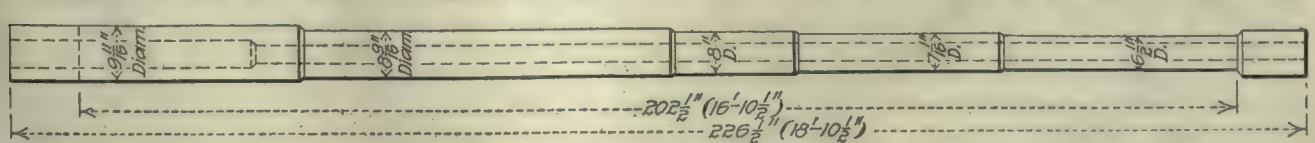


FIG. 2. TUBE OF 4-IN. GUN

ARMY ORDNANCE NEWS

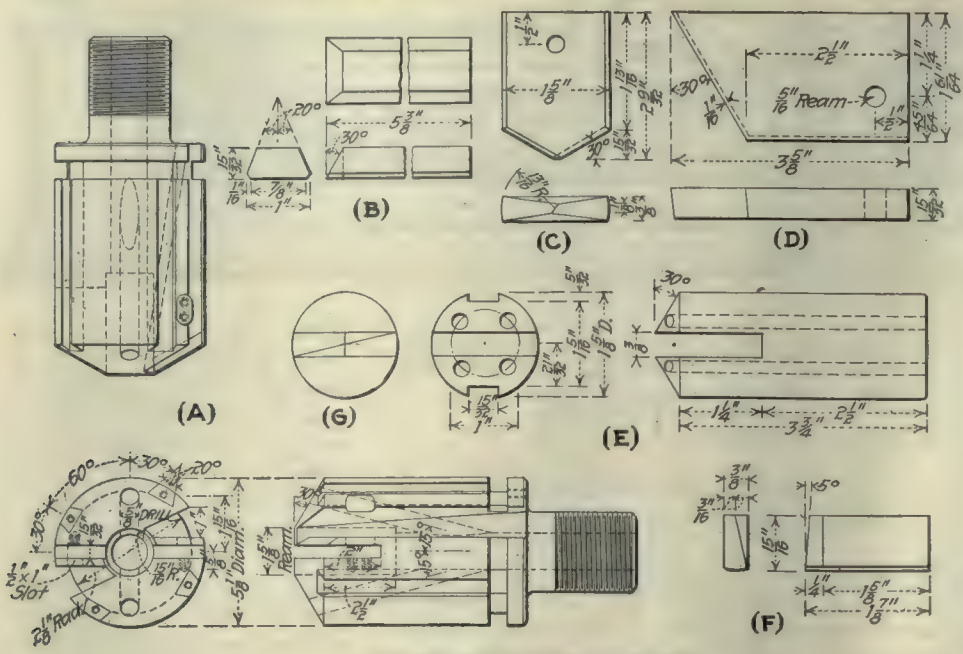


FIG. 3. BORING HEAD FOR JACKET

this being shown at *B*. One form of pilot drill is shown at *C* and another at *F*. The first is a single solid cutter while the second is in two parts, put together as at *G*, and held in the holder *E*. This holder has four holes for lubricant, these holes communicating with the central chamber in the body of the boring head. It will also be noted that there is a $\frac{15}{32}$-in. slot on each side of the pilot drill holder. These fit the cutters on each side of the boring head and effectively prevent turning in the head itself.

The flat boring cutters for the head are shown in detail at *D*, the lip clearance and the location of the chip-breaking notches being left for determination in the shop, which is a very sensible thing to do. In order to utilize worn cutters provision is made for turning back the front face of the boring head after there has been an accumulation of worn boring cutters.

A very similar type of boring bar was used in the tube, but owing to its being of somewhat smaller diameter it presented different problems of construction, and is on this account shown in detail in Fig. 4. The head or body is shown at *A*, two cross-sections showing the holes for the lubricant being shown at *B*, the hardened wearing strips at *C* and the main cutters at *D*. At *E* are shown both the two-part pilot drill and the holder, these being very similar to those shown in Fig. 3. In view of the difference in diameter, however, it seems best to give considerable detail to the dimensions, which may well form a guide for anyone with deep boring to do. The illustrations show the details so clearly that further description is unnecessary.

The cutting lubricant for the sawing and for the gun boring was made of a 30 per cent. soluble oil mixed with 15 to 20 parts of water. but it should be understood that this performance could not be counted on as a regular thing.

Some Excellent Records

The following records on boring have been made:

5000 ft. of guns bored in July with 3 lb. 13 oz. broken drill blades.

6000 ft. of gun bored in August with 3 lb. 4 oz. broken drill blades.

48 ft. continuous cutting with $3\frac{5}{16}$ drill without grinding.

42 ft. continuous cutting with $5\frac{3}{16}$ drill without grinding.

39 ft. continuous cutting with $7\frac{1}{4}$ drill without grinding.

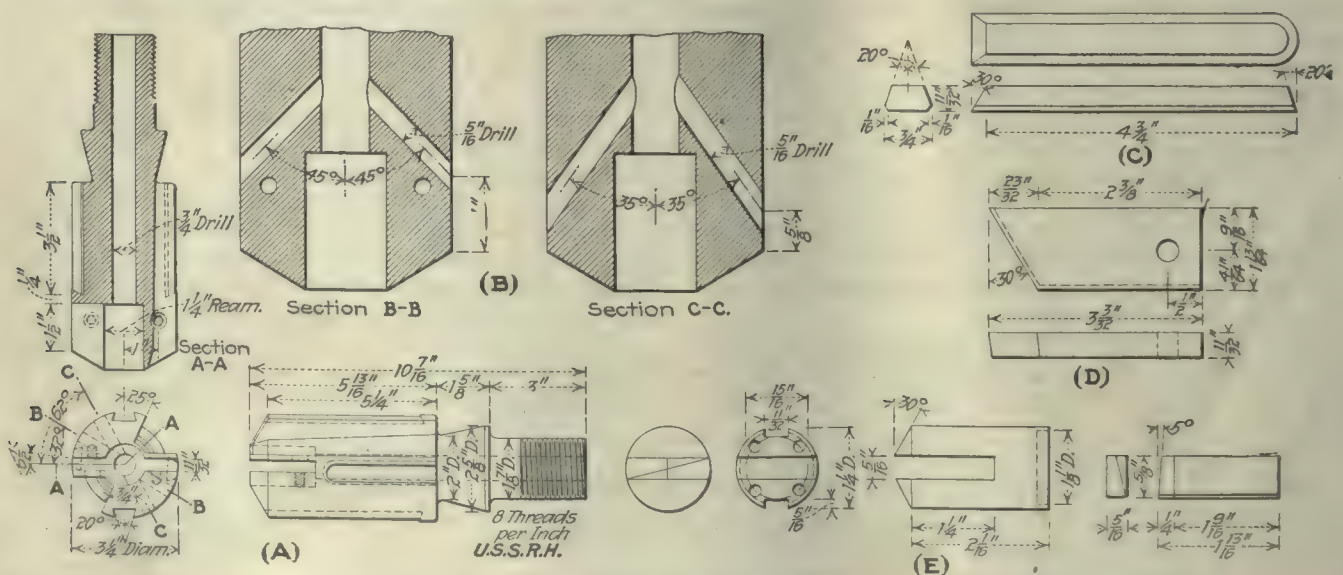


FIG. 4. DRILLING HEAD FOR TUBE

ARMY ORDNANCE NEWS

They have also made speed records on boring as follows:

53 in. per hour with $3\frac{5}{16}$ drill.
48 in. per hour with $5\frac{3}{16}$ drill.
36 in. per hour with $7\frac{1}{4}$ drill.

These speed records cannot be maintained without increasing the breakage and the frequency of grinding cutters. As far as the experience of this shop shows in this line of work the speeds covered in the body of this article are the most efficient from all standpoints.

The work on the gun tubes is also interesting, the tubes being over 18 ft. long in the rough and weighing 4378 lb. After removing the test pieces the weight is 4110 lb., and when rough-turned and bored, 2223 lb.

PERSONALS

Maj. John M. Parker, who has been Chief of the Military Guard Section, has been discharged. His home is at Owego, N. Y. He attended Cornell University and studied mechanical engineering. He is also a member of the New York bar.

* * *

First Lieut. P. H. Taylor, who is an electrical engineer and a graduate of Lafayette College, has been discharged from service. His home is at South Germantown, Penn. He has been on duty at the Aberdeen Proving Ground as a proof officer.

* * *

First Lieut. Richard C. Eggleston, 5035 Florence Ave., West Philadelphia, Penn., has been dismissed from service. He is a graduate of Yale and was formerly employed by the Pennsylvania Railroad Co. and in the service he has been on duty in the Planning Section of the Engineering Division.

* * *

Maj. Frank W. Wood of Cleveland, Ohio, president of the Wood & Spencer Co., machinists and machinery manufacturers and also president of the Cleveland Castings Pattern Co., has been recently discharged from the service. He served about eleven months in France in the Construction and Maintenance Division.

Pliny Holt Perfecting New Cannon Carriage

Pliny E. Holt, of the Holt Manufacturing Co., and recently in charge of the corps of engineers engaged in the development work of artillery tractors for the Ordnance Department, has, since leaving the Government employ, been working upon new problems in gun motorization. Mr. Holt, who was born in Loudon, N. H., became an Ohioan at the age of six and a resident of Minnesota at the age of ten, inheriting at an early age his taste for travel which takes him from the Stockton plant of the Holt company in California to the Peoria plant of the company and to Washington at frequent intervals. He is a graduate of the University of Minnesota and paid his college expenses by conducting an electrical repair shop in the afternoons, attending classes in the forenoon.

His connection with the Holt Manufacturing Co. dates from Feb. 15, 1896. Since then until he resigned to accept a position as expert for the Government during the war, Mr. Holt's experience has covered all branches of tractor work. To him more than to any other



PLINY E. HOLT

man belongs the credit for the successful development of the "Caterpillar." He organized the Aurora Engine Co., at Stockton, in 1905. In 1909, Mr. Holt moved East, bought the Colean plant at Peoria and organized the Holt Caterpillar Co.

In 1913, he was made vice president and general manager of the consolidated companies, including the Holt Manufacturing Co., Holt Caterpillar Co., Houser & Haines Manufacturing Co., the Best Manufacturing Co. and the Aurora Engine Co.

During the time that Mr. Holt was in Washington he not only supervised the design and building of the pilot vehicles which were afterward called the 10-ton, 5-ton and $2\frac{1}{2}$-ton artillery tractors, but in addition to this he made the preliminary study of the one-man tank which was later built by the Ford company. He also supervised the work of preliminary design of the 150-ton tank and started work on the 1500-ton tank at the request of the Naval Consulting Board, which work was finally completed in conjunction with the engineers of the Westinghouse company. On Aug. 3, 1918, Mr. Holt was appointed by General Williams as chairman of the board organized to handle the production of the caterpillar-artillery program.

Freight Forwarding for Export*

By W. J. RILEY
Export Manager, Judson Freight Forwarding Co.

The forwarding of export freight has many complex problems, the solving of which the exporter is glad to be relieved. This article tells in detail what must be done in forwarding export freight and sets forth the duties of the forwarder. The forwarder must know specifically what can and cannot be exported from this country and imported into other countries. He must be familiar with and think in terms of permits, licenses, declarations, banking requirements, collection facilities, insurance, risks of war, loss, damag, theft, customs regulations at home and abroad, the most favorable routes by land and water, etc. His services are as valuable to the exporter as are the services of the custom-house broker to the importer.

THE freight-forwarding business is divided into several classes. Some forwarders confine their efforts to domestic business, and some even to certain commodities within limited territories. Some forwarding companies extend their activities to cover all branches of both foreign and domestic business. The subject to be considered on this occasion is the forwarding business in connection with foreign trade only.

Briefly, then, a freight forwarder is one who is able to handle in every detail any kind of a shipment from any point in this country to any point in any other country which can be reached by any form of recognized transportation.

A forwarder is in business because the requirements of business have created him. His services are sought for the same reason which impels a man to hire a plumber when he has a leaky faucet, or to employ a doctor when he is sick. The point is that the forwarder is a specialist in his line, just as truly as any tradesman or professional man is a specialist in his vocation.

Knowledge Required

He must know, or be able to find out very quickly, what articles our Government will permit to be exported and what the governments of other countries will permit to be imported. If there are any restrictions he must know the character and extent of such limitations and how to overcome them.

He must know all about the permits, licenses and declarations which are required and how to obtain them. He must have a thorough knowledge of all banking requirements and collection facilities in this country and other countries; he must be able to quote instantly approximate figures and quickly to quote actual figures of cost to handle a shipment of any commodity from point of origin to final destination, including all of the elements which form a part of that cost.

He must know all about the various kinds of insurance covering marine, war, theft, pilferage, loss, and damage, and be able to quote cost of coverage, against these risks.

He must know the customs regulations at home and abroad, as well as the most favorable trade routes at different seasons and under varying conditions, in order that the promptest, most economical, most satisfactory service may be secured not only for the consignor in this country, but for the consignee in a foreign country.

In short, a forwarding agent must know everything in connection with transporting a shipment which the shipper does not know, and which he cannot learn without incurring a greater expense than the cost of the forwarder's services.

Service To Be Rendered

Having stated what a forwarder must know, it follows that he must be able to translate his knowledge into service. Otherwise, his service, which is all that he has to sell, would be as useless as the wisdom of an astronomer in toting a hod of bricks.

He must make prompt, complete and courteous replies to all inquiries, and must anticipate the shipper's needs and provide him with shipping-instruction blanks to be filled out to meet all possible emergencies.

He should be able to immediately place insurance with any insurance company named by the shipper, or to arrange for such insurance under a blanket policy which every up-to-date forwarder provides for immediate use. He must maintain his own warehouse or have warehouse connections to take care of goods at assembling points and at ports of exit pending shipment. He must make all arrangements to comply with custom house and consular requirements.

The forwarder must secure and book steamship space for each individual shipment; and in many cases, he must contract such space in advance for the protection of, and in anticipation of, the needs of his patrons.

He must maintain offices manned by experts who are capable of attending to every detail in connection with clearing shipments from port of exit. In many cases, this involves the work of locating cars in railroad yards and shipments in freight houses and warehouses, and in seeing that they are moved at the proper time to the docks, and cleared on the steamer for which booked.

He must not only maintain offices in United States ports of exit, but he must have agents or representatives in the principal ports and cities of all foreign countries. He must have banking credit and facilities for discounting drafts when required and for making collections at foreign destinations.

In order to take care of the prepayments of rail and ocean charges which are demanded by railroads and steamships pending reimbursements on the part of the shipper, the forwarding agent must have a considerable amount of invested capital.

As the methods of handling shipments via the Pacific differ somewhat from the methods via the Atlantic and Gulf Ports, it may be well to describe these conditions briefly and separately.

Consignments to Australasia or the Orient are, with few exceptions, handled on through bills of lading, covering rail and ocean movement from point of origin to final destination.

To enjoy the proportional rail export rate and other

*From an address before the Sixth National Foreign-Trade Convention, Chicago, Apr. 25, 1919.

benefits of these through bills of lading, it is necessary that every consignment shall be contracted for and booked in advance with a steamship line.

A rail permit must be obtained and the shipment must then be made within the limits prescribed by railroad regulations: namely from 25 to 30 days from Chicago territory, and from 30 to 35 days from eastern territories prior to the scheduled sailing of the steamer on which shipment is booked. The permit number must be shown on the initial line of the bill of lading.

These through export bills of lading are not, as might naturally be expected, made up by the railroads, but are made up by the forwarder at his own expense. The railroad company furnishes the blanks; the forwarder fills them out in every detail including shipping permit numbers, order numbers, descriptive markings, and every item and condition necessary to make a complete document. On nearly all trans-Pacific shipments, it is necessary for the forwarder to make up from 20 to 25 copies of each lading. The shipper usually requires two or three originals and several non-negotiable copies for his own use; the other copies are required by the railroad and steamship companies and also for the use of the forwarding agents at port of exit and for custom-house purposes, etc.

Bills of Lading

As soon as possible after the shipment moves from point of origin, copies of the bills of lading and full instructions as to steamship bookings are mailed to the agent of the forwarding company at port of exit, who then takes care of custom-house requirements, checks up the shipments to see that they are brought down to the docks and placed on the boat. The forwarder's agent at port of exit then advises the home office of particulars of clearances, which are, in turn, communicated to the shipper.

As is generally known, railroad companies do not issue through bills of lading covering export shipments via Atlantic Coast ports. The rail movements and the ocean movements are handled separately. On less than carload lots, it is not absolutely necessary to make advance steamship bookings although it is desirable to have these bookings made whenever this is practicable. These LCL shipments must, of course, be warehoused between the time of arrival at New York and departure of steamer.

Carload lots require the issuance in advance of a G. O. C. (General Operating Committee) permit, which permit is not issued until after a firm booking has been made with steamship company and evidence submitted that this has been done. This permit specifies the dates within which the shipment must be made. Notice of arrival of cars is furnished to the forwarder's agent at the port, who arranges for prompt transfer to the loading dock.

The steamship companies furnish blank bills of lading to the forwarder, who makes up, at his own expense, all the necessary copies to comply with the requirements of the shipper, the banks, the steamship companies, customs house, etc. This entails issuance of from 15 to 20 copies of each steamship lading. The forwarder's agent at port of exit sees that all the papers controlling or concerning the shipment are mailed on the boat which carries the freight or on some fast mail steamer which will reach the consignee as early or earlier than the goods will arrive at destination.

The forwarder's agent at the port advises the home office of clearances, which are in turn communicated to the shippers.

Shipments via Gulf ports are handled practically in the same way as via the Atlantic. It might be stated at this point that the question of having railroads issue through bills of lading from point of origin to destination via Atlantic and Gulf ports is now having serious consideration. The consensus of opinion is that arrangements for such through bills of lading will be made in the near future.

Having now outlined the duties and service of the forwarders under normal conditions, it might be appropriate to refer to conditions which existed during the war. There were, of course, many disappointments to shippers, some of which may have been attributed to the forwarders, whereas, the latter, like the shippers themselves, were simply the victims of war conditions.

War Conditions

For instance. The Railroad Administration provided time limits and rules governing shipments from interior points to the ports. The shipper may have complied with these requirements. His shipments may have reached the port in time for the scheduled sailing, but the consignment may have been shut out on account of steamer having over-booked its capacity, or the sailing of the steamer may have been cancelled, or the Government may have, at the last moment, commandeered a large portion or the entire capacity of the steamer. In other cases, the shipments may have failed to reach the ports on account of congested conditions of the railroads particularly in the vicinity of the ports. These conditions were, in most cases, unavoidable and in many cases beyond the control of the forwarder. As a consequence, storage charges and demurrage charges accrued, for which it is frequently found impossible to obtain any redress. Upon reflection, it will be realized that the disappointments and the extra costs which the shippers may have been called upon in many instances to pay, were not due to failure on the part of the forwarders to do everything that possibly could be done, but was due entirely to the war conditions which are now ended. The services which have been rendered in the past by the forwarders may be accepted as an evidence of the assistance which they can render to the shipping public in the future.

It may not be generally known, but it is nevertheless a fact, that the principle of consolidated cars which enables the forwarder to make reduced rates on LCL shipments and to offer improved service in connection with handling the same, was finally approved and supported in a case which was taken up to the United States Supreme Court by three or four forwarding companies. At that time, a few of the railroad companies were opposed to the principle involved. It is only fair to say, however, that since that time the railroad companies generally have recognized the value to themselves of the consolidated car principle and may now be found to be favoring the forwarders as an adjunct to their business. A few months ago, an order was issued to discontinue the issuance of through bills of lading on export shipments via Pacific Coast, and the cancellation of all export-rail rates. This order was, of course, fought by shippers; and without in any way minimizing the efforts of the shippers, it may be truthfully asserted that the forwarders, by their united efforts and their knowledge of the business, were able to demonstrate the evil effects of the proposed order to

the Railroad Administration so promptly and clearly that the Railroad Administration was led to cancel the order. Of course, the cancellation of the order to discontinue issuance of bills of lading carried with it the continuance of through export ladings, for if the original order had gone through, all export shipments would have had to move on local bills of lading and at local rates from point of origin to the ports. Another case is that of the demurrage tariffs at the ports, particularly on the Pacific Coast. The storage and demurrage charges assessed, worked a great injustice to the shipper who had complied in every way with the rules and regulations governing this traffic as laid down by the carriers. These matters have been greatly modified and the charges reduced, largely through the efforts of the forwarding companies in connection with the various boards who were in control.

The Forwarder's Value

The forwarder is not only necessary to the average shipper who wishes to engage in foreign trade, but his services are frequently employed by the larger concerns of the country who have their own export organizations to look after their own business, which is perhaps the best form of testimony which the forwarder can submit as to the value of the services which he can render. The reason for this is that the forwarder's connections and dealings are so wide and cover so many different fields of operation, bringing him into contact with cargo or so-called tramp steamships as well as with all of the regularly established lines, that he can frequently offer facilities to the big industrial companies which their own organizations do not cover.

The forwarder, through his agents and correspondents in foreign countries, is able to obtain particulars of manufactured articles and materials for which there is a market in foreign countries. These opportunities are submitted to the forwarder's customers, who are thus enabled to increase their business and frequently are placed in a position to open up an entirely new field for trade. Many merchants and manufacturers of this country have received their first foreign orders through the information originally furnished by the forwarders, and these orders were subsequently retained by the services of the forwarder.

Methods of Making Connecting-Rods

By Frank C. Hudson

The design of connecting-rods is much alike in all motors at present, the cap being held to the rod by two bolts as in marine-engine practice. A few still adhere to the cap with but one bolt and a hinge joint on the other side, but the four-bolt rod seems to have gone "by the board."

When it comes to the manufacturing methods, and I might say the principles involved, there is quite a difference of opinion. In most cases the rod is forged complete at the crankshaft end and the cap is afterward removed by sawing or milling. A few do, or did, forge the cap separately, face the surfaces on both rod and cap, drill for the bolts and after bolting them together, treat the piece as a solid rod in the boring and subsequent operations.

Some bore the holes in both ends of the rod, finish the holes with the proper center distance, then saw off the cap and use shims to replace the metal removed by the saw. Others, following airplane-motor practice, seat the cap and rod carefully together, without shims or liners of any kind, and finish the rod as though it were solid instead of having a removable cap.

The Spring of the Rod

Forgings vary a trifle in length and in other dimensions, and substantial boring fixtures are necessary to prevent the drill or boring tool from following the forged depression or hole as the case may be. The forgings are also apt to be a bit bent on cooling and some builders straighten the forgings quite carefully before the first operation. One difficulty is that, after the outer skin of the metal is removed in some places, the rod is very likely to spring in another direction. To help in avoiding this, one maker at least, subjects the straightened rod to a heavy pressure in what may be called a coining die, to help get it to the desired dimensions and to aid in holding the metal against further changes.

There is also quite a difference in practice regarding the machining of the holes in the rod. One well-known maker broaches both holes and fits the bearings shells directly to the broached surface. Others ream the holes, while still others believe that they should be carefully ground to secure the best results. The advantage of securing a firm and true seat for the bearing shell is of course admitted, but the method of finishing the hole does not of itself insure the holes being parallel. The motors with bearings cast directly into the rods avoid this difficulty.

Securing Alignment of Holes

It is customary to first finish the sides of the rod ends and work from these in securing holes parallel with each other. These surfaces are carefully preserved and in some cases rest on three-point bearings to insure squareness. But even this sometimes fails to insure the accuracy desired. The usual practice is to bore and ream or grind the large end of the rod first, as this gives a larger working surface for holding the rod.

One motor builder, who is very particular about the rods being parallel, has abandoned using the side of the large end in favor of the bore. He uses an expanding mandrel inside the crankpin end, after the hole has been carefully ground, and finds the results very satisfactory. The argument is that the bore presents a much larger working surface than the side and is therefore more reliable. Unfortunately all the methods seem to leave the necessity of a slight straightening of the rod at final inspection and it is something of a question as to how the steel behaves when it gets hot and is being hammered by the explosions at the rate of from 500 to 1000 times or more a minute.

The question of finishing connecting-rods all over seems to be solved in most cases by not doing it. One builder of high-grade cars finishes the rods all over as in airplane-motor work. Others building cars of equal grade do not attempt to finish the outside of the rods. All good builders select the rods for a given motor very carefully and allow but slight variations in weight whether they are rough or finished. There is a slight chance in favor of the finished rod changing less under the stress of service, but little trouble seems to develop in practice in either case. And it is practical results which tell us how valuable our theories are.

EDITORIAL

How Flexible Plans and "Know How" Made Rapid Production Possible

THE story of the Lincoln Motor Co.'s growth from a big idea to the actual building of Liberty motors at the rate of fifty a day in the short space of seventeen months, is well worth a little careful study on the part of every manager, designer and worker in mechanical lines.

In the first place the Osler idea goes into the discard because Henry M. Leland was seventy-four years old when the U. S. A. entered the war. The site of the plant was an open field, but both Henry M. and his son, Wilfred C. Leland, had the "know how"—dating back to the days before the automobile, when the machine-tool industry claimed them.

Two days after the company was incorporated it received an order for six thousand Liberty motors, the first to be awarded. The factory was yet to be built and the American Bridge Co. estimated from six to nine months' delivery for steel. A long-distance call found that steel was in process which could be used if plans were changed to fit the section of steel being rolled. In ten days the steel was being delivered at the factory site.

Machine tools had to be secured, and here personality played its part—the old connection in machine-tool lines helped to get the machines in record time. Eighty-five tool designers worked to equip the plant with over sixty-five hundred separate and distinct designs from which a total of over ninety thousand special tools were made. Many of these were due to the changes which were made in the motor itself.

At the end of a year the force had increased from one hundred to six thousand men and women, two thousand motors had been produced, and the rate of fifty a day had been attained. Contrast this with the plant of the best-known English maker with three years of aircraft-engine experience. With ten thousand employees the output was fifty motors a *week*.

There are several points in the success of this plant which have a direct bearing on the manufacturing of both the present and the future of this country. A man's capacity and not his age should determine his opportunities for service. Plans should be flexible enough to meet conditions, as shown by the change of shop plans to get steel quickly. A demand for exact sizes desired might have caused months of delay in getting the shop into operation.

The human factor in management helped greatly to secure the maximum output. The Lelands believe in helping men and women by giving them a sense of responsibility and teaching them to help themselves.

The output of the unnamed British aircraft motor company shows very clearly why it was not possible to adopt any of the foreign motors if we were to secure rapid production. Our Navy Department took this matter up very carefully and finally decided it was out of the question.

There were many unnecessary delays in getting an early production of motors due to the close tolerances demanded on non-essential dimensions, tolerances which were afterward greatly increased to allow production and with no detriment to the running quality of the motors. This, however, does not reflect on the builders but on the designers, who were supposed to be practical motor engineers. But in spite of these delays we were able to produce motors much more rapidly than any other country, which perhaps makes the delays more bearable.

There were other builders of Liberty motors who did excellent work both in production and in quality, but this was the only plant built exclusively for the purpose. The necessity of building a new plant, of equipping it and of securing mass production in seventeen months, makes it a most notable achievement and one full of inspiration for all red-blooded Americans.

Adapting Ideas to Our Own Needs

ADAPTABILITY is perhaps the most valuable asset of any mechanic, no matter what his position. The manager adapts plans and methods which have proved successful in other industries, to fit his own problems. The superintendent and foremen do the same, getting down to more detail in the use of specific machinery, tools and fixtures, and the machinist who can utilize his previous experience by adapting it to the new requirements, is of more value than the one who cannot change his work or his method.

The great value of the articles in the *American Machinist* and other publications is not that the tools and methods described will exactly fit the conditions in other shops but that they contain ideas and suggestions which can be adapted so as to be of value in a dozen classes of work. The principles involved, whether it be the method of locating or centering, of clamping or of machining, are all worthy of careful study. And unless this is done, the main value of the device may be easily overlooked.

If for example, it is found that the great majority of motor builders begin to machine their pistons by centering by the inside, it can be assumed that this method has been found most satisfactory for securing walls of equal thickness. This can then be accepted as a principle to be followed in all similar work, in work where it is necessary or desirable to have the inside of a casting concentric with the outside in the finished product.

In a similar way other fundamental principles of modern machine production can be determined and used to facilitate manufacture of various kinds. Without adaptability, the ability to modify and utilize ideas along similar lines, we lose much of the value of the experience of others. We can always keep tabs on our qualifications, however, by asking ourselves how we can adapt the ideas we see to our own work, and we should continually do so.



The National Machine Convenes at

THE semi-annual meeting of the National Machine Tool Builders' Association was held at Atlantic City, May 12 and 13. Some 300 members and guests convened at the headquarters at the Hotel Traymore, to consider and discuss after-the-war problems affecting the machine-tool building industry.

President A. E. Newton, in his opening address on Monday morning, May 12, called attention to the necessity of avoiding self delusion in the matter of costs. He stated that one of the principal lines of effort of the Association for the past several years has been to lead machine-tool builders to establish cost systems which would actually give accurate cost figures on the product. Mr. Newton pointed out the fact that there is usually a serious discrepancy between individual costs and the collective cost of doing business over a period of time; in other words, that the sum of the individual costs during, say a six months' period, seldom equals the total cost of doing business over that same period. Therefore the average manufacturer of machine tools or other machinery, unless he has a system of balancing individual costs against total periodical expenses, makes but 30 or 40 per cent. of his expected profits as shown by individual costs. He also pointed to the fact that a decreased volume of business, such as confronts the machine-tool industry, must inevitably increase costs by increasing overhead expense. These matters must be carefully considered by any manufacturer who contemplates a policy of price adjustment at the present time.

Howard W. Dunbar, of the Norton Co., reported to the Association the progress of work by the safety committee. He called attention to the proposal of the Bureau of Standards to constitute itself a source for the compilation of standardized safety codes, and to the alternate proposition to put this work under the control of the American Engineering Standardization Committee.

A most interesting and entertaining address was given by Mark Sullivan who told of his experiences at the Peace Conference and gave some food for thought as to the probable effect of the war on industry. Mr. Sullivan pointed out that first in importance is the loss of man power of the white race. Human beings are fundamental to wealth, and the existing number of capable human hands must inevitably influence the world's wealth. France has lost industrially, out of some 18 million males, a total of one and one-half million dead and an equal number permanently incapacitated from future efforts other than to merely take care of themselves. Other European countries have suffered in like proportion—the former Central Empires even more severely. One-third of the European industrial workers are permanently out of it. In addition to this present loss, the birth rate in France has fallen to one-half the pre-war standard, being now but 9 per 1000 per annum. He also pointed out, that at this rate, it would require an average length of life of 112 years per individual to maintain the present population of France. Great Britain has had a somewhat similar experience, for in 1918 for the first time the birth rate has been such as to be exceeded by the death rate. America, while it has not been so seriously affected by direct casualties, nevertheless, will suffer from this condition since Europe has normally furnished us with the necessary annual increment of crude labor. This has averaged one million immigrants per year. At a value equivalent to the nominal one of $1000 per individual this has meant a labor asset to the United States of a billion dollars per year, which we may consider as now totally withdrawn.

Mr. Sullivan called attention to the fact that due to the loss of man power and the declining birth rate, the full effect of the world's wounds will not be apparent for 20 years. At that time, due to these causes the white males of 21 years of age will be approximately one-half the number that we could have expected if the world war had not occurred.

While disbelieving in the possibility of such an event as a struggle between the white and the yellow races, Mr. Sullivan pointed out the fact that if such a struggle should occur it would most probably be in 1939, at which time the white race will be possessed of its minimum fighting manhood, relatively to the yellow race.

Turning to the aspect of the material losses brought about by the war, the speaker said that everything of this nature in Europe can be characterized as being in "bad shape." No adequate repairs have been made in five years and the result is typified in the condition of the French rolling stock. On a pre-war basis France



Tool Builders' Association Atlantic City

maintained a total of 250,000 railway cars in operation; at present there are not more than 100,000, and judging from Mr. Sullivan's personal experience, every one of these 100,000 cars has flat wheels!

In Great Britain it normally required the construction of 90,000 buildings per year to keep even. Since building has been practically prohibited in that country for the past five years, the deficit today amounts to nearly half a million buildings.

Mr. Sullivan drew some interesting pictures of the Peace Conference and of the part that was taken in it by Americans. Our representatives were the first to discover the fact that it would be impossible to collect the total cost of the war from the defeated enemy, this cost amounting to over $100,000,000,000 and that the maximum as shown by inventory, that could be gotten from Germany, was some $28,000,000,000. This amount to be collected is very carefully and insistently designated as "reparation"—the word *indemnity* being tabooed as conflicting with one of the 14 points which prohibited "indemnities."

Americans, according to Mr. Sullivan, were the first to discover, through the American Army Intelligence Service, that there was real danger of Bolshevism in Germany, due to lack of food and employment. As a result, the blockade was partly lifted on food and certain raw materials.

Charles F. Lang, president of the Lakewood Engineering Co., urged that we realize that the world had undergone more and greater changes than ever before and that we must prepare for still different conditions. Pre-war standards and prices have gone never to return, and an era of unlimited competition is sure to result disastrously for all. We have learned how to coöperate during the war and the benefits of this must not be lost now or in the future.

Mr. Lang traced the growth of business from the small one-man shop, through the combinations which resulted in the Sherman law and pointed out the bad effects of that law. He urged such legislation as may be necessary to allow legitimate coöperation, on the ground that a return to unlimited competition means destruction or centralization of business in the hands of a few.

The automobile industry was cited as an excellent and practical example of stabilized prices. Every buyer had the assurance that, during a given period, the price would not be lowered. A similar plan would, be believed, stimulate buying in all industries. The world's shelves are empty and there is ample business ahead for all.

Mr. Lang also traced the labor problem, pointed out that unions for collective bargaining were made necessary by the selfish action of some employers during the days of cut-throat competition and expressed gratification at the coöperation which is being shown between capital and labor in many instances. The war has shown labor its power and by coöperation and education we must show how it should be used. The spirit of coöperation must be fostered and the closer the manufacturers can work with the labor organizations, the better for all. The time may even come when there may be a new organization to which both can belong.

In the matter of foreign trade, Mr. Lang also pointed out the need for the same kind of fair dealing if we are to continue friendly relations with all the world. All were urged to buy for present needs at prevailing prices, to cease waiting for decreases which were sure to be slight, and to aid in keeping business moving by showing faith in the future, which is sure to be justified if we put our shoulders to the business wheel.

Director Stratton of the U. S. Bureau of Standards made an address, illustrated with stereopticon slides, on the work of the United States Department of Commerce, particularly that phase of it which had to do with the activities of the Bureau with respect to machinery building. He was followed by Allen Walker of the Guaranty Trust Co., who spoke on "Combinations Under the Webb Act."

The convention appointed a committee, of which Stanley H. Bullard is chairman, to consider the question of acquainting not only the users of machine tools but the public at large, with the facts concerning the importance of the machine-tool industry as a factor in the maintenance and the advancement of the nation.

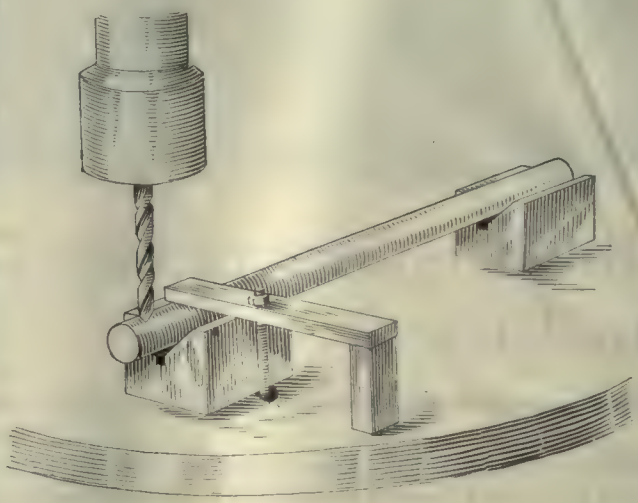
At the executive session of the Association, in addition to the resolutions of a routine nature, the following was adopted:

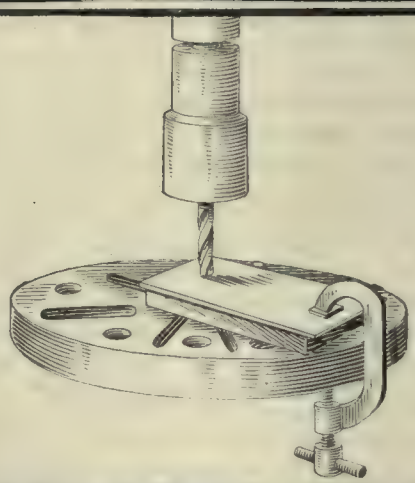
"Resolved that the National Association of Machine Tool Builders herewith expresses its disapproval of any or all attempts to make the adoption of the metric system compulsory."

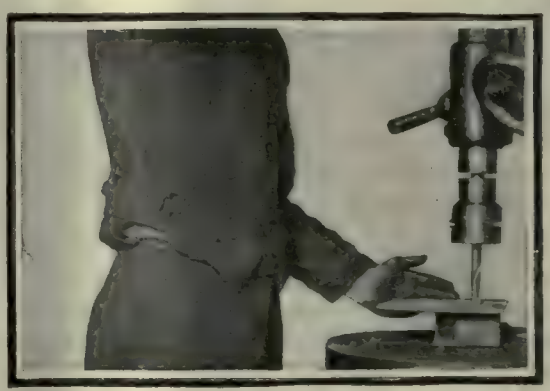
CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas

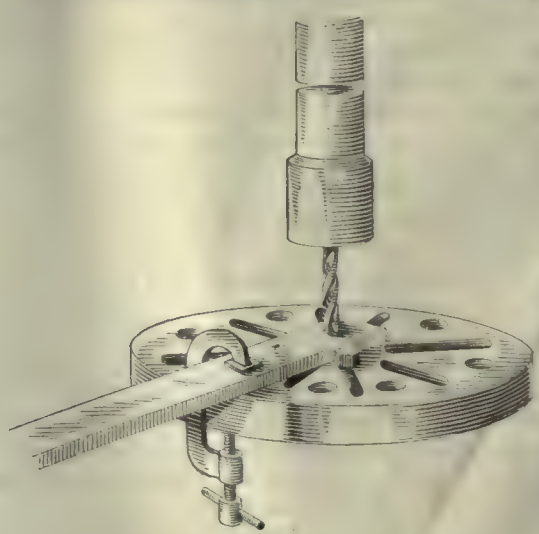












Gear Steels*

BY DR. J. HEBER PARKER
Carpenter Steel Co.

There was a time, not so very long ago, when gears of ferrous metal were made entirely of cast iron. When gears of steel came into use the manufacturer who could advertise that the gears in his machines were cut from solid steel blanks thought he had reached the acme of perfection in the strength and wearing qualities of his gears. He never heard of case-hardened gears or gears made of carbon steel and hardened, nor would he have believed such things possible. The service demanded of gears in the automotive industry has changed all this and the author of this paper tells us of the composition of steels that are suitable for gears which are either to be case-hardened or hardened and tempered by simply heating and quenching.

FROM a commercial standpoint, gears may be divided into three groups—gears for automotive service; gears for electric car service, and what may be called commercial or jobbing gears.

Gears for automotive service include those used for automobiles, both trucks and pleasure cars, airplanes, tractors, motor boats, machine tools, etc. Upon gears of this group there has been devoted a great deal of study and work as regard different types of analysis and the heat-treatments for each type, and also the matter of design as applied to the metallurgical side of the question, such as minimizing the matter of warpage in hardening, etc. In fact, it may be said that the story of the development of gear steels for automotive work is in great part the story of the development of alloy steels of the last 15 years with which the writer has been closely connected.

Steels for this work are divided into two groups—steels for case-hardened gears, where there is a hard surface and soft core, and steels for tempered gears, where there is uniform hardness throughout the entire tooth section. Much has been said about the relative merits of each group. It is a long story and may be passed over by expressing the opinion that, in a general way, each has its own special field, the case-hardened gears for constant mesh service, and the tempered gears for change or clash gear service. Certainly the tempered-steel clash gear does not realize the experience of the case-hardened gear in the same service, when hard, case-hardened clash faces are chipped off with the resultant exposure of the soft core, and consequent trouble with bearings impregnated with hard-steel chips. Tempered gears have sometimes been criticised on account of pitted tooth surfaces which were found after limited service. It is believed that this pitted condition is caused by excessive unit tooth pressure due to several causes. A few experiences where the condition of pitted surfaces was corrected may be of interest.

Causes of Pitting

First—Misalignment of gears was believed to be the cause of the trouble, thus throwing an excessive load upon only a part of the tooth and vastly increasing the unit tooth pressure. When the gears were properly adjusted and the load properly distributed, pitting disappeared.

Second—A little lower drawing temperature after hardening which resulted in an increase of about five points in scleroscope hardness eliminated pitting. The slight increase in hardness was sufficient to enable the gear tooth to withstand the unit tooth pressure put upon it.

Third—The horsepower of a car had been changed without any change in the transmission. The pitting which occurred was eliminated by increasing by $\frac{1}{8}$ in. the length of the tooth face. This increase resulted in decreasing the unit tooth pressure to a safe figure. Properly case-hardened gears, which have a scleroscope hardness of about 90, will undoubtedly withstand, without pitting, unit tooth pressures which will give trouble in the case of a tempered-steel gear which is about 75 scleroscope hard. The case-hardened gear, however, is not as tough nor strong, and in clash service has the disadvantages before mentioned. The tempered gear also will warp less in heat-treatment than the case-hardened one, for it reaches an elevated temperature only once in heat-treatment, and that for only a few minutes as compared with the long high heat for carburizing, and two subsequent elevated hardening temperatures for treatment after carburizing.

For automotive work case-hardening steels of six types are generally used, three of the types quite commonly, while the other three have a more restricted use on account of their higher cost with, perhaps, a little more careful heat-handling requirements. Table I gives type analysis of each, together with the physical properties of the core, when properly heat-treated, which may be expected when these steels are made by mills having more of a quality than a tonnage perspective.

Carburizing

The physical properties given in the table were secured by treating standard test pieces in sand for the length of time and at the same temperature, as would be used in carburizing, for the various types of steel. Test pieces were then allowed to cool in a box and given a full double treatment which would have been given a piece of the respective steels to put them in their best possible case-hardened condition. Test pieces were then ground to size and pulled.

TABLE I. ANALYSIS AND PHYSICAL PROPERTIES OF CASE-HARDENING STEELS

Name	C.	Mn.	Si.	P.	S.	Cr.	Ni.	E.L.	T.S.	El.	Red.	Brinel	Sclero	Guillery Impact	Sclero of Case
Simple carbon	0.20	0.50	0.20	0.04	0.04	....	....	50,000	75,000	20	55	190	30	18 Kgm	90
Mild chrome nickel	0.20	0.60	0.20	0.04	0.04	0.40	1.25	100,000	150,000	12	40	287	40	10	90
3½ per cent. nickel	0.20	0.60	0.20	0.04	0.04	....	3.50	105,000	160,000	13	45	302	50	11	90
5 per cent. nickel	0.15	0.40	0.20	0.04	0.04	....	4.75	125,000	175,000	15	50	321	54	10	90
Medium chrome nickel	0.17	0.40	0.20	0.03	0.03	1.00	1.75	140,000	180,000	13	50	340	58	11	90
High chrome nickel	0.12	0.40	0.20	0.03	0.03	1.25	4.00	150,000	200,000	13	52	375	60	10	90

In regard to the operation of carburizing, so much has been written upon this subject that it would be superfluous to go into it here in detail. Case carburizing compounds have been very thoroughly developed and compounds are available which will produce in the case different carbon contents, that is, 0.60 per cent., 0.80 per cent., 1.00 per cent. carbon, etc.

Carburized pieces should not be quenched directly from the carburizing box, except in cases where a hard surface only is desired and nothing in the way of strength and toughness of core is expected. If carburizing temperatures are relatively low; that is, about 1550/1560 deg. F., good results may be obtained by a single quench after pieces have cooled in the carburizing box and have again been reheated to the proper temperature. For best results, however, a double quench after carburizing is desirable; the first quench from a temperature sufficiently high to refine the core, which is low in carbon, and the second quench at a proper temperature to refine the case, which is very high in carbon. Drawing after final hardening is desirable to relieve hardening strains and to secure increased toughness.

*A paper presented at the annual convention of the American Gear Manufacturers' Association, Cleveland, Ohio, Apr. 15, 1919.

Warpage of case-hardened gears as a result of heat-treatment always occurs to a greater or less extent. The warpage will be somewhat reduced if care is taken to anneal forgings before machining.

Forgings as they come from the hammer, and cooled under varying conditions, always have some internal strains. The release of these strains by annealing leaves the metal in a state of rest which makes possible a decrease in warpage in the finished pieces, for without the annealing, the strains in the metal due to forging often are relieved during the case-hardening operations, with the result that they are the direct cause of some of the warpage experienced.

Tempered gears are made principally from four types of steel, two of which are in common use while two types are more rarely used, especially one of the latter, an air-hardening chrome-nickel steel, which has been used very little in this country. Table II gives the type analysis and physical properties of these steels in gear condition.

In addition to these standard types there has been sold a silico-manganese steel of approximately 0.50 per cent. carbon, 0.75 per cent. manganese and 1.50 per cent. silicon, which has, when hardened and drawn for gear condition, an elastic limit of approximately 225,000 lb. per square inch. This steel when properly hardened remains practically constant as to size, and has proved most satisfactory as a steel for clash or change gears.

Gears for Commercial or Jobbing Work

This particular field, as the speaker understands it, covers by far the biggest field of work for a number of your member companies. The steel used, or perhaps more accurately speaking, the ferrous materials used, may, perhaps, be put into five groups:

First—Cast iron and semi-steel.
Second—Steel castings.
Third—Unhardened and untreated steel.
Fourth—Case-hardening steel.
Fifth—Tempering steel.

Cast iron and semi-steel—Orders to the foundry usually call for iron castings, meaning an ordinary gray-iron casting, without any chemical or physical specifications. Physical tests of ordinary cast iron, as given by Kent, show a tensile strength of from 20,000 to 22,000 lb. per square inch. The elastic limit is not clearly defined for cast iron and is usually not given. There is also, as you know, no ductility; break occurs and that is the end of it.

The hardness is extremely variable and varies with the size of section, temperature of casting, and the analysis of the iron. But in any event it is quite low.

Semi-steel is a name given to cast iron to which has been added, by melting in the cupola, steel scrap of varying proportions up to 20 per cent. or even 30 per cent. The addition of steel increases the density of the iron and also its strength, and results in better wearing qualities on the gear teeth than is obtainable with cast iron alone.

Steel castings—Steel castings for gears unless the analysis and physical properties are specified will usually be found to have approximately the following analysis and tensile properties:

	Per Cent.
Carbon	0.30 to 0.40
Manganese	0.40 to 0.75
Silicon	0.20 to 0.50
Phosphorus	Not over 0.06
Sulphur	Not over 0.06
	Lb. per Sq.In.
Elastic limit	25,000 to 35,000
Tensile strength	60,000 to 70,000
	Per Cent.
Elongation in 2 in.	18 to 22
Reduction of area	25 to 30

Unhardened and untempered steel—Steel for this class of gears is usually picked up out of warehouse stocks by the gear maker and is generally considered by him as good or bad, depending entirely upon his ability to machine it easily. It may represent almost anything from 0.15 per cent. to 0.40 per cent. in carbon with usually very high values for manganese, phosphorus and sulphur, the latter two elements being those whose presence are necessary in relatively large amounts in order to insure easy machining. The tensile strength of steel of this charcater will vary between 55,000 and 70,000 lb. per square inch with an elastic limit approximately half of this amount and an elongation of 20 to 30 per cent. in 2 in. For gears of ordinary service it is undoubtedly superior to either cast iron, semi-steel or steel castings untreated, but, of course, cannot compare in service with either the case-hardened or treated gears.

Case-hardening steel—This steel is purchased in bar form, in forgings and in rolled blanks. The standard analysis is as follows:

	Per Cent.
Carbon	0.15 to 0.25
Manganese	0.40 to 0.60
Phosphorus	Not over 0.04
Sulphur	Not over 0.05

Steel with carbon over 0.25 per cent. should not be used except in very special cases on account of the hard brittle core which will result, and where tooth sections are relatively small it would be well to hold the carbon to 0.20 per cent. as a maximum. The same remarks regarding case-hardening treatment apply here as given under case-hardening steel for automotive work. In a general way, the physical properties in the core may be expected to closely approximate those given above for simple carbon steels.

Range of Carbon Contents

Tempering steels—Again bar stock, forgings and rolled blanks represent the conditions in which this steel reaches the gear maker. A handbook, by a steel manufacturer of forged and rolled carbon steel spur-gear blanks, gives two ranges of carbon contents for this type of work. The medium grade of 0.35 to 0.50 per cent. and the hard grade of 0.55 to 0.65 per cent. carbon. The speaker is of the opinion that the latter grade is too high in carbon for quenched gears, and that 0.35 to 0.50 per cent. carbon is the range which will, on the whole, give most satisfactory results from the standpoint of ultimate service, warpage in hardening and breaking either in hardening or in service. The physical properties to be expected from this type of gear will vary considerably, depending upon the carbon content, the size of the tooth section and the quenching medium, whether it be oil, water or other aqueous solution.

In a general way, an 0.40 per cent. carbon steel 1 in. round as rolled will show approximately:

	Lb. per Sq.In.
Elastic limit	50,000
Tensile strength	90,000
	Per Cent.
Elongation in 2 in.	20
Reduction of area	40

The use of case-hardening and tempering alloy steels, in place of simple carbon steels, for jobbing or commercial gears undoubtedly will largely increase. The speaker believes this development can be made especially promising in the field for gears made of alloy-steel castings, where the use of the electric furnace makes possible a better grade of alloy-steel castings than could be formerly obtained. Just one instance of one type of service will show the possibilities. Sixteen-inch merchant mill pinions made of 0.40 per cent. simple carbon-steel castings untreated, lasted in service on the average from 9 to 12 months; 0.50 per cent. carbon chrome nickel-steel castings heat-treated, lasted on the same job seven years and are still going. The possibility for a gear maker in developing a

TABLE II. ANALYSIS AND PHYSICAL PROPERTIES OF TEMPERING STEELS

Name	C.	Mn.	Si.	P.	S	Cr.	Ni.	E.L.	T.S.	El.	Red.	Brinell	Sclero.	Guillery Impact
Medium chrome nickel, Type "A"	0.50	0.40	0.20	0.03	0.03	1.00	1.75	260,000	300,000	6	16	495	76	5 Kgm
Mild chrome nickel, Type "B"	0.50	0.40	0.20	0.03	0.03	0.7	3.00	235,000	260,000	7	18	444	74	5
High chrome nickel	0.40	0.40	0.10	0.03	0.03	1.25	3.50	250,000	285,000	6	18	490	76	5
Air-hardening chrome nickel	0.30	0.40	0.20	0.03	0.03	1.50	4.50	220,000	255,000	9	22	460	70	7

field of this kind seems almost without limit, especially if this development is worked out in close coöperation with a steel foundry making electric steel castings.

Special attention should be paid to the matter of design of castings which are to be case-hardened or tempered. Sections throughout the casting should be as nearly uniform as possible, and a little extra weight to accomplish this will more than pay for itself. Sharp or short angles should be avoided for they are sure to result in trouble during heat-treatment. Sharp machined angles at the bottom of keyways also should be avoided for the same reason.

Whether gears or pinions are made from castings or forgings, the metallurgist, from a theoretical standpoint, would design them to be of uniform section, with no overhanging teeth, with no undercut teeth, and with no sharp angles either cast or machined; he would have a steel sound and in good condition, of the proper chemical composition for the particular heat-treatment to be given, and annealed to relieve all strains before machining; he would have a heat-treating equipment in line with the high-grade machine tools of which the mechanical man likes to boast, and controlled by pyrometers the accuracy of which is maintained to compare favorably with the micrometer measurements of the finished gears. The nearer this ideal is attained, the better will be the gears produced.

And now, just a word about steel making. Most of the steels you are using, with the exception of electric steel castings, are melted in the open-hearth furnace. You are going to hear a great deal in the near future about electric steels. Clever salesmen will speak in a mysterious way about the wonderful effect electricity has upon the steel, etc. You, of course, realize that the electric current provides only the heat, the fuel if you will, to melt the steel and to provide the temperature necessary to refine it. The electric furnace, with its ease of temperature control, its ability to provide reducing conditions for the bath, and its elasticity of handling, provides the opportunity to make steel of exceptional quality. The steel produced, however, will vary from an ordinary open-hearth grade up to a crucible grade, depending upon the skill and previous experience of the maker. The maker with the large tonnage perspective does not and will not make the same quality of electric steel as the maker of crucible steels who has had for years a quality perspective. Their standards of quality and their methods of manufacture are entirely different from the time the steel is melted until it is shipped. When, therefore, you want the best electric steels produced, the steels which will give you maximum service, look up the makers with the quality perspective, the quality reputation.

Wage Disputes and Cost of Living

By L. W. ALWYN-SCHMIDT

The readjustments in working conditions which are now going on in all sorts of shops are offering us fine opportunities for improving these conditions and also the relations between workmen and employers. If the opportunities are accepted in the right spirit by both sides the chances are that changes for the better with lasting results can be effected.

LABOR unrest is a disease for which there is no complete cure, but there are means to mitigate its evil influence on industry. The work has to begin in the factories and workshops and must be a part of the effort to bring the men to a realization of the fact that their prosperity is not an individual experience of their own but rather the result of a corresponding prosperity of the whole.

On the other hand, there remains the unfortunate fact that the same factors of extensive and well-paid employment which benefit the men also attack their economic position by raising the cost of life's necessities. The effect of high wages is neutralized by the decline of the buying power of the dollar. This is an experience which we have all undergone during the last four years and high prices doubtless are at the bottom of much of the present dissatisfaction in labor circles.

The time has come when both workman and employer must face this problem with a view to finding a more satisfactory solution than those so far attempted. The strike may seem an easy way to enforce a discussion of the grievances of labor and the resulting higher wages may bring a momentary relief. But it is a very crude way of settling a dispute because it leaves in abeyance the most essential part of the controversy, its underlying cause. This has been realized with increasing clearness during the last few years and has led to various attempts to eliminate the variation of the cost of living as a factor in wage disputes. No satisfactory solution of the problem has yet been found, but the need is so great that even the small progress that has been made so far deserves the attention of all those dealing with the handling of labor.

The problem of adjusting wages both to the individual earning capacity of the operator and to the relative buying power of the dollar is especially difficult in the machine construction industry. Many of the American machine shops are doing nothing but contract work, and the quality and extent of their services constitute the commercial commodity which they offer to the market. To keep the cost of these services at a competitive rate and to adjust it always so finely as to secure to all the workers that income which is commensurate with the general economic condition of the country, is no easy matter.

Problem of Wage Stabilization

For the production engineer the problem appears in the form of wage stabilization. It is to the interest of the shop to have an operating force as nearly uniform in number and productive ability as is humanly possible. In order to keep down the number of changes in the force, the men should be satisfied with the conditions of their work, and to maintain efficiency they should be free from economic worries. There should finally be the knowledge that the job is safe and worth keeping.

View may differ on what constitutes a living wage, but there is no doubt that even under difficult circumstances an agreement can be reached on a minimum wage scale, which, prior to 1914, there was little difficulty in sustaining. Men who were not satisfied with their earnings could either improve their services and qualify for better-paid jobs, or they could leave the work. Others could be found to take their places. Unfortunately, in recent years minimum wage arrangements have lost a good deal of their value to the men and the employers owing to the unreliability of the

basic purchasing power of the monetary unit. As the problem seems to be caused nearly entirely by the rise in the cost of living it has been attacked mostly in this direction. The method of attack has varied, but in the majority of cases no other solution has been found than that of raising the wages of the men from time to time.

Wage increases, however, are far from satisfactory in dealing with variations in the cost of living. The trouble reappears almost immediately after an increase has been granted and the men are always bound to be the losers in the race against mounting expenses.

The Wage Dispute Problem

The shop is no better off than the men, for a wage dispute coming in the middle of a large contract may overthrow the whole cost estimate and turn an estimated profit into a clean loss. The consequence is resistance by the management to the demands of the men and very likely a strike results which does not improve matters, but makes the situation worse. The problem must therefore be attacked from another quarter. Wages must be adjusted automatically to the purchasing power of the dollar.

To illustrate the problem, a small example may suffice. Suppose that our factories would pay in goods instead of money. Let the weekly ration of a man consist of a dozen eggs, three quarts of milk, six quarts of potatoes, six pounds of meat and other commodities. If the factory had to buy these goods every week it would have to pay the existing market price. The monetary payment to the men is really the equivalent of these commodities in cash. If the purchasing power of this equivalent is sufficient only to supply 9 eggs instead of twelve and only 4 pounds of meat, the man is not getting his full equivalent. He will be dissatisfied with his earnings and will demand more.

Commodity as a Basis for Wage Payment

The factories which have tackled the problem in their general wage policy have agreed upon the quantity of commodities or their equivalent value due to each man as wages, and have made good his monetary loss by adding to his wages the difference between the assumed value of the commodity and the price for which it might be purchased. The second solution is that of keeping down the cost of the ordinary necessities of life to an agreed level by artificial means, thus obviating an adjustment of the wage scale because living conditions are constant.

In Europe where the labor is generally far more stationary, the solution lies in stabilizing living conditions. Labor legislation, factory benefit associations, coöperative stores and the formation of special labor colonies have all contributed to success. When coöperative stores exist, the company has only to pay an increased amount to them when the cost of living rises, so that the same wages will purchase the same amount of necessities and the loss to the store is paid by the company. Some of the large railroad shops in South America have tried the scheme of paying their men partly in cash and partly in trade money which was accepted at the company's store and whose value could be stabilized.

A variation of this general system consists of the arrangement of rebates with the local merchants which are not payable at once but on a quarterly basis. This scheme was extended to include the lower salaried officials of the company and when hard times came they were glad enough to avail themselves of the rationing system.

The difficulty with these arrangements is that the men are limited to dealing with only certain shops, a restriction which would hardly suit the American workman.

The American method of stabilizing wages as mentioned above is open to objection in that it complicates the cost figures on the product. There is no reason, however, why the same amount which was added to the wages should not be added to the selling price of the product, thus maintaining the balance between labor cost and sale price.

The economic life of the world has undergone enormous changes during the last four years, and no force, however strong, can bring us back again to the summer of 1914. There is no denying that wages are in the decline again. No force whatever can hold them on their present level, and when they drop the artificially inflated commodity prices will go with them. The old system of striking for higher wages, of arbitrary agreements which are useless to both parties when they are made, has failed to produce results and will probably find its final doom during the coming readjustment. It is time to try something new, holding a better promise for permanency, and the introduction of wage agreements based on the varying purchasing power of the dollar may prove a solution.

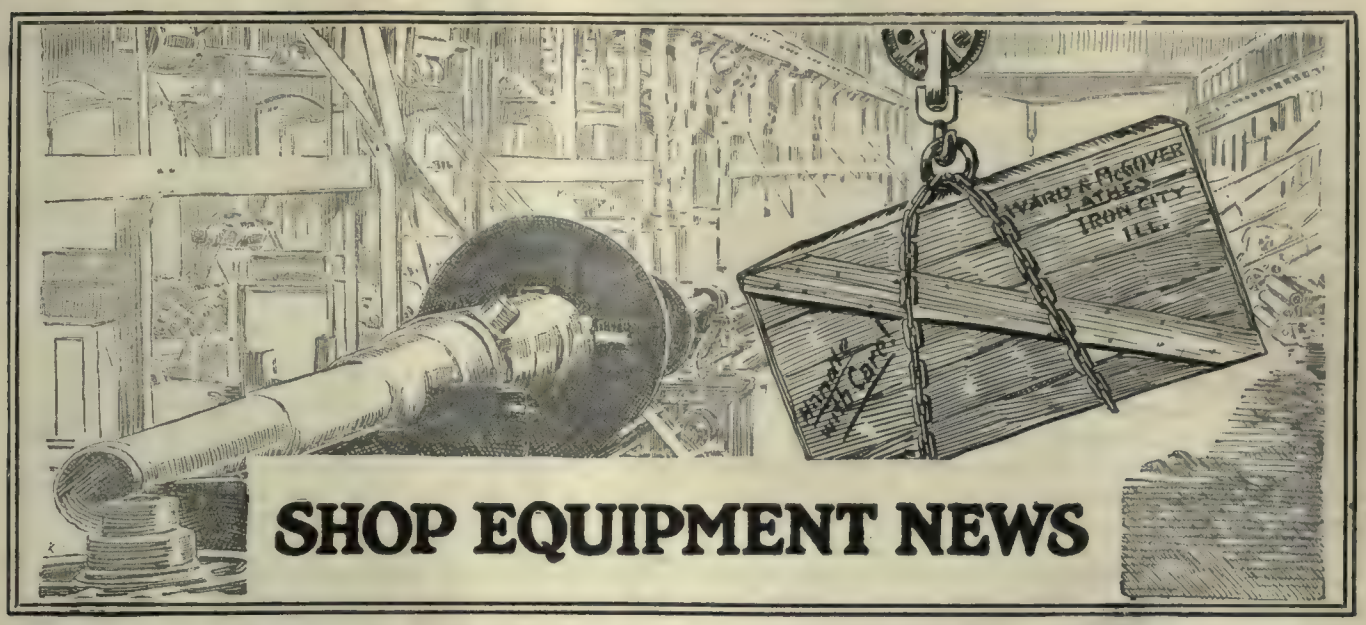
Reducing Idle Machine Time

By C. Hamilton

In a good-sized machine shop with which I am connected the tool-shop foreman is also in charge of all ordinary machine repairs. Under the pressure of Government work the oiling of machines and shafting, to say nothing of the air hoists of which we have nearly a hundred, became as perfunctory as the motions of a sleepy hound scratching fleas.

As a result shut-downs for galled shafts and burned bearings kept the repair gang on the jump and production lagged. Machinists were at a premium and scarcer than hens' teeth, and the boss was in a quandary. Finally he dug up four or five old chaps whose production days were over but who could still navigate, and set them to work as shaft nurses. One man was given a can of grease and an oiler, and was introduced to every air hoist in the shop. He was constantly on the go, and air hoists which had almost forgotten the existence of lubricants took a new lease of life with a joyful sputter. Failures in this section were almost entirely eliminated and the shafting troubles were reduced 50 per cent. in the first month of the new system.

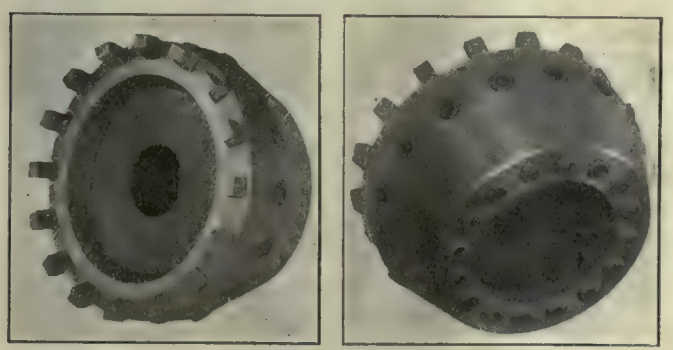
The shop was divided into sections and each man was made responsible for his section and every oil pocket in it. The machine operators were relieved of all responsibility of routine lubrication and only took care of the necessary oiling incident to the work they were doing. Production promptly took a climb and the tool-shop foreman had time to change chews and pass the time of day occasionally without wondering where the next S. O. S. was coming from. He even had time to build a new jig once in a while and get production out of his own department instead of keeping his expensive toolmakers on the jump doctoring sick machinery.



SHOP EQUIPMENT NEWS

Runde Face Mills

The R. W. Runde Machine, Tool and Die Works, Detroit, Mich., has just placed on the market a line of hardened-body face mills one of which is shown in the illustration. The mills are made in sizes as desired and



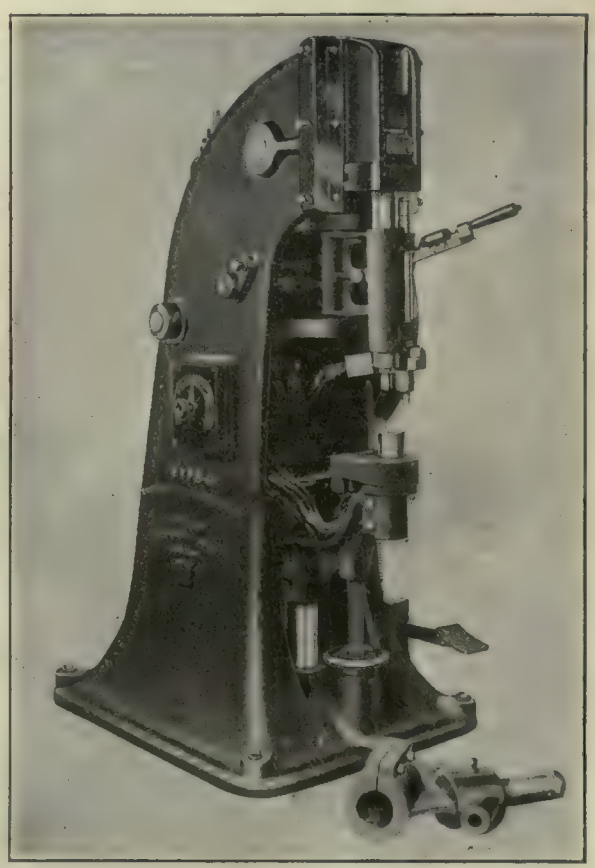
FRONT AND BACK VIEWS OF THE RUNDE HARDENED-BODY FACE MILL

adapted for various types of milling machines. The advantages claimed are, that the cutter always maintains its original diameter automatically; the individual blade adjustment permits grinding the blades by hand without removing the body from the machine; there is a comparatively small surface to be ground; both ends of the blades can be used allowing the ends to be made with different shapes if desired; only five minutes are required to grind and replace a set of blades; blades too short for use in the cutter can be used in lathe, shaping-machine, or planing-machine toolholders; additional sets of blades may be obtained without excessive cost, and a hardened body making for long life.

Thomson Type C Electric Riveter

The illustration shows the Type C electric riveter now being marketed by the Thomson Electric Welding Co., Lynn, Mass. This machine is of medium size and will handle any commercial lengths of rivets successfully from $\frac{3}{8}$ up to $\frac{3}{4}$ in. in diameter.

The rivet to be headed is first set in place in its hole and the work is then laid on the lower die of the riveter so that the under head of the rivet rests in a small recessed pocket provided on the face of the lower die. The head is swung to the left by the controlling lever, bringing the copper die at the right directly over the rivet shank. By pulling down on the operating handle the copper heating die is forced into



THOMSON TYPE C ELECTRIC RIVETER

contact with the upper end of the shank to be heated. Pressure on the push button at the outer end of the controlling handle turns on the current and heats the rivet. When the rivet is heated to the proper degree the pressure on the hand lever is released and the

head swung to the right, bringing the steel heading die in line with the rivet. The foot treadle is then depressed, engaging a clutch that causes the heading die to make one full down stroke only and return to its starting position when the clutch is automatically disengaged. A safety device is provided that prevents any premature depression of the foot pedal by a careless operator or by accident, this device making it impossible for the power press to act unless the steel die is in proper position.

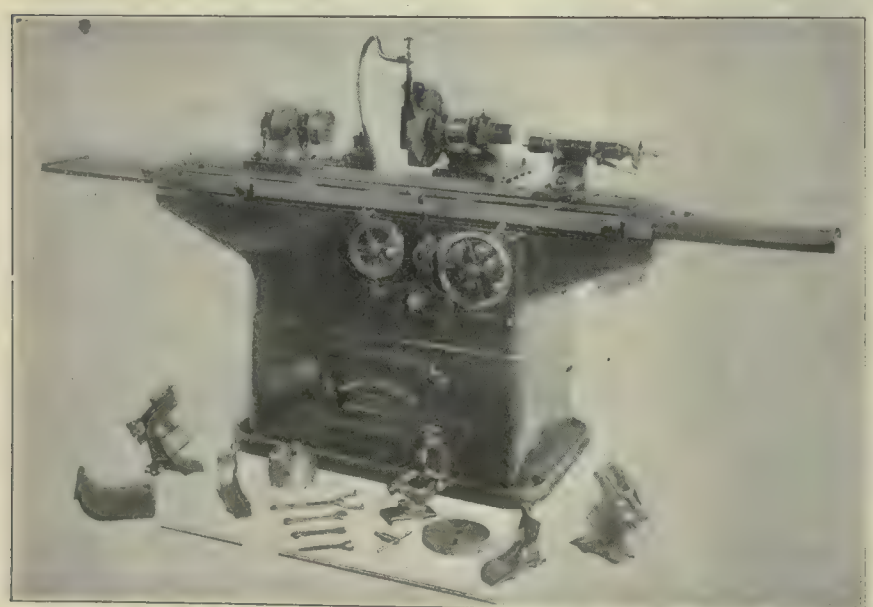
The press is constructed with a spring-cushion release having an adjustable tension, this feature being said to remove considerable stress from the press in case a rivet happens to be a little long. Another advantage of this type of construction is that rivets of different lengths may be used without any additional adjustment of the pressure springs. Another feature claimed for the machine is that by proper manipulation of the heating die with the operating handle the heat can be made to commence about the middle of the rivet shank, this method of heating being said to give a much better filling of the rivet holes than is possible where the rivets are first heated and then put in place. It is also stated that the slow squeeze given by the press gives a much better filling effect than hammer blows.

Fraser Universal Grinding Machines

The Warren F. Fraser Co., Westboro, Mass., has recently placed on the market four universal grinding machines that are somewhat similar to those described on page 270, Vol. 49, except that the new machines are arranged for countershaft drive. The new machines are known as No. 2-C with a capacity of 10 x 30 in., No. 2-AC with a capacity of 12 x 30 in., No. 3-C with a capacity of 10 x 42 in., and No. 3-AC with a capacity of 12 x 42 in.

The bed is built in two sections, the sub-base being cast hollow and ribbed internally, and arranged to rest on the foundation at three points in order to preserve alignment. The wheel-stand slide is supported on the base which, together with the sub-base, forms a continuous support reaching to the floor. The slide is so designed that the wheel can be used in any position without interference. Transverse movement of the wheel slide is controlled by a handwheel having a micrometer dial, the working parts being protected from dust and water by a metal cover. The automatic crossfeed has a range of adjustment from 0.00025 to 0.005 at each reversal of the table, and may be adjusted to operate at each alternate reversal of the table. The wheel spindle is of hardened steel ground to size and runs in bronze boxes provided with adjustment for wear. The wheel is mounted on a collet that is attached to the spindle by a nut and taper fit so that additional wheels may be mounted on collets and changed quickly for special work.

The swivel table turns on a hardened and ground central stud and is provided with a scale reading to 6 deg. and also to 2½ in. of taper per foot in both directions. The table has a slot of special form so that the head and tailstocks are aligned against the front edge of the table in clamping. The motion of the table is controlled by dogs, the brackets for which slide on racks to allow for quick adjustment. Screws are fitted for fine adjustments. The table moves on one V- and one flat-way, the wearing surfaces being protected from dust by metal covers, oil being distributed by means of rolls in oil pockets. Three wheel speeds, eight table speeds and eight work speeds are provided. The reversing mechanism is a special feature. It is stated that this allows work to be ground close up to a shoulder. It is provided with means to give a slower travel close to the reversal than in the central part of the traverse, this completely grinding work close to the shoulder and also allowing an easier reversal of the carriage. It also allows higher rates of table traverse. The headstock is arranged to swivel through the entire circle and is graduated to read in degrees. The spindle is of hardened and ground steel and runs in bronze boxes that are adjustable for wear. The tailstock is provided with both lever and screw action, and is also equipped with a device that allows spring tension or rigid action to be used as desired. It is also provided with a holder adapted to receive carbon points so that the wheel can be trued without removing the work. The lubricant pump is of the submerged centrifugal type, with all bearings above the liquid. The flow is regulated by a valve located above the wheel. An internal grinding fixture is supplied that is of the high-speed ball-bearing type with a maximum spindle speed of 25,000 r.p.m. The standard equipment consists of one four-jawed chuck, faceplate, two universal back rests, one center rest, two adjustable dogs, set of telescopic water guards and wrenches. The back rest supplied can be used either universal or plain.

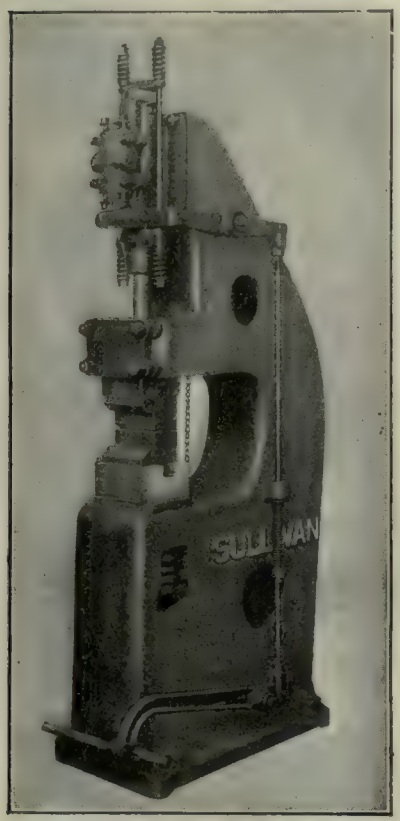


FRASER UNIVERSAL GRINDING MACHINES

Made in four sizes, No. 2-C 10 x 30 in., No. 2-AC 12 x 30 in., No. 3-C 10 x 42 in. and No. 3-AC 12 x 42 in.; automatic crossfeeds, 0.00025 to 0.005 in.; size of wheel, 10 in. in diameter with 3-in. hole and thicknesses up to 1½ in.; graduations on swivel table, up to 6 deg. on each side or up to 2½-in. taper per foot in both directions; wheel speeds, three, 1910, 2300 and 2875 r.p.m.; table speeds, eight, 10 to 165 in. per min.; work speeds, eight, 17 to 340 r.p.m.; diameter of front spindle bearing, 1¾ in.; diameter of spindle nose, 1⅞ in.; taper hole in spindle, No. 2 Morse; speed of internal grinding fixture, 25,000 r.p.m.; weights, No. 2-C machine, 3300 lb., No. 3-C machine, 3700 lb.

Sullivan Air or Steam Hammer

A hammer built by the Sullivan Machinery Co., Chicago, Ill., known as its "Utility Hammer" is shown in the illustration. It is especially adapted for forging either pick- or chisel-point cutter bits, chisels, wrenches or small tools of all kinds, straps, levers, keys and wedges, or the thousand-and-one jobs that come along in any fair-sized machine shop. The strokes are controlled by a foot treadle and a single blow or many in succession may be struck, and either light or heavy, as desired. A very powerful "slugging" blow may be obtained at full stroke.



SULLIVAN UTILITY HAMMER

Specifications: Throat from center of die to face of column, 15 in.; will take work up to 2 in. thick; hammer is capable of 600 strokes per min.; net weight, 1,675 lb.; over-all height, 6 ft. 6 in.; depth of base, 29 in.; width of base, 16½ in.; hammer cylinder, diameter, 55 in.; hammer cylinder, stroke 5¾ in.; air pressure required, 80 to 100 lb.; air consumption at 90 lb., 93 cu.ft. per minute; total striking weight, 100 lb.

The use of air to run this hammer is claimed to have a number of advantages over a belt drive, as the air-thrown valve gives a wide range of striking power and great sensitiveness of blow. The air exhaust can also be used to blow chips and scale from the die, which is very important where cut dies are used. The hammer may be had equipped for the use of steam where desired.

Beaman & Smith Continuous Manufacturing Milling Machines

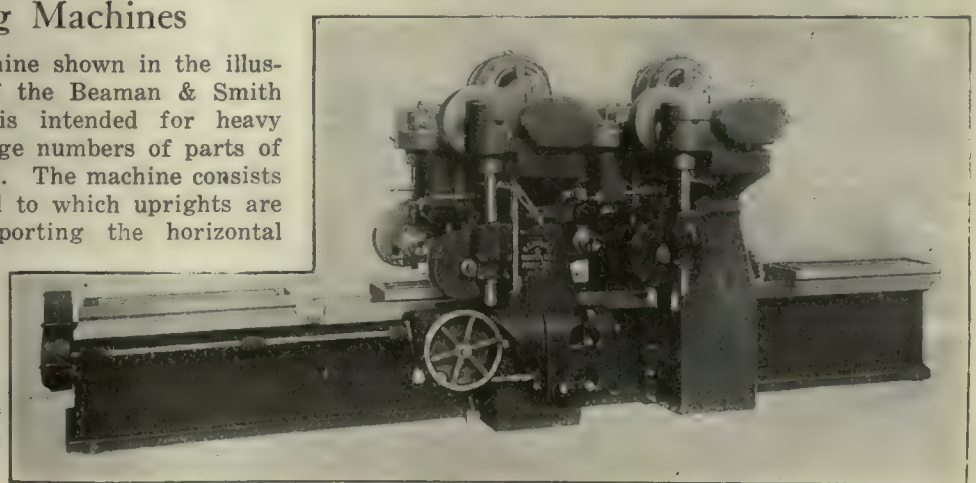
The continuous milling machine shown in the illustration is a recent product of the Beaman & Smith Co., Providence, R. I., and is intended for heavy manufacturing work where large numbers of parts of the same type have to be milled. The machine consists essentially of a substantial bed to which uprights are attached, these uprights supporting the horizontal spindle heads and the cross-rail, which in turn carries the vertical spindle heads. Each pair of uprights with its bank of spindles is one milling unit. As many spindles can be mounted on this unit as necessary and as many units may be attached to the bed as are required to do the work in hand. The feed-driving mechanism is carried on one unit only and the removable tables that carry the work are fed along the bed, taking a fast motion when the cutters are idle and a slow motion when the cutters are working.

These tables, after having passed all cutters, are lifted from the bed and the finished work removed, while another table with the work in place is placed on the front end of the machine and the process repeated. Four tables are generally necessary to maintain continuous milling. The tables travel on flat-ways with slight tapers on the inside edges to accommodate corresponding tapers on the bottoms of the tables, these serving to center the tables without wedging and allowing them to be put on and removed easily. When traveling under the cutters, the tables pass under gibs fastened to the bed, to guard against any upward motion while the cut is in progress.

The feed shaft runs the entire length of the bed and is driven from the front end. It carries a number of worms, so spaced that the traveling tables are picked up by one worm before they have left the preceding one. The spacing of the worms makes it impossible to set a table in the wrong position on the bed, and no matter where set it will pick up and travel instantly. The feed and fast motion are available in either direction. Gearing is used to secure four changes of feed, which vary from approximately 3 to 8 ft. per min. with a fast motion of about 12 ft. per min. when the cutters are idle. Two changes are possible through change gears at the end of the gear box, while two more are secured through a feed-box gear-shifting lever. The feed and fast motion are controlled by a single lever, this construction making it impossible to engage both at the same time. The feed is driven through a vertical shaft connected by bevel and reducing gears to the main drive shaft.

A motor is furnished to drive each separate unit, the motor-driving mechanism being carried on the crossrail supported by the upright, the drive being through gears. Change gears are incorporated in order to allow the various spindles to be driven at high speeds.

The spindle heads are cast in one piece and are moved along the ways by hand-operated screws, wear being taken up by taper gibs. Clamps are incorporated to secure the heads firmly in place when the desired positions have been secured. Three standard sizes of spindles are made, the diameters of the front bearings



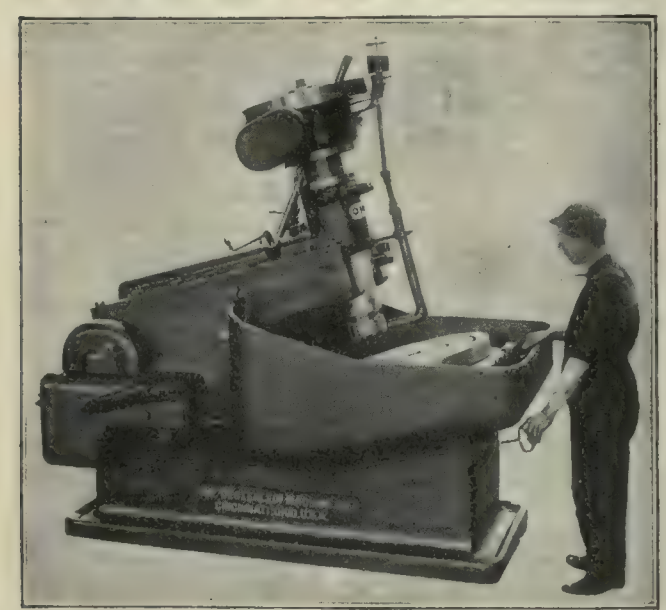
BEAMAN & SMITH CONTINUOUS MILLING MACHINE

being 3⅝, 4⅝ and 5⅝ in. respectively. They are provided with hand in-and-out adjustment by means of a rack-and-pinion mechanism, the pinion being for adjustment only, the quill being held in final position by clamps. The control of the machine is centralized at the unit that carries the feed gears.

"Ohio" Tilted Rotary Milling Machine

The Oesterlein Machine Co., Cincinnati, Ohio, has just developed and placed on the market a new type of milling machine that is known as the "Ohio" tilted rotary. The machine may be used either as a station machine or for continuous milling. The chief features claimed are the great rigidity, the elimination of considerable idle time between cuts and the construction that enables a generous supply of lubricant to be supplied to the cutter.

The body of the machine is cast in one piece and the spindle head is suported by a ram that slides in ways, the construction being somewhat similar to that of a shaping machine except that the ways are inclined 15 deg., the table also being inclined so that the motion of the spindle head is at right angles to the table axis.



"OHIO" TILTED ROTARY MILLING MACHINE

Inclination of table, 15 deg.; diameter of table, 30 in.; worm for table drive, 4 in. in diameter, 1¼ pitch; taper in spindle, No. 16 B. & S.; capacity of lubricant pump, 35 gal. per min.; capacity of reservoir in base, 60 gal.; indexing mechanism for table, 2 to 72 divisions; width of belt, 4 in.; spindle speeds, 30 with 15 pairs of change gears; diameter of lower spindle bearing, 4½ in.; weight of flywheel on spindle, 250 lb.; area of table bearing, 475 sq.in.; area of ram bearing, 1000 sq.in.

The spindle is driven from the pulley through miter gears, an intermediate shaft, change gears, and a set of bevel gears; the intermediate shaft being splined to allow for the reciprocation of the ram. The intermediate shaft is made in two sections so that by uncoupling and turning the first change-gear shaft the direction of rotation of the spindle can be reversed. The spindle is carried in a sleeve, the upper end of which is attached to the speed-box casting. The lower bearing is of phosphor bronze while the upper is of the radial-thrust ball type. The spindle sleeve may be moved in the spindle head, the barrel being split for clamping the sleeve after adjustment. In order to prevent vibration of the spindle a flywheel weighing 250 lb. is mounted on the upper end.

The ram is fed radially over the surface of the table by a cam giving a slow motion during the cutting stroke and a rapid reverse. The travel of the ram is adjusted by a slide operated by a lever at one side, and a double-row ball bearing serves as a cam roller. The camshaft is driven by a worm and wormwheel in the feed box, a four-gear feed-change mechanism regulating the feed of the table when continuous table motion is desired or the rate of motion of the cam when the indexing mechanism is in use. The entire indexing mechanism and cam can be omitted where continuous milling only is to be handled. The feed change gears regulate the rate of travel of the ram while the throw of the cam regulates the length of travel. The indexing mechanism gives from 2 to 72 divisions and is timed by cams on the camshaft wormwheel.

The table is set at an angle of 15 deg. and is driven by a worm and wormwheel, two circular and four radial T-slots being provided for clamping the work.

The lubricant pump is attached to the side of the machine and is belt driven, the lubricant being raised under pressure to a distance above the machine and expanded in a large pipe before it flows to the cutter. The chips carried away by the lubricant are deposited in a pocket from which they may be removed from the front of the machine.

The oiling is centralized at a number of prominent points in order to lessen the danger of some bearings being overlooked. All bearings are of the ball type or of bronze and the table surface and ram slides are of chilled steel.

How Would You Prevent Oil From Discoloring Finished Surfaces?

By G. R. Smith

On page 802 of *American Machinist* the question is asked, "How do you prevent oil from discoloring finished surfaces?"

At one time I had charge of 50 machines, all having a considerable area of polished surface, which soon became brown and unsightly from the dried oil. After trying many solutions to remove this I at last found that alcohol would do the trick almost instantly.

Wet a small piece of waste in alcohol and clean off the discoloration, wiping dry with clean waste, and then each week at closing time wipe these polished surfaces and keep them clean.

Bringing Out Over-Exposed Blueprints

By S. F. Gibson

When blueprints have been permitted to remain in the printing frame for such a long time that they are over-exposed, they may be restored almost to their normal color by adding about one teaspoonful of hydrogen-peroxide solution to each quart of the water in which they are washed. The procedure is to first wash the prints in clear running water until all the blue liquid which results, has been washed away. Then the prints are soaked in the peroxide solution until the proper color appears. After this, the prints are again washed thoroughly in clear water. A print which has had the correct exposure or one which has been under exposed, will not be adversely affected by the process.

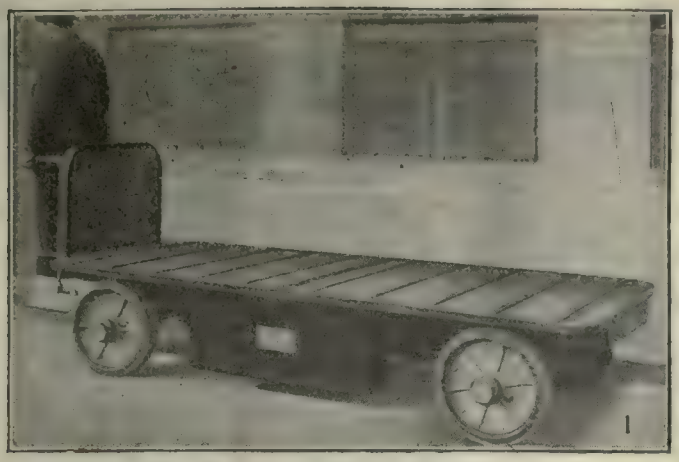


FIG. 1. LONG WHEELBASE TRUCK



FIG. 2. SHORT WHEELBASE TRUCK

Industrial Truck with New Features

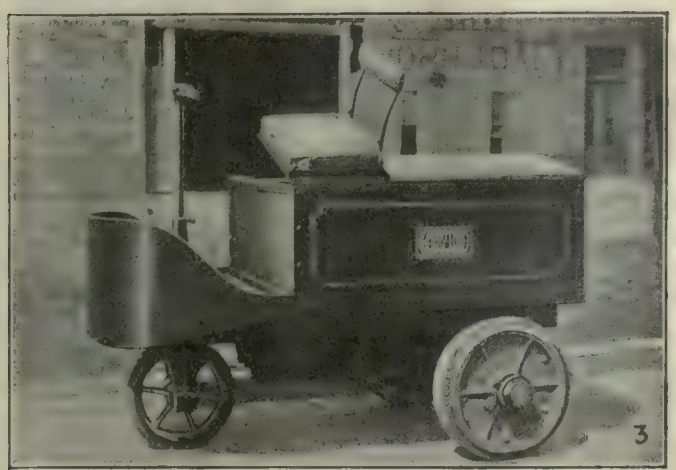
At the New York Motor Truck Show the Karry-Lode Industrial Truck Co. of Long Island City showed an industrial truck which attracted attention because of its similarity, on a smaller scale, to the ordinary motor truck.

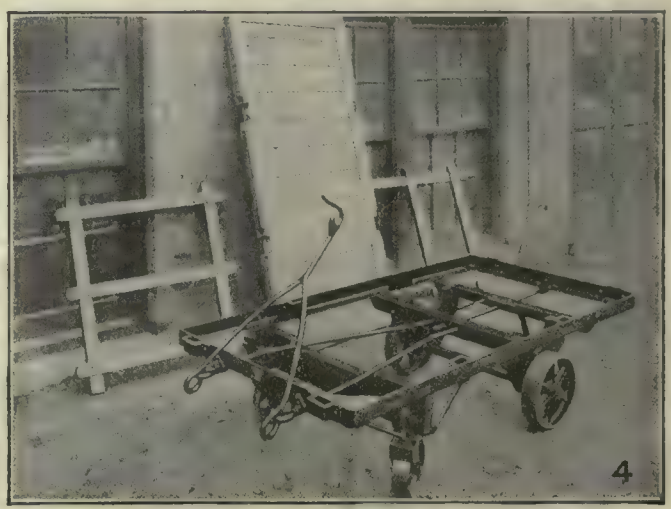
Several models are offered, that in Fig. 1 having a wheelbase of 80 in. and a loading platform 116 x 45 in. The capacity is 4000 lb. and the motive power is a 3½-hp. electric motor wound for 30 volts and 40 amp. Three forward and three reverse speeds are provided; the rated speed on the level is from 1 to 7 m.p.h. and the rated mileage on the level is 25 miles.

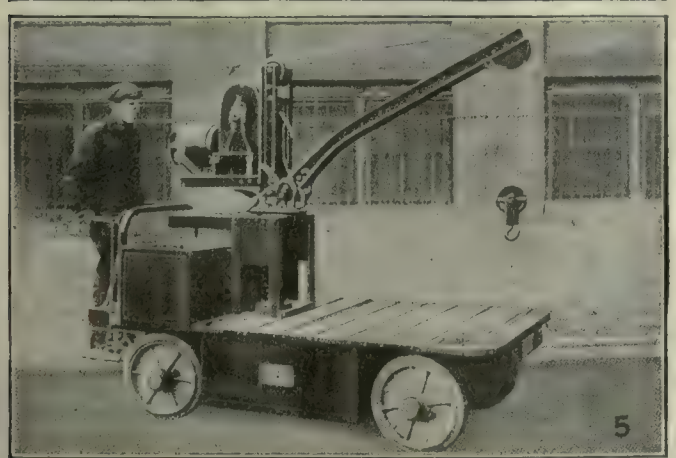
The model shown in Fig. 2 differs from that of Fig. 1 only in having a smaller battery and a shorter wheelbase, 60 in. instead of 80. Its performance is the same and its loading platform is 96 x 45 in.

Fig. 3 shows the three-wheel tractor model, which is rated at about the same figures as the trucks and has a drawbar pull of 500 lb. Two steel trailers designed for use with the tractor are shown in Figs. 4 and 6.

The short-wheelbase truck is shown in Fig. 5 fitted with a compensating crane which makes it a valuable vehicle for handling heavy pieces. It is claimed that this outfit will enter a standard freight car without difficulty. The swing of the crane is 180 deg. and it will lift 1500 lb. at a speed of 12 ft. per minute.









FIGS. 3 TO 6. TRACTOR, CRANE AND TRAILER MODELS

Fig. 3—Three-wheel tractor. Fig. 4—Trailer stripped showing frame. Fig. 5—Truck equipped with crane. Fig. 6—Trailer with floor and gates.



Sparks from the

American Steel and Its Part in Reconstruction

Distribution of Steel Rails at Present Extends to Twenty-three Countries To Be Used in Extending Lines of Communication

Another chapter in the story of American steel and the part it will play in reconstruction and in the extension of lines of communication throughout the world is written in the export statistics of rails, railroad spikes, and other iron and steel railway track materials, such as switches, frogs, fishplates, splice bars, etc., shipped to foreign countries since the armistice was declared. The quantity and value of these products exported during the four months ended with March, the average monthly price thereof in December of each year, and the shipments during the calendar years 1911 to 1918 are given below:

Calendar year	Steel rails			Railroad spikes*		Other railway track material (value.)*
	Tons	Value	Price per ton in December	Pounds	Value	
1911	420,874	$12,229,045	$29.11	.....	.....	.....
1912	446,473	13,053,774	29.62	.....	.....	.....
1913	460,553	13,979,549	31.23	25,375,827	$483,283	$3,088,866
1914	174,680	5,103,918	27.05	15,489,687	258,808	1,775,391
1915	391,379	12,095,170	32.65	29,693,252	591,752	4,857,047
1916	540,828	20,417,582	38.43	53,428,813	1,489,091	6,540,187
1917	512,669	24,023,090	52.65	47,467,317	2,009,808	8,194,270
1918	453,944	26,440,780	60.80	22,330,104	1,229,083	5,546,969
December, 1918	44,982	2,735,544	60.80	1,708,554	116,787	541,522
January, 1919	65,024	4,221,563	64.90	3,509,054	189,408	543,330
February, 1919	66,900	4,611,982	68.94	4,206,228	258,073	905,264
March, 1919	48,955	3,051,611	62.30	4,185,816	193,987	515,535

*Not separately stated prior to July 30, 1912.

While a greater quantity of these products was shipped to France than to any other country during the war, it is noted that with this single exception Cuba has recently become the leading market for steel rails exported from the United States. From comparatively modest purchases prior to the war, Cuban imports of this commodity during the last three years reached a total tonnage of 187,798, valued at $8,146,383, as compared with 159,335 tons, invoiced at $9,812,418, shipped to Japan; 155,932 tons, worth $6,565,708, to Canada; and less amounts to other countries during the same period.

An analysis of the advance figures for March shows a distribution of American steel rails extending to 23 countries, about 18,000 tons, or over one-third the total exportation, going to France. Cuba, Japan, and Canada were also large purchasers during recent months.

Foreign Demand for Steel

Early in the history of the steel industry there arose the foreign demand for American steel rails, developing from an average annual exportation of less than 300 tons in the period 1867-1870 to an average of 474,705 tons during the four calendar years of the war period 1915-1918, although the exports did not reach six figures until near the end of the century. From 1900 the volume increased, with slight fluctuations from year to year, until the record-breaking shipments of 540,828 tons, valued at $20,417,582, occurred in 1916. The total shipments of steel rails for the four-year war period were 1,898,820 tons, invoiced at $82,976,622, as compared with 1,502,580 tons, worth $44,366,286, exported during the pre-war period of four years, 1911-1914, representing an increase of 26 per cent. in tonnage and 86 per cent. in value of the total shipments during the war period over the exports for the previous four years.

Like other great staple commodities, the value of steel has soared to unprecedented heights during the war and since the armistice; the average monthly export price of steel rails during the war culminated in the record figure of $62.20 per ton in November, 1918, $68.94 per ton being reached in February, while the advance figures for March would indicate a price of $62.30 per ton of foreign shipments.

In addition to $82,976,622 worth of steel rails shipped during the four-year war period, railroad spikes valued at $5,319,734 and other track material valued at $25,138,473 were exported; or a total of $113,434,829 for all iron and steel railway track materials.

* * *

Government To Hold Rochester War Plants in Reserve

The War Department is planning to hold in reserve the cannon plant of the Symington-Anderson Co., the Symington Forge Corporation plant on University Ave., and the Symington Machine Co.'s plant on Leighton Ave., Rochester, N. Y. It is understood these plants will be maintained as branches of the Watervliet Arsenal.

New Officers of Wolverine Tube Company

The Wolverine Tube Co., 33rd St. and McGraw Ave., Detroit, manufacturing brass and copper seamless tubes, has been purchased by a group of prominent men of the industry. H. A. Higgins, former president of the company, who represented all of the stockholders in the transaction, said that business had reached such proportions that the officers, who have other business interests, could not handle the company's affairs unless a complete reorganization was effected.

Newcomers include Charles C. Limbocker, president, who has represented A. H. Wells & Co. of Waterbury, Conn., in western territory for the last 10 years; Harry J. Hooks, secretary and treasurer, for the last 14 years representative of the United Wire and Supply Co., Providence, R. I.; George R. Anthony, vice president, who was general manager of the Detroit plant of the American Radiator Co., and William H. Sherman, factory manager. Mr. Sherman was connected with the United Wire and Supply Co., at Providence for 24 years as general superintendent. He is one of the pioneers of the tube industry. The new officers will make extensions and additions as needed.

* * *

French-American Bank Leases Floor

The French-American Banking Corporation has leased the ground floor at 65 William St., corner of Cedar St., New York, and will open for business there about June 1. The lease extends for a period of years.

The corporation is an alliance of the National Bank of Commerce in New York, the First National Bank of Boston and the Comptoir National d'Escompte de Paris, formed to foster trade between France and the United States. It was incorporated at Albany, N. Y., Apr. 29. It is capitalized at $2,000,000, with a surplus of $500,000.

The officers of the corporation are Maurice Silvester, president; Roger P. Kavanagh, vice president and treasurer; John E. Rovonsky, vice president; F. Abbot Goodhue, vice president and Thomas E. Green, secretary.

* * *

Boys from Service Entertained

The employees of the Southwark Foundry and Machine Co., Philadelphia, gave a reception and dance to the members of the company who were in the world war and are now returned. The affair was held in Mercantile Hall on May 6 and was attended both by employers and employees.

World's Industrial Forge

By E.C.Porter, News Editor

Plans Discussed for the Disposal of Waste Material

A committee, representing the National Association of Waste Material Dealers, held a meeting in the office of C. W. Hare, the Director of Sales, War Department, Washington, D. C., to discuss the Government surplus of waste material and the best means of disposing of it to the advantage of the Government and with least disruption to markets.

The Government has in surplus about 605,000 tons of steel and steel scrap, which it was agreed could be best sold by sealed bids.

The non-ferrous metals now held as surplus by the Army were discussed in detail. It was suggested that it would be preferable to sell the aluminum back to the manufacturers to dispose of for the Government at little or no cost, thereby tending to stabilize conditions as much as possible. On the other hand, the committee pointed out that they should have an opportunity to bid on any aluminum and aluminum scrap, for the reason that in many instances they ought to be able to offer very good prices on non-ferrous metals.

There are about 31,907 tons of brass in the form of ingots, rods, sheets, etc., to be disposed of as well as 33,000 tons of field artillery cases, 1000 tons of cartridge cases and 2939 tons of brass scrap in the shape of turnings, etc. Some of this surplus is high-grade brass and some of it is leaded. The committee was advised that the Director of Sales' office is in touch with the brass manufacturers and negotiating with them with a view to their taking over the Government's surplus. The committee called attention to the fact that they should have an opportunity to bid on this surplus because they have extensive markets.

There are about 465 tons of cupro nickel to dispose of in the form of sheets and cupro nickel in the form of turnings. The committee pointed out that it will be difficult to find a market for this metal, as cessation of war has greatly lessened the demand for it. Cupro nickel is used largely in the manufacture of ammunition. The committee recommended that the cupro nickel surplus should be offered to the mills and dealers.

The War Department officials advised the committee representing the National Association of Waste Material Dealers that arrangements had been made whereby all copper and copper scrap is being disposed of by the copper producers, operating through the United Metals Selling Co. The committee was advised that the only copper scrap being sold by the Government would be in small lots of less than 10,000 lb., in certain instances where the Government might be dismantling a certain plant.

With regard to lead and spelter, the committee was of the opinion that it might be advisable for the lead producers to take over the surplus and dispose of it along the lines followed in the case of copper.

* * *

Begins Work on National Association Building

During the past week, work was started upon a building which it is planned to make the national home for all trade associations now located, or which will locate in the future, in New York City. Among the advantages which are expected from this plan are: Closer coöperation between allied industries; greater convenience for business men desiring to see several associations; special advantages for coöperative meeting rooms, and added prestige due to having a high-grade building devoted to the interests of business men in the heart of the hotel, railroad and subway terminal districts of New York.

The building will be near the corner of Fifth Ave. and 43rd St., extending through the block to 44th St. It will be 20 stories high, having about 275,000 sq.ft. of floor space, and will be terraced above the 12th floor to conform to the New York zoning law for conservation of light. An arcade with display rooms will extend through from 43rd St. to 44th St. It is the first large business building enterprise started in New York since the armistice was signed. The contract was let to Fred T. Ley & Co.

The name of the structure will be the National Association Building. It will be ready for occupancy the latter part of next January. Further information may be obtained by addressing Willard C. Brinton, 17 W. 44th St., New York.

* * *

Vacations for All Clark Employees

All employees including those paid by the month, day or hour who have been employed one year will be allowed one week's vacation with full pay, according to a plan announced in February at the annual meeting by Eugene B. Clark, president of the Clark Equipment Co., Buchanan, Mich., manufacturers of internal gear drive axles and disk steel wheels for motor trucks.

The new plan goes into effect this month and includes mechanics, toolmakers, foundrymen and all men irrespective of the basis of employment. Heretofore this privilege has been granted only to officials and to the office and clerical forces of the company.

American Automobiles in Venezuela

Prices Fifty to One Hundred Per Cent. Higher Than in United States. Use of Tractors and Motor Trucks Increasing

There are about 300 automobiles in the Puerto Cabello district of Venezuela, chiefly five-passenger cars of American manufacture, which retail at prices from 50 to 100 per cent. higher than in the United States. Consul F. A. Henry writes that while the use of motor trucks will probably increase in the future there are certain factors which tend to restrict the growth of this trade. Among these are the scarcity of skilled automobile mechanics, the enormous prices asked for gasoline, even though it is produced in the country, the poor quality of the roads, and the cheap cost and care of pack animals.

Consul George E. Chamberlin reports that about 50 tractors are in use in British Guiana, chiefly in the rice and sugar industries, and that there is no doubt the number will be greatly increased within a year or two. Owing to the soft character of the soil during the wet seasons the caterpillar type is very popular.

In Paraguay almost all residences are built of cheap brick which is manufactured locally, and then the façades are finished with a thick layer made of a mixture of lime and cement. For this purpose about 5000 bbl. of cement are imported annually.

On account of climatic conditions, due probably to the ocean trade winds, iron wire for screening of a quality such as is guaranteed in the United States for four years lasts but one year in Colombia. Copper-wire screening has been found very satisfactory, and a market may develop for this commodity there in time. The chief hindrance is the high duty of 20c. per gross kilo on copper goods.

The imports of wire nails into Argentina during 1917 amounted to 822,459 kilos; brass nails, 51,915 kilos; and cut nails, 1,136,819 kilos. Such articles have been furnished almost exclusively by the United States during the war period.

* * *

Germany's Disabled

In Germany an order has been issued requiring all public and private works, offices, and authorities to employ at least one severely disabled man for every 100 officials, employees, or workmen without distinction of sex. In agriculture 50 is substituted for 100. This order not only applies to the war disabled but to men disabled by accident.

Business Items

The Federal Tool Steel and Alloy Co. has moved its offices from Platt St. to the Woolworth Building, New York.

Edward J. Smith, 30 Church St., New York, announces that a new office has been established in the Mills Building, El Paso, Tex.

The Reliance Electric and Engineering Co. announces its removal from West St. to the Hudson Terminal Building, New York.

The E. B. Hayes Machinery Corp., Oshkosh, Wis., is planning to double the size of its plant and make a considerable increase in equipment.

The Chicago Pneumatic Tool Co. has moved its Milwaukee office from Room 1305, Majestic Bldg., to Room 1418 in the same building, where more convenient quarters have been obtained.

The Gale-Sawyer Co. has moved its manufacturing business from Boston to its new factory, South Weymouth. The general office and salesroom is located at 36 Oliver St., Boston, Mass.

The Booth-Hall Co., designers and builders of electric furnaces, has announced the removal of its executive and sales offices to Rooms 1007-1008 Hearst Building, 328 West Madison St., Chicago, Ill.

George G. Porter, one of the founders of the Porter-Cable Machine Co., Syracuse, N. Y., has opened an office in the New Keith Building, of the same city, as consulting mechanical engineer and factory organizer.

Briggs & Turivas, Inc., Westminster Building, Chicago, Ill., has opened a New York office at 1805 Equitable Trust Building. This office will be under the direction of Carl R. Briggs, president of the company.

The Liberty Systems Corporation of Edwardsville, Ill., has taken 13,000 ft. of floor space in the Overland Building, 2310 Locust St., St. Louis, Mo. It has been reorganized and has increased its capital to $1,500,000, and at present is employing 30 toolmakers and special mechanics.

Jeutter & Co. has established a factory at Charles City, Ia., for the purpose of manufacturing optical goods such as lenses for cameras and moving-picture machines. This is the only factory of its kind located west of the Mississippi River. P. A. Jeutter, M. Mickelson and A. Worth are members of the firm and are from South Bend, Ind.

The Van Dorn & Dutton Co., Cleveland, Ohio, manufacturer of gears, has opened branch offices at New York and Chicago. Harry F. Keegan, formerly with the Chicago surface lines, will manage the Chicago branch, with offices at 1241 First National Bank Building. His brother, John Keegan will manage the New York one, with offices at Room 317, 30 Church St.

Trade Currents

Cleveland Letter

While the week shows no marked improvement in machinery and machine-tool demand over that at the beginning of the month, there has been none of the slump prevalent in spots during the fore part of the year, and the situation locally seems to have settled down to a more stable basis. It is admitted in leading manufacturing and distributing establishments that while the actual demand is not as large as it was six months ago, yet inquiries are normal for this time of the year.

The most significant development of the last week or so is the increase here in inquiries and orders for higher grade equipment than was the case during the greater part of 1918. Manufacturing interests, according to one leading distributor, are now disposed to weed out the equipment of cheaper or inferior grade that they hastily stocked up with to meet the war-time need for speed, and now are installing better and more expensive equipment, making for more permanent character to their establishments. The main increase in the last week or so is in small equipment rather than large machines. Leading items still are milling machines, radial drilling machines, automatic screw machines and vertical boring mills.

About the largest order placed in this district this week was by the Ajax Manufacturing Co., for the production of forging equipment. Items called for have been a No. 3 horizontal boring mill, a 20-in. vertical slotting machine, a 42-in. lathe and several shaping machines.

Most of the small machines and tools are being absorbed by local and nearby automobile manufacturing interests and automobile-parts producers.

Chicago Letter

Continued good business is the cheerful story heard in most machinery dealers' offices. The surprisingly lively pace struck six weeks ago is keeping up. The announced decision of some of the great corporations to postpone the purchase of large lists until what appears to them to be a more favorable time has not had the depressing effect that might be expected, for the reason that purchases by small plants are making up the difference.

The factor most inclined to cast gloom over the situation is the recurring and spreading labor troubles, several large Chicago plants being affected as well as plants in Wisconsin and neighboring Illinois cities. It is understood that one Chicago corporaiton is transferring a large quantity of machine tools to a plant in another city to get away from strike troubles.

Inquiry and demand for medium and heavy machinery are excellent. Large lathes, boring mills, planing machines, etc., are sold with surprising frequency.

Factories using large quantities of machinery report the booking of many contracts, which is a good indication for the future.

Personals

CLARENCE T. WROE, assistant manager of the Alfred Herbert Co., New York, sailed for England, Apr. 28. Mr. Wroe will be gone several weeks.

W. F. ROCKWELL, vice president of Torbensen Axle Co., resigned May 1, to become general manager of the E. B. Hayes Machinery Corporation, Oshkosh, Wis.

E. K. THOMAS, formerly of the M. M. Granton Chemical Co., New Brunswick, N. J., has taken a position as superintendent with the Hunter Saw and Machine Co., Pittsburgh, Penn.

THOS. K. EGAN, for several years plant superintendent of the Reed-Prentice Co., resigned the first of the year to take a position with the D. E. Whiton Machine Co., New London, Conn.

A. C. LINDHOLM has resigned as mechanical engineer with the Colts Patent Fire Arms Manufacturing Co., Hartford, Conn., and is now general manager for the Franklin Machine and Tool Co., Springfield, Mass.

LIEUT.-COL. JOHN J. SWAN, formerly Personnel Branch, Operation Division, General Staff, after the armistice, Classification Division, Adjutant General's Office, resigned Apr. 7, to become associated with the Prest-O-Lite Co., Indianapolis, Ind.

JOHN F. NEVILLE, formerly with W. A. Tottle & Co. of Baltimore, Md., and Jas. McCafferty & Sons of Brooklyn, is now associated with the Hilo Varnish Corporation. Mr. Neville is well known to both the hardware and paint trade in this territory.

H. H. LOTZ, formerly with the Lowe Brothers Co., has become associated with the Hilo Varnish Corporation, Brooklyn, N. Y. Mr. Lotz will make his headquarters at Dayton and will look after both the manufacturing and the jobbing trade in southern Ohio.

MISS CELIA FERN HASKINS, St. Louis, Mo., will be the first woman to graduate from the electrical-engineering department of the University of Missouri. She will receive the degree of bachelor of science in electrical engineering at the June commencement.

FRANK J. TONE has been made president of the Carborundum Co., Niagara Falls, N. Y., succeeding the late Frank W. Haskell. GEORGE R. RAYNER has been made vice president, succeeding R. B. Mellon of Pittsburgh. F. H. MANLEY retains the office of treasurer.

J. A. TAGGART has severed his connection with the Advance Machinery Co., Van Wert, Ohio, after 20 years association and is now associated with A. L. Fader under the firm name of Fader & Taggart, 547 Washington Blvd., Chicago, Ill., doing business as direct factory representatives. The new firm is planning to handle several lines of wood-working equipment.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as deired

Balancing Machine, Dynamic

Crawford Tool and Manufacturing Co., 1617 South Crawford Ave., Chicago, Ill.

"American Machinist," May 1, 1919

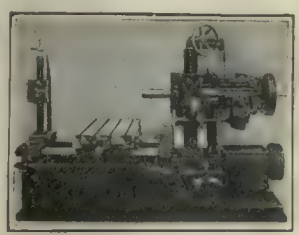


Suitable for use on flywheels, pulleys, gearwheels, turbine rotors, waterwheels, connecting-rods, propellers, fans, separator disks, clutch-assembly parts, induction rotors, pistons and other such bodies as must be put into dynamic balance. Other bodies can be balanced with the use of special fixtures. In handling any of the above bodies they need not be in static balance before being operated upon. Capacity, work from 4 to 36 in. in diameter and weighing up to 600 lb. at 500 r.p.m.; speed of machine, 250 to 900 r.p.m.; tight and loose pulleys, 4 x 3 in., 1150 r.p.m.; floor space, 3 x 6 ft.; height of table, 44 in.; diameter of table, 24 in.; diameter of base, 27 in.; horsepower for belt drive, ¾; horsepower for direct-connected motor drive, ½; weight of bare machine, 1175 lb.

Drilling and Boring Machine, Horizontal

Morris Machine and Tool Co., Cincinnati, Ohio

"American Machinist," May 1, 1919

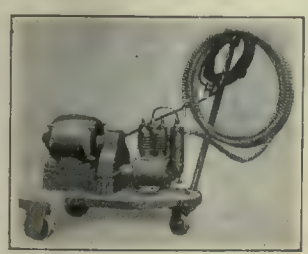


Smallest diameter spindle, 1⅝ in.; diameter of spindle nose, 3½ in.; taper in spindle nose, Morse No. 5; spindle traverse, 17¼ in.; maximum distance between spindle and outer support, 48 in.; size of table, 20 x 36 in.; longitudinal feed of table, 31 in.; crossfeed of table, 28¾ in.; height from table to floor, 31 in.; feeds, six, 0.006, 0.009, 0.012, 0.017, 0.022, and 0.030 in. per spindle revolution; spindle speeds, 18 through speed box, 15 on pulley, 20 to 350 r.p.m.; driving pulley on speed box, 14 x 3¾ in., 400 r.p.m.; size and speed of motor 5 hp., 1200 r.p.m.; net weight, 6500 lb.

Air Outfit, Portable Motor-Driven "Master"

Hartford Machine Screw Co., Hartford, Conn.

"American Machinist," May 1, 1919



The "Master" portable compressed-air outfit on which a number of changes have recently been made. The outfit is said to be very useful in cleaning machine parts and can be readily transported from place to place about the shop and connected to any regular electric-light socket. A new motor is now being fitted. The pump is a two-cylinder machine, a small expansion chamber being used instead of a regular tank. The bore of the pump is 1¾ in., the stroke 2 in. and the motor is of ½ hp. The outfit shown is mounted on a metal truck with three wheels, but a stationary outfit is also manufactured.

Milling Machine, Slot

Beaman & Smith Co., Providence, R. I.

"American Machinist," May 1, 1919

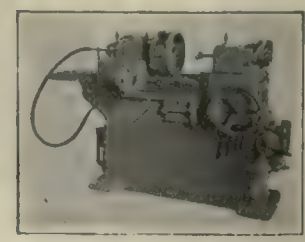


Designed for milling internal grooves in gun carriages, but can be readily adapted for slotting any hole over 7 in. in diameter within practical limits. The bed is of the box type and carries individual motors for the cutter and feed, as well as the milling-bar supports and a revolving table for cutting two slots with one set-up of the work. Fast forward and reverse motion are provided for the milling bar. The cutter is carried on a vertical spindle in a steel bar and is driven through reduction gearing by a variable-speed motor, allowing the spindle speed to be adjusted to meet requirements. Two changes of feed are secured through change gears and a large variety through the variable-speed motor, ranging from ⅛ in. to 4½ in. per minute, the rapid traverse giving from 4 ft. to 12 ft. per minute. The revolving table carries the work and is operated by hand.

Grinding Machine, Bore

Taylor & Fenn Co., Hartford, Conn.

"American Machinist," May 1, 1919



Entirely self-contained and may be driven from a lineshaft, or an intermediate jackshaft may be used if desired. The crossfeed instead of being placed under the wheel head is placed under the work head, the wheel head remaining in a fixed position in regard to the base or body of the machine. Capacity of machine, holes 8 in. long and 8 in. deep, it being possible, however, to grind slightly larger holes in emergency; diameter of inside of chuck guards, 12 in.; swing of machine without chuck guard, 14 in.; work speeds, four, arranged in geometrical progression; table feeds, three, arranged in geometrical progression; speeds of wheel spindle, two for each size of spindle, spindle feed furnished ranging from 6000 to 25,000 r.p.m.; width of main driving shaft belt, 1¾ in.; travel of automatic crossfeed, 3 in.; floor space, 42 in. wide, 95 in. long.

Milling Cutters, Self-Tightening Inserted-Tooth

Gale-Sawyer Co., 36 Oliver St., Boston, Mass.

"American Machinist," May 1, 1919



The features claimed are that the pins and other small parts generally used in fastening the teeth in place are done away with; the method of holding the blades makes it impossible for them to become loose or change position while the cutter is in operation; the harder the cutter is driven the tighter the blades will be held, and that it is impossible for the cutter to become frozen on the arbor or shank due to excessively heavy work. The body is made in two sections. These two sections are slightly separated and the slots for the cutters or teeth are milled for the insertion of the blades, the alternate slots being at angles of 7 and 15 deg. with the center line. After the slots have been milled and the blades put in place, the cutter is screwed onto the spindle or adapter, this operation serving to press the sides together, and to clamp the blades securely.

Chuck, Parallel-Grip Master-Hinge Collet

American Pneumatic Chuck Co., Chicago, Ill., Manufacturers; Neidow & Payson, 9 South Clinton St., Chicago, Ill., Sales Agents.

"American Machinist," May 1, 1919

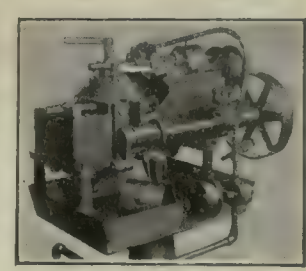


The important departure from the usual type of collet chuck is that with the parallel grip the work is held with the same pressure the full length of the gripping surface, irrespective of any variation up to ¼ in. in size or taper. The device is made with an open rear end for bar work. The pull of the draw rod is directly on the jaws, the hinge pins not being subject to stress. A long slow taper bearing on the front end of the jaws is provided to insure a powerful grip and long wear, but the gripping power may be adjusted so that thin walls will not be crushed. False jaws either blank or shaped to the work, and an adjustable stop, can be furnished as extras. The chuck can also be made with two or four jaws instead of three if desired. It is regularly made in 2-, 3-, 4- and 6-in. sizes with outside diameters of 4⅝, 5¾, 6⅞ and 9 in.

Centering Machine, Differential-Cross

Porter-Cable Machine Co, Syracuse, N. Y.

"American Machinist," May 1, 1919



The work comes to the machine with the center hole through the hub bored and reamed and the ends of the hub faced. The work is clamped to the indexing turret by an arbor and the indexing mechanism is arranged to turn the cross 90 deg. after each operation. The centering tool is a regular combination drill and countersink. The indexing and feed of the tool are automatic and a circulating pump provides lubricant. The capacity of the machine is said to be approximately 90 crosses per hour.

Patented Aug. 20, 1918

Foremen of Heller Brothers Company Go to School to Improve Production

A. G. Heller, of Heller Brothers Co., Newark, N. J., has organized a group of foremen of the various departments to study modern production methods. The object of the course is to train the men in the principles of foremanship, to develop their qualities of leadership and to give them a broad view of their work and of industry as a whole. The course is under the direction of John Calder, mechanical engineer, of the Business Training Corporation, 185 Madison Ave., New York, which has charge of all the details and supplies the textbooks.

The course lasts three months, and the men devote about three hours of spare time to the training. It consists of textbook study, quiz questions, practical problems, lectures and conferences. The general subjects covered by the training include handling men; materials from purchase to final product; plant plan and layout; the principles of organization; the elements of cost finding and cost accounting; record keeping; industrial relations; hiring and firing; welfare work; safety; plant teamwork, etc. Everything is taken up in a practical way and the men are encouraged to apply the ideas they acquire.

Obituary

FREDERICK HOLZ, one of the best-known machine-tool men in Cincinnati, died May 12. A sketch of his life, together with a picture of him, will appear in our next issue.

Trade Catalogs

Bulletin 258. W. A. Zelnicker Supply Co., St. Louis, Mo. Circular; pp. 6; 3½ x 8½ in.; giving various weights and sections of rails, bars, frogs and switches.

Internal Chucking Grinder No. 1. Security Tool Works, Chicago, Ill. A four-page circular illustrating the simplicity of countershaft and belt drives of the internal chucking grinder; also giving its dimensions. Complete specifications are given on grinder spindles.

Enthusiasm and Other Things. Metropolitan Sewing Machine Corporation, Nyack, N. Y. Booklet; pp. 32; 5 x 8 in.; bound in heavy cardboard. It is an interview between a salesman for the Weiss automatic design cutting and sewing machines and a knit goods manufacturer.

New Publications

Our Public Debt. By Harvey E. Fisk. One hundred and twenty-six 5 x 7-in. pages; cardboard binding. Published by the Bankers Trust Co., New York City.

This book has been prepared from a fresh study of original data and it is claimed to be the only publication giving a complete historical and descriptive account of the public debt of the United States. It is divided into three parts; the third part containing tables of Liberty Bond values which will be generally appreciated by all dealers and large investors in Liberty Bonds. Copies of this book may be had by anyone interested upon application.

How Business with Foreign Countries is Financed. Booklet; fifty 8-in. pages, 6½ x 9½ in. Published by the Guaranty Trust Co., of New York. It is for exporters and importers and others having business or financial relations with foreign countries.

The booklet contains 28 reproductions of specimen forms of drafts, letters of credit, bills of lading, invoices, and other documents generally used in connection with the financing of exports and imports. Explanatory notes accompany each illustration and features in the documents of particular importance are noted. The use of the documents is also explained when that seems necessary. Special attention is given to those which bear directly upon the development of dollar exchange. The booklet is printed in attractive type upon coated paper and is carefully indexed. At the end there is a table of currencies of various countries and their value in United States dollars. This booklet is not for sale, but will be sent on request to manufacturers, shippers and others interested in foreign trade.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Commercial Attaché Chester Lloyd Jones has arrived in Madrid, Spain, and opened his office in the American Embassy. He would be glad to receive from American manufacturers and exporters copies of their catalogs, with price lists and other pertinent information. Publishers of trade journals who will furnish the attaché office with their publications are assured that they will be utilized freely. Catalogs and trade publications should be addressed to the Commercial Attaché, American Embassy, Madrid, Spain.

It has been arranged to have published in two commercial papers, namely, the Bulletin Commercial et Industriel Suisse, of Geneva, and the Revue Economique, of Lausanne, trade opportunities compiled from the commercial correspondence received from America, giving the name of American firms, the goods which they are offering, and the connections desired. Special care will be taken to keep the lists published well up to date. Relative to the publishing of offers in the Revue Economique by American firms who wish to establish relations in the Geneva consular district, Vice Consul John T. McCutcheon states that the results from this method of advertising obtained up to the present time have been very satisfactory. The secretary of the local chamber of commerce reports that they have received a flood of inquiries from Swiss business people desiring to get in touch with American firms as a result of the first issue of the "trade opportunities." In each case the address of the company has been given, so that direct communication may be made. The chamber of commerce has been able to increase its subscription list for the magazine, as people subscribe in order to see these commercial opportunities.

A company in Belgium desires to purchase 300 tons of steel strips for the manufacture of lap-welded boiler tubes. Correspondence may be in English. Reference. No. 29,340.

Firms in Belgium are desirous of securing agencies and consignments of the following American goods: Drills, shapers, hacksaws, lathes, machine tools of all kinds, concrete-mixing machinery, etc. No. 29,334.

Catalogs are desired by a trading corporation in China, with a view to securing agencies for the sale of hardware, heavy metals, machinery, chemicals, stationery, piece goods, fancy goods, paper, upholstery, etc. References. No. 29,328.

Forthcoming Meetings

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

The American Supply and Machinery Manufacturers' Association and the National Supply and Machinery Dealers' Association will hold a joint convention at Pittsburgh, Penn.; headquarters, William Penn Hotel.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

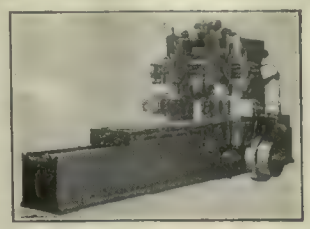
Condensed-Clipping Index of Equipment

Cup, paste on 3 x 5-in. cards and file as desired

Planing Machine, 30-In. Special Forge

Cincinnati Planer Co., Cincinnati, Ohio

"American Machinist," May 1, 1919

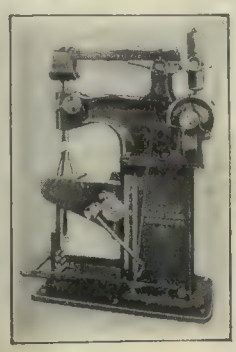


A 30-in. machine said to have been designed throughout for extra-heavy duty, special care having been taken in the design of the side heads. The bed is of box section and strengthened where the gearing and uprights are mounted. The table is also of the box type, the bottom being entirely closed so that no chips can go through the table. The housings are of box type and are keyed, bolted, and pinned to the bed, and tied together at the top by a heavy arch. The side heads can be run down completely out of the way of the rail, which has a box brace on the back to give additional stiffness. Vertical and horizontal power feeds are supplied to each head from the same friction that operates the rail heads. All gearing and racks are of steel, the driving gears being of chrome-nickel steel, and the high-speed bearings of bronze. The machine has been arranged for motor drive from the top of the housing, but any type of drive may be obtained.

Hammer, Riveting

High Speed Hammer Co., Inc., Rochester, N. Y.

"American Machinist," May 1, 1919

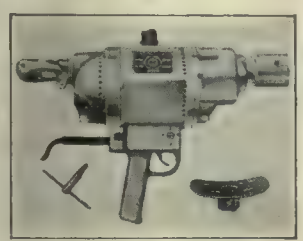


Will produce full round heads cold from $\frac{5}{8}$ to $\frac{3}{4}$ in. and oval heads of from $\frac{7}{8}$ to $1\frac{1}{2}$ in. The machine is said to be sufficiently heavy to stand up under the constant vibration required, the bronze vibrator, which is the connecting link between the hickory helve and rubber cushions, constituting the member through which all shock is transmitted to the helve where it is absorbed. This vibrator is of solid bronze and weighs 40 lb. The eccentric and rear main shaft are made from one solid piece of special steel ground to size and mounted on ball-thrust bearings. Capacity, round heads, $\frac{5}{8}$ to $\frac{3}{4}$ in. in diameter, oval heads, $\frac{7}{8}$ to $1\frac{1}{2}$ in.; height, 6 ft.; length of hickory helve, 2 ft. 8 in.; horizontal gap, 16 in.; vertical gap, 16 in.; dimensions of base, 2 ft. x 3 ft. 8 in.

Drill, ¼-In. Electric

Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md.

"American Machinist," May 8, 1919

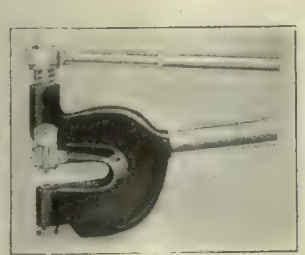


Horsepower of motor, $\frac{1}{4}$; capacity, holes up to $\frac{1}{4}$ in. in diameter; current consumption, 700 watts; no-load speed, 600 r.p.m.; weight, $21\frac{1}{2}$ lb.; current used, either direct or alternating of 25, 40 or 60 cycles. The machine will operate from any two wires of a three-phase circuit. The motor is air cooled by a fan mounted on the armature shaft which draws in air at one end of the motor and expels it at the other. The drill spindle runs in a bronze bushing, thrust being taken by a ball-thrust bearing. The commutator end cover is entirely separate from the armature-shaft bearing and can be easily removed for inspection or adjustment of the brushes, this also eliminating the possibility of the armature shaft binding in its bearings in case the end cover is accidentally distorted by dropping the drill.

Punch, Hand "Jiffy"

Paul W. Koch & Co., 19 South Wells St., Chicago, Ill.

"American Machinist," May 8, 1919



For use on sheet metal and will punch holes $\frac{5}{32}$, $\frac{7}{32}$, $\frac{7}{32}$ or $\frac{1}{4}$ in. in diameter in metal up to 10 gage thick. The weight is 5 lb. and the over-all length is $9\frac{1}{2}$ in. The throat is deep, allowing holes to be punched at a considerable distance from the edge of the sheet of metal, and a one-piece automatic disappearing stripper is used, giving a clear view of the punch mark, as well as permitting a number of sheets to be punched at one operation. The punches are of the crowned floating type, a feature that is said to greatly reduce punch breakage. The punch is driven through the metal by one-half a turn of the lever handle.

Scale and Reference Table, Steel, No. 97½

Lufkin Rule Co., Saginaw, Mich.

"American Machinist," May 1, 1919

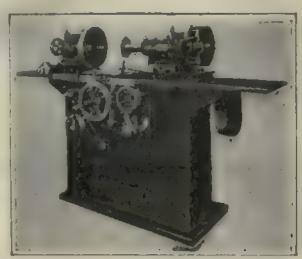


The device carries on one side tables of tap and drill sizes, U. S. Standard, including fractional as well as numbered sizes; also S. A. E. and Briggs pipe standard, and a 6-in. scale graduated in 32nds of an inch. The other side carries a 6-in. scale graduated in 64ths of an inch, with the improved feature of readable graduations, and a table of common fractions and their decimal equivalents. The device is in the form of a semi-flexible 6-in. steel rule, $1\frac{1}{2}$ in. wide, and has legible figures throughout. It is convenient to be carried in the pocket and also has a hole at one end so that it may be hung up.

Grinding Machine, Chucking

Security Tool Works, Chicago, Ill., manufacturers; Security Mechanical and Engineering Sales Co., 115 South Clinton St., Chicago, Ill., sales agents.

"American Machinist," May 8, 1919

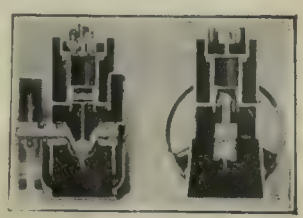


Capacity, 14-in. swing with lengths up to 12 in.; spindle speeds, four, 3500, 4500, 7000 and 12,000 r.p.m.; speed of small spindle, 25,000 r.p.m.; swing of swivel base, 45 deg. each side of center; speeds of work spindle, six; 40 to 500 r.p.m.; length of table, $55\frac{1}{2}$ in.; width of table, $14\frac{3}{4}$ in.; floor space, length, 80 in., width, 32 in.; height, 52 in.; weight, 3500 lb.; countershaft pulley speed, 500 r.p.m., diameter, 12 in., belt face, 3 in.

Air Compressors

Ingersoll-Rand Co., 11 Broadway, New York City.

"American Machinist," May 8, 1919



Sizes, $2\frac{1}{2}$ x 3 in., $3\frac{1}{2}$ x 4 in., $4\frac{1}{2}$ x 5 in. and 6 x 6 in. Capacities, 3 to 45 cu.ft. of air per min. The small-size compressor can be used for pressure requirements up to 200 lb. per sq.in. if desired. The machines are single-acting, vertical type, belt driven or motor driven as desired. They are said to be so balanced as to operate satisfactorily if bolted to any solid flooring. The smallest size is built for either air or water cooling, the former being for intermittent service, while the larger machines are built for water cooling only, employing a reservoir-jacket system. The largest machine is also built with a closed jacket for the pressure circulation of water. The crankshafts and connecting-rods are drop-forged while the bearings are die cast and removable in case of wear. Lubrication is by the automatic splash system.

Tapping Machine

Bicknell-Thomas Co., Greenfield, Mass.

"American Machinist," May 8, 1919



This machine has a cone friction driving mechanism which, it is said, enables the operator to tap to the bottom of a hole without danger of breaking the tap, and also enables the operator to tap a large number of holes. Has a two-speed geared transmission that is said to be noiseless. This runs in grease which serves to lubricate all parts of the machine except the motor. All spindles are hardened and ground and the main spindle runs on ball bearings. The table slide, which is made to hold suitable work-holding fixtures, has ball bearings, making it sensitive in operation, and has an adjustable stop for the table. The machine is furnished either with or without oil pump and piping. It is stated that the machine has tapped as many as twenty-four $\frac{3}{4}$-in. holes per minute.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$30.75
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	26.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural sahpes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.37	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅛-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Near Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.50	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
⅛, 5/32, 3/16, ¼, 5/16, 3/8 No. 8, 7/16 and No. 10	25.50 to 33.00	3/16 by 12 in. long	14.00
½		3/16 by 19 in. long	12.00
No. 12		¼ by 19 in. long	10.00
5/32, No. 14 and 1/16		¼ by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		⅛	33.00
		5/32	30.00
		3/16	38.00

Domestic 20c. for 1/16, 15c. for ⅛ to 3/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	⅜ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	⅜ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	15.75	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	4.75	5.25	7.00
Spelter	6.40	6.55	7.00
ST. LOUIS			
Lead	5.00	5.60	6.80
Spelter	6.05	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

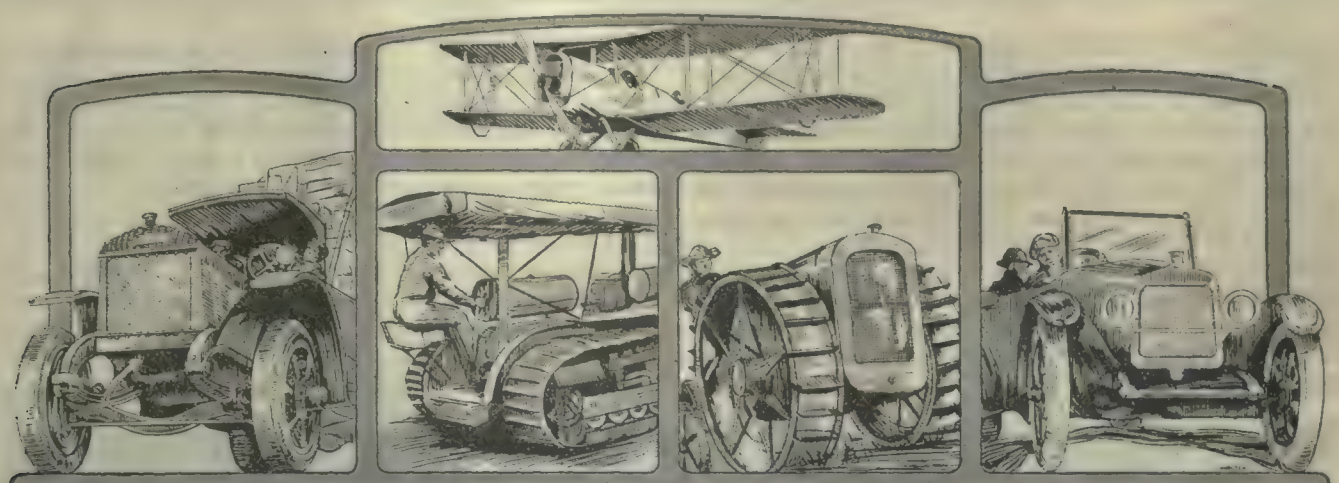
	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	23.00	22.50	31.50–33	23.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	23.00	34.00	22.00	31.00
Brass sheets	20.50	23.75–28	30.75	23.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	30.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	43.00	41.25	39.00	45.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

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AUTOMOTIVE CONSTRUCTION

Welding Operations on Liberty Motor Cylinders

By H. A. CARHART
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The welding problems here outlined and the experience with the various methods and different apparatus, cannot fail to be of value to all who use, or who contemplate using, similar welding methods. The fixtures shown in this article are also suggestive and should prove very helpful in other lines of work.

WHEN the Lincoln Motor Co. began the welding of cylinders, their equipment consisted of two 300-lb. Davis-Bournonville generators with a capacity of 600 cu.ft. per hour, and one battery of ten 200-cu.ft. oxygen cylinders. This equipment was placed in the rear of the main building and was connected by pipes to the welding department. After six months of increasing production, they found that their generating plant was overloaded, and as this was their only method of welding, they decided to build a large generator house, capable of producing gas for completely welding 1000 cylinders per day.

The generator house consisted of a large brick building divided into four compartments: Generator, oxygen, oxygen storage, and carbide storage rooms. The generator room was equipped with twelve 300-lb. Davis-Bournonville generators with a capacity of 3600 cu.ft. per hour, making what is considered the largest equipment of generators in the world. This is shown in Fig. 1. The 12 generators are divided into four batteries of three each. Each battery is equipped with a washer, this being a tank so arranged that the gas passes through 4 ft. of water which removes the solid particles. The batteries are connected by a manifold which is so constructed that it is possible to cut off certain batteries when they are disabled, without affecting the feed pipes.

There are four 1½-in. main feed pipes that transmit the gas from the generator house to the welding department where another manifold was placed to bypass a defective feed pipe should there be any. From this point the gas is piped into units of 48 stations, each station being equipped with a Davis-Bournonville regulator to equalize the pressure.

The oxygen is received in cylinders containing 200 cu.ft. at 1800 lb. pressure. They are then connected in two batteries of 20 cylinders each by manifolds. The oxygen room is shown in Fig. 2. They are so connected that should one battery give out the other would furnish the necessary supply. Each manifold is equipped with a Davis-Bournonville high-pressure regulator which reduces the pressure to 30 lb. The oxygen is then conveyed to the welding department through two 1½-in. feed pipes in a similar manner to the gas.

The first serious trouble was experienced with the torch equipment. The nature of the trouble was severe backfiring, sometimes running back as far as the regulator. After a thorough investigation it was found that this was due to careless operators extinguishing their torches without turning off the gas and oxygen. It is obvious that the oxygen, being of the higher pressure, would then back up into the gas line and cause a very explosive mixture.

As this situation involved the personal element, it was decided to devise a filter as a safeguard against the backfiring reaching the main feed pipes. This filter consisted of a barrel of about ½ in. inside diameter and 2 in. long. Each end was supplied with a cap which was threaded to complete the line from the regulator to the torch-hose connection. The barrel was fitted with a piece of fine wire gauze at each end and filled with fine aluminum shavings. This contrivance would tend to filter the gas or oxygen and would not allow any backfire to pass through it and, therefore,

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protecting the regulator and lines from disintegration. The torch equipment consisted of Davis-Bournonville torches on heavy work, such as elbows and flanges, and Torchweld on lighter work such as cylinder jackets.

The oxy-acetylene flame has a temperature of approximately 6300 deg. F. When properly produced this flame is small, neutral, neither oxidizing nor carbonizing, and is applied with almost pencil-point concentration. It is in this form of a properly proportioned high-temperature flame that the great success of the process lies. The highest temperature of the best fuel furnaces is about 3000 deg. F., and of the oxy-hydrogen flame, something less than 4000 deg. F.

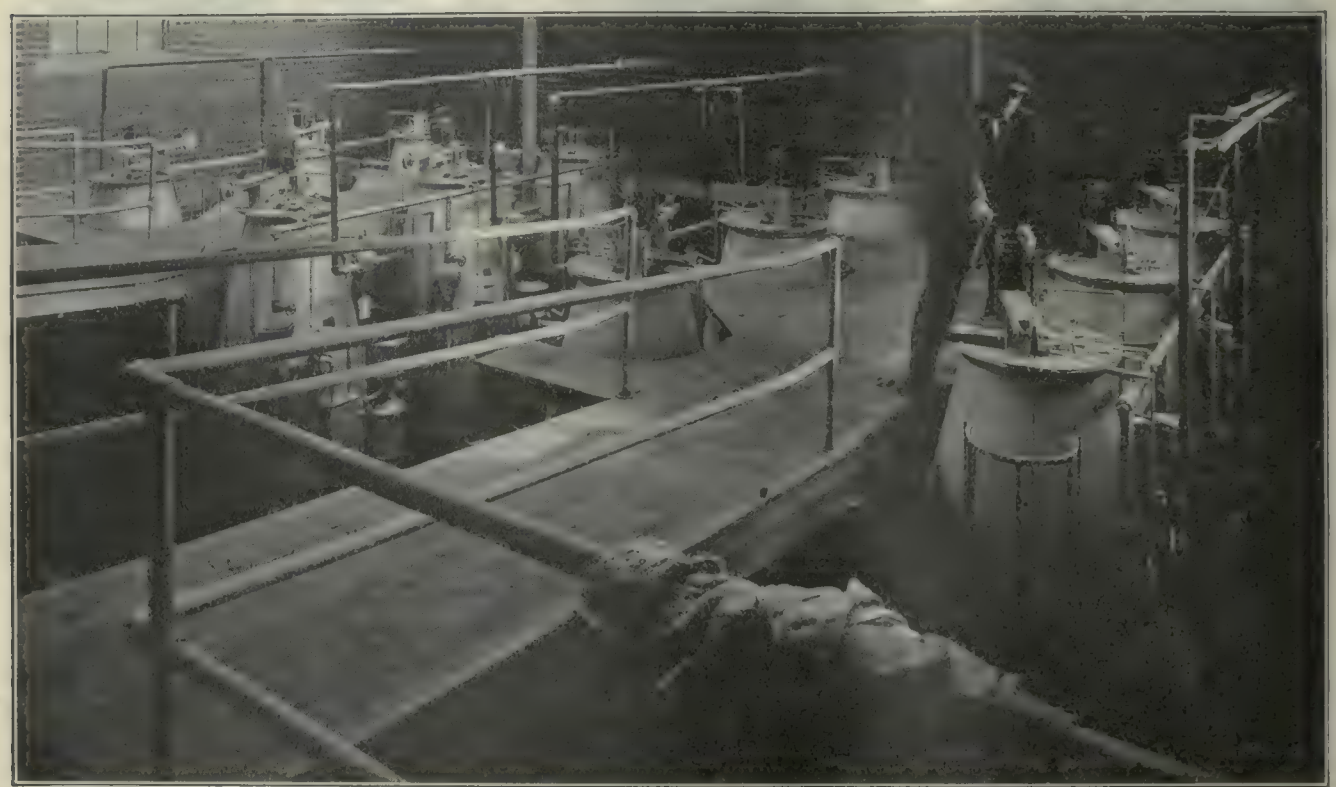


FIG. 1. THE GAS GENERATOR ROOM

In the early stages of the welding, the cylinder was assembled to the exhaust and intake elbows on a large pilot fixture, Fig. 3. The fixture consisted of a pilot with a head to fit the curvature of the dome. The head was equipped with hand screws for securely fastening the elbows in place after being located. A pair of clamps, operated by a cam and equalizing arrangement, was fastened to the base for exerting an extreme downward pressure upon the flange and thus holding the dome against distortion. This method of holding gave very uncertain results due to the expansion of the metal at the point of welding which would sometimes force the elbow to creep ahead of the welding torch; and also the heat from the highly radiated head of the welding torch progressing circularly down the cylinder dome and walls had a tendency to drop and distort the dome.

Then they removed the clamps and pilot from the fixture and slightly decreased the radius on the head. This, when assembled, had a tendency to decrease the radius of the dome by the extreme pressure applied with the hand screws through the valve guide holes forcing the head against the dome. In this manner of assembly, the elbows were first tacked to the cylinder by an electric arc, Fig. 4, and then welded by gas. The results were somewhat better but distortion still existed.

They next proceeded to heat-treat the cylinder but with no better results. It was then thought probable that placing the cylinder in water up to the welding portion, consequently keeping it cool, would tend to eliminate distortion. It is obvious that when this method is employed, it necessitates the use of more heat, more careful handling, and due to the rapid cooling, does not give a homogeneous weld. This idea was then abandoned and the cylinders were welded and afterward placed into a vat of warm water for rapid cooling, which helped to subdue a portion of our trouble.

The next development was to purchase a 6-arc close-circuit welder from the Arc Welding Machine Co. This consists of a motor generator and regulator set with an exciter. The exciter is a small motor-generator set which furnishes the current to excite the fields of the regulator. The regulator controls the current and voltage which is furnished by the generator to satisfy the number of arcs being used. Each arc is cut in use by an automatic relay, which was inefficient because of the fact that should an operator break his arc too quickly the relay would not respond, the line would be open, and all other operators would lose their arcs.

The direct-current electric arc is essentially unstable. It consists of a series of pulsations. If each pulsation be divided into several units, some of the units will show a very strong exposure while the rest will steadily

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die down until only the slightest trace of the arc can be seen. It invariably requires a higher electromotive force to start the arc than is thereafter required to maintain it; therefore, if there is the slightest irregularity in the current, the arc will probably be broken.

In carrying out the process of welding, the work is connected to the positive pole while the electrode is connected to the negative. The arc, which is struck between the work and the electrode, is in reality a miniature electric furnace with a temperature estimated



FIG. 2. WHERE THE CONTAINERS ARE FILLED

at 9000 deg. F. The intense, but highly localized heat of the arc, melts the electrode as well as a portion of the work. The molten electrode is deposited on the work where, if properly controlled, it mingles with that portion of the work which has been melted, forming a perfectly homogeneous joint.

Preventing Distortion

So the Lincoln Motor Co. carried on, for a small period, experimental production of arc welding the cylinder. This eliminated the dome falling and other distortion, but due to the fact that the human element was involved and the breaking of the arc for the reasons given, it was almost impossible to produce a cylinder which would not leak in the weld. The leaks could not be repaired by the arc unless the previous weld was chipped off, which made the first a very inefficient operation. If repaired by the gas, the metal would be porous, so they decided arc welding was much more inefficient than the torch method.

In the meantime, it was learned that the Nordyke-Marmon Co. were arc welding both elbows three-fourths of the way around and the balance, which is the section between the two elbows in the center of the dome, with an acetylene torch. It seems, according to their data, that the dome sunk in arc welding in reciprocal ratio in relation to the amount of expansion that took place when gas welding the balance, thus bringing the dome back to its original position. As the equipment at the Lincoln plant did not allow them to employ this process, it was not tried out.

The next development was building the fixture that would accurately locate the assembled cylinder and elbows for tacking and thus eliminate this uncertain, inefficient process of setting them upon a pilot and surface plate, which had been heretofore employed. The fixture consisted of a cast-iron ribbed framework surrounding the cylinder with an expanding pilot for centrally locating the cylinder. A hinged plate at the bottom of the fixture located the flat on the cylinder bolt flange, which is parallel to the portholes, and the latter in turn are parallel to the elbow locating plugs. Two of these plugs, which enter into the valve guide holes, are located on a hinged gate which is closed after the cylinders and elbows are placed into the fixtures. The two plugs are then forced into the valve guide holes together with the plugs locating the portholes situated on the sides of the fixture. Inasmuch as this operation and all future operations of the cylinder depend on the proper alignment of the elbows with the flat on the bolt flange, it is absolutely necessary that all burrs on the locating portions be removed.

Using Revolving Fixtures

These fixtures are placed in pairs on a revolving stand, Fig. 5, so situated that one of the fixtures is inside the welding booth being tacked while the other is outside being set up. After tacking, the cylinder is removed and inspected for the alignment of the elbows. In this operation, the cylinder is placed on a fixture which consists of a pilot mounted parallel on a surface

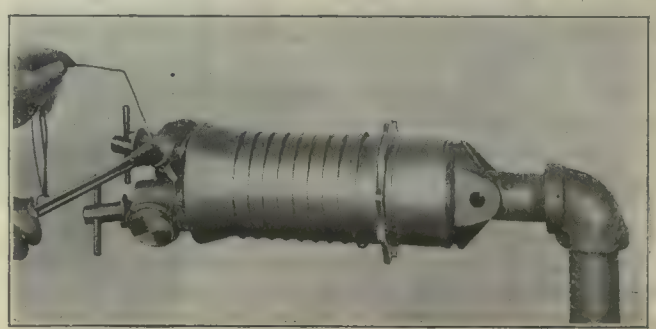


FIG. 3. TORCH-WELDING THE ELBOWS

plate with a dial indicator arrangement for locating the flat. Arbors are placed in the valve guide pin holes and a reading taken with a Brown & Sharpe dial indicator. If this reading is within the limits specified, the cylinder is passed on for welding. If not, the tacks are broken and the cylinder reset and tacked again.

In arc welding, the last development in endeavoring to overcome the distortion caused by the heat is shown in Fig. 6. This consists of two ½-in. capscrews, a ¾-in. capscrew and a 1-in. plug. The top of the plug has the same radius as the top of the dome and was inserted in the center of the head. The two ½-in. capscrews were screwed into the head through the spark-plug holes so as to relieve part of the entire strain from the hand screws. The ¾-in. capscrew was placed on the under side of the head so that when it was tightened it would exert a pressure against the top of the dome. Even with this fixture in place the elbows had a tendency to creep and distort, the domes dropped, and we were confronted with either re-machining or heating the domes to restore them to their original position.

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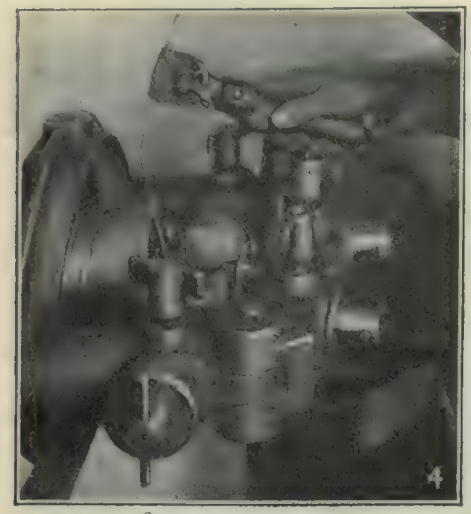


FIG. 4. THE FIXTURE FOR HOLDING THE ELBOWS.

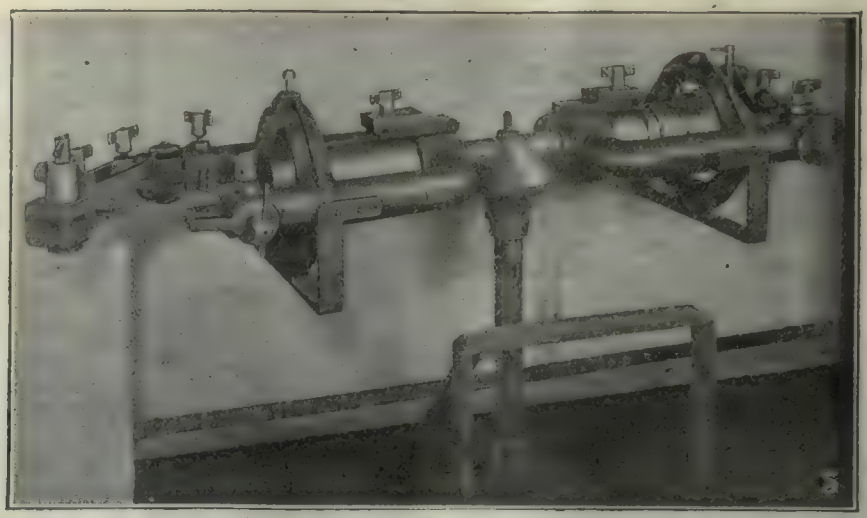


FIG. 5. A DOUBLE FIXTURE FOR HOLDING THE ELBOWS

The process of arc welding had up to this time, been applied manually only. The operator brings the end of the negative electrode into contact with the positive work, starting the flow of current, then slightly separating them to form the arc, and hereafter maintains the arc by gradually bringing the wire toward the work as fast as the former is melted. The temperature of the arc being exactly proportionate to its length, variation in the length results in a lack of uniformity in the weld. Because the arc is inherently unstable, it is impossible in manual welding, for even the most skilled operator to keep the arc length constant. In fact the personal element enters so largely into the process that it is difficult to even maintain the arc constant for more than a few seconds at a time. Short-circuiting of the wire upon the work results in burning the metal and thus causing a weak spot in the weld.

The reasons already given are responsible for the efforts exerted toward producing and making practicable an automatic pencil or electrode feeding device for use on elbow welding. The first effort concentrated the solenoid idea of holding the length of the arc. Experimental work was carried out on a lathe whose spindle rotated once in 45 seconds. A center fixture was built to rotate the cylinder between centers so that the welding portion between the cylinder and elbow would rotate from the axis between centers. A small direct-current motor fixture was placed so that the electrode was fed upon the work to be welded at a 30-deg. angle. The speed of the motor regulated the feed of the electrode.

The electrode never melts uniformly, as there are hard and soft spots in the wire, and so it was necessary to control the speed of the motor by the arc and that was done in the following manner: Several grids of resistance were cut in series with the motor. Each grid was connected by a bypass which was closed and opened by relays, these being operated by a solenoid that was cut in series with the arc. The same trouble existed as in the direct-current hand arc. There were several leaks which were almost impossible to repair due to the burning of the metal.

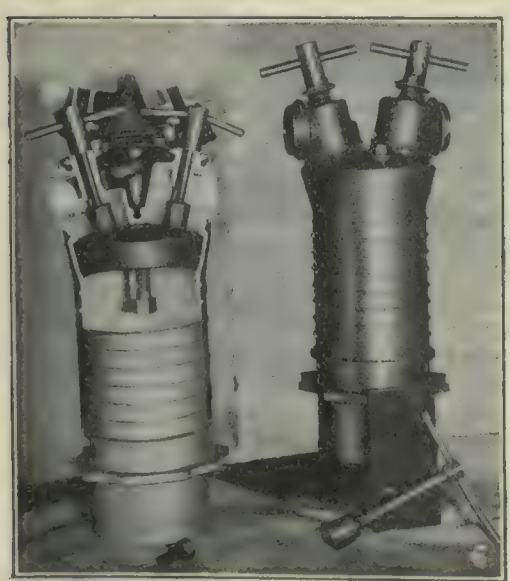


FIG. 6. THE FIXTURE FOR HOLDING CYLINDER CROWN.

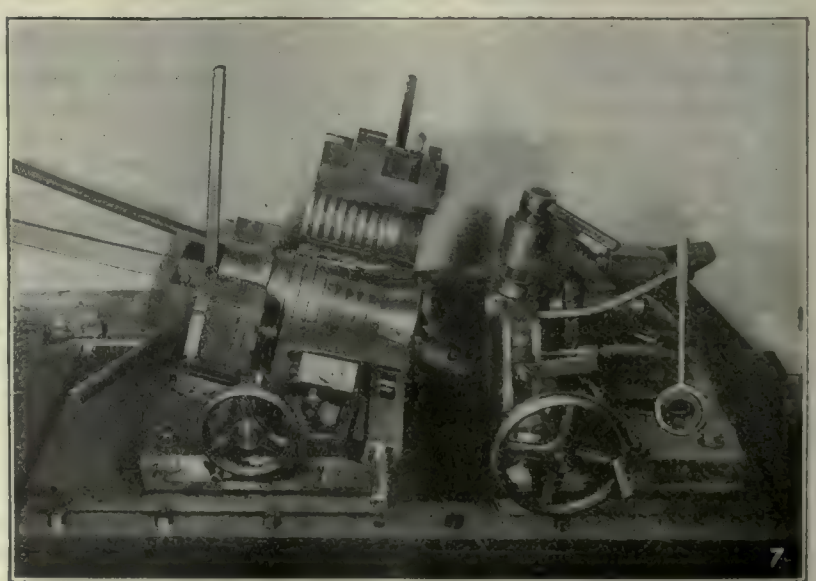


FIG. 7. THE BUTT-WELDING FIXTURE

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After further investigation, it was found that the Arc Welding Machine Co. had produced an automatic pencil feeding device. The motor speed was produced and regulated by the exciter and regulator of their welder. This was given several tests but the leaks still existed so this method was never put into operation.

The Lincoln company next investigated the butt welder, which is becoming more and more practical daily. Previous to the time of this investigation the Ford Motor Co. had succeeded in producing a butt welder for welding the semi-finished elbows to the cylinder, re-machining them afterward. The adoption of this plan would have caused delay and would have necessitated so much additional equipment that it was considered impractical for them and they experimented with butt welding the finished elbow to the finished cylinder. This experimental work was carried out on a Thomson butt welder for which there was developed an experimental fixture to carry out the ideas in mind.

They then designed and built a more elaborate fixture, Fig. 7, of Tobin bronze with which they were able to weld at the rate of 25 cylinders per hour, having 1 per cent. leaks and without any distortion. Fig. 8 shows the machine in operation. The elbows and cylinders necessitated a slight change at the point of welding. The nature of the change was to allow $\frac{3}{16}$ in. of extra stock on both, for a flash and weld. After welding, this was chipped off of the outside with an air hammer while in a holding fixture and reamed from the inside with a special inserted-blade shell reamer. A 24-in. Cincinnati drilling machine was used with a swinging fixture that indexed in the valve guide hole. This method gave complete success and they were about to install four additional welders when demand for production suddenly came to an end.

They also devised a fixture for salvaging cylinders which were distorted out of the limits by heat. This was a heavy cast-iron die with hardened-steel bushings and plugs. When the cylinder was in place and the plugs inserted, the cylinder and elbows would conform to the specified print dimensions. If the cylinder was off square or off angle, it was placed in the fixture and heated with acetylene torches, and the locating plugs inserted forcing the elbows back into position.

After welding, the welds were hammered with a 1-lb. peen hammer, to remove the scale and loosen any poor welding, so that any leaks would show up in the water test. The cylinder was then inspected.

The water jackets are then fitted to the cylinder, and the latter when assembled, is placed in a clamping fixture, Fig. 9. This fixture consists of a frame with two jaws which are placed around the jacket for holding while being tacked. The equipment used in this operation is a miniature-style Torchweld torch, equipped with a No. 3 tip and $\frac{3}{32}$-in. Norway welding wire.

After being tacked, the cylinder is placed in another fixture, and the bottom of the jackets are welded to the jacket flange on the cylinder. The fixture employed in this operation is a fork made of steel 1½ in. wide, so shaped as to fit the top of the cylinder and thus keeping it in an inserted position. Welding the bottom first was considered to be an advantage as the heat applied at that point had a tendency to draw the jackets closer together. It was also considered advisable to leave an opening between the jacket halves of about $\frac{1}{16}$ in. to $\frac{3}{32}$ in. to take care of the contraction which the different jacket-welding operations tended to produce.

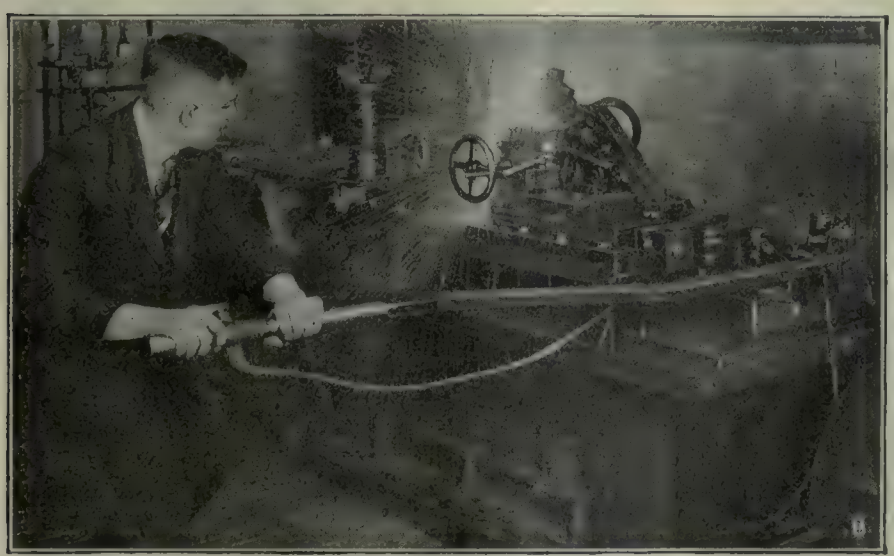


FIG. 8. A WELDING DEVICE IN OPERATION



FIG. 9. TACKING THE JACKET

The cylinder was next placed in a horizontal position on a cast-iron table, and the jacket-side seams were welded. The welds were started from the bottom proceeding upward to the portholes. The cylinder was then placed in an upright position and the top seam completed. The equipment used in this operation was a miniature Torchweld torch equipped with a No. 2 tip and $\frac{1}{16}$-in. Norway welding wire.

The next operation was to weld the jacket around the two spark plugs, valve guide and camshaft housing bosses. The fixture employed in this operation carries a pilot upon which the cylinder can be turned circularly. The equipment used is the same as before except that a No. 3 tip was found best.

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Next came the welding of the jacket around the porthole flange. The fixture used in this operation consists of a standard with a revolving cradle to lay the cylinder in. The revolving motion of the cradle, together with the varying height of the standards, gives the operator easy access to weld. The equipment used is a No. 1 Torchweld torch equipped with a No. 3 tip and $\frac{1}{16}$-in. Norway welding wire.

The next operation consists of welding both water pipes to the jacket and the jacket seams between the valve guide and porthole flanges. This is shown in Figs. 10 and 11, both inlet and outlet being handled in the same fixture. This fixture is equipped with two devices for holding the water pipes in their proper position while being welded and is so arranged that it can be oscillated to suit the position in which the operator is welding. The cylinder is located by a flat clamp which locates the flat on the cylinder bolt flange in proper relation to the pipe-holding devices.

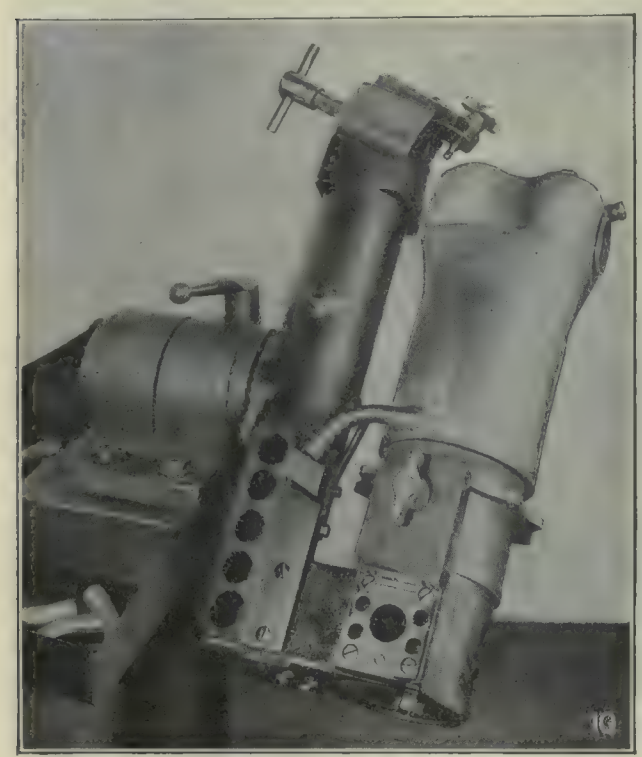


FIG. 10. WELDING THE INLET PIPE

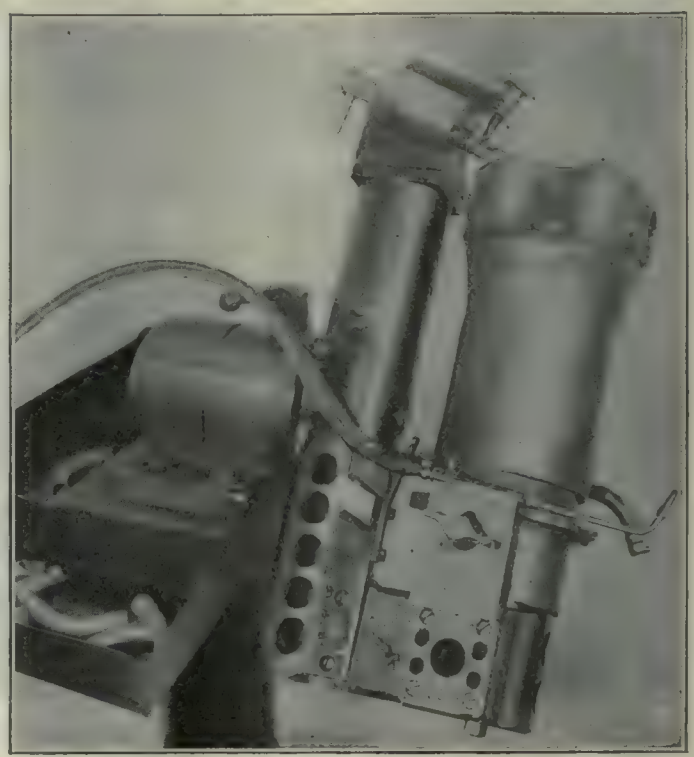


FIG. 11. WELDING THE OUTLET PIPE

The jackets seams are welded first, followed by the water outlet pipe. In these two cases, the cylinder is welded in an upright position. The locating clamp on the bolt flange flat is then released and the cylinder given a half-turn to the opposite flat. The inlet pipe is then placed in its holding device and welded with the fixture in a semi-horizontal position to suit the welder.

The cylinder is then removed and the water pipes inspected for proper location. If it is passed, the cylinder is hammered with a rawhide hammer to remove scale and loosen any poor weld, after which it is tested for leaks. If leaks are found, they are repaired by expert welders and returned for re-inspection.

The next operation consists of assembling the flanges to the cylinder. This operation employs two fixtures, shown in Figs. 12 and 13. These are placed on a revolving stand that is operated similar to the elbow tacking fixture. The fixture consists of an expanding pilot for holding the cylinder control, and a stop for locating the flat on the bolt flange. A bridge is built over the pilot with a yoke and two clamps to locate the flange. The cylinder is slipped on the fixture far enough for the yoke to square up the flange. The pilot is then expanded and the clamps tightened up, drawing the flange to its proper position. It is then tacked by the electric arc.

The electric arc used for tacking was produced by a motor-generator set of the Lincoln company's own make. The generators were rewound and their normal speed reduced so as to make them produce a low voltage and high amperage. The current was then passed through a rheostat which was made up of a series of cast-iron grids of resistance. This gave the necessary supply of current for each arc, which was generally 30 volts and 110 amperes.

After the flange was tacked on the cylinder, it was then welded. The first experience was welding them with oxy-acetylene gas. This proved very inefficient and slow, and necessitated the employment of a good many welders. They then experimented, using the direct-current arc and found it doubled the production per welder. As the arc was cheaper, it was decided to investigate the different types of welding outfits for the purpose of adding additional equipment to arc weld the entire flange production.

It is obvious that in direct-current welding, a power plant is necessary, which requires a heavy motor-generator set and an elaborate switchboard, the whole set weighing about 2000 to 3000 lb. The secret of holding

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and controlling an alternating-current arc has heretofore been long experimented on. The device of the Electric Arc Cutting and Welding Co. proved of light weight and practical, consisting of a special type transformer without any moving parts.

It is one of nature's laws that the heat in the arc is the product of both the current and the voltage across it, which is identical with the energy. An experienced operator can weld from almost any source of direct-current power supply if he is provided with the means

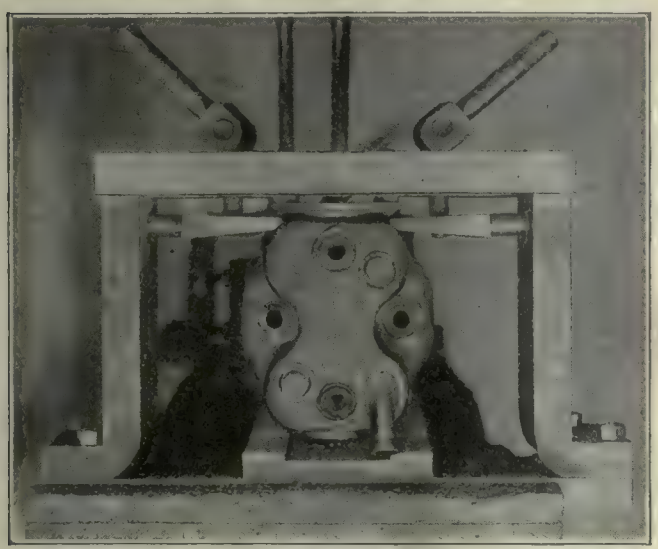


FIG. 12. END OF THE FLANGE-WELDING FIXTURE

of holding the current substantially uniform which is a very difficult proposition. The variety of arc lengths which the direct-current machine makes it possible to hold, often makes the operator careless, so that he burns the metal and causes leaks and crystallization.

The alternating-current machine holds this arc wattage and heat substantially constant for any given setting, which is necessary for different classes of work and electrodes. The arc length must be held almost uniform, as any variation will cause it to break. As soon as any person becomes accustomed to the sound and sight of the arc and can deposit the molten metal where he desires, it is inexcusable to burn the metal

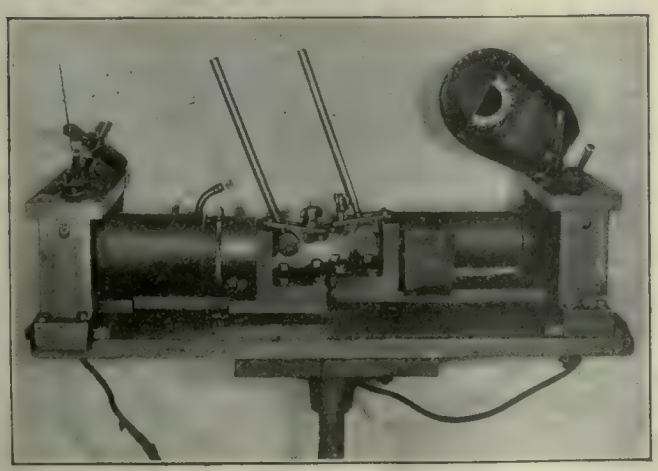


FIG. 13. DOUBLE FIXTURE IN USE

from too much heat or to make imperfectly joined, or "cold shot" welds from too little heat. Different metals, electrodes and conditions in the welding department require various amounts of heat and varying temperatures. These adjustments are obtained by a handle which adjusts a laminated core in the transformer induction circuit. There are several taps arranged on a plugging board that cut various windings in the transformer secondary winding. The transformer is cooled by a fan.

The transformer is approximately 85 per cent. efficient whereas the direct-current motor-generator sets vary from 5 per cent. to 60 per cent. efficient. It deposits metal at about 5c. a lb., which is very much cheaper than the direct-current or gas. The 60-cycle type of alternating-current machine weighs about 200 lb. and is equipped with handles so that it may be carried to any location, set on a bench and be ready for use. Another good feature of the alternating-current arc is the deposition of the metal with a smoother surface than with the direct-current arc.

After investigating these features thoroughly, 10 of these machines were purchased and it was found that they increased production from 36 to 80 cylinders per man, per nine-hour day. The best results were obtained by using a $\frac{1}{8}$-in. flux-covered wire for an electrode, several different kinds of flux being used. Some very important experiments were carried on, using boron sub-oxide and titanium, magnesium and sodium silicate, the latter giving the best results for various kinds of wire. It was found necessary to put round disks of sheet asbestos in the portholes to obstruct the iron oxide from sticking inside the valve cages. Cylinders were then sent to be tested for final leakage inspection.

The Cost Department of the Future

BY ENTROPY

Should the cost department be a part of the machinery of production or should it be a sort of detective branch to stand off at a distance and criticise?

To the question put in this way there can be but one answer. Every part of the organization should pull together toward one common end. Every part must think in one direction and that is toward the greatest possible production with the least effort. Any part of the organization which is putting on the brakes and slowing up for imaginary obstacles is a money loser.

If the cost department puts itself in a critical attitude it antagonizes the profit-making function of the business, upsets the minds of the persons criticised and puts itself in such position that its recommendations are not well received. If it will instead make itself into an interrogation point and inquire as to why costs in a certain department for a certain operation took a jump, it may find there was good reason for the increase.

The production department should produce and do nothing else. The cost department should find out what is being done by the production department without disturbing the latter in any way. It should not ask a production foreman to make a single entry on a scrap of paper for its benefit, nor ask a producing workman to step to one side to let a clerk pass by. It should be

self-effacing but persistent in its search for facts. The cost department's own men should count and check parts made and operations performed.

To be sure if it does all these things and the work is charged against it instead of being absorbed in the total overhead charges the management may discover that cost-keeping is more expensive than they thought it was, but it is better to face things as they are than to deceive oneself by charging the cost of one thing against another just because that other can stand the charge better. Too often the cost department spends the greater part of its time playing solitaire with overhead charges, and too little on actual day by day and operation by operation, costs of manufacture. It is not enough to know that in a given room with a large number of operatives the total cost of making so many thousand pieces was so much. The valuable thing is to know which is the operative that makes the most money for the firm; who it is that uses the least material, oil, waste, etc., and at the same time turns out the most work per dollar of total expense; if all the profit in a room with a hundred operators is made by ten why not dispense with the other ninety. In other words cost-keeping is not altogether a matter of total costs but has to do with the individual work of the employees. The cost of keeping these individual records is large but unless they are so kept an opportunity for profit is overlooked and meritorious cases can only come to light through observations of the foreman.

The Worker and the Foreman

Foremen have their own personal comfort to look out for and it is natural for them to hold the good money makers back rather than help them to promotion. A good worker is a great help to a foreman. Good workers are apt to be promoted if the management knows about it, and if they are, the foreman does not get the benefit of their services, consequently foremen are much inclined to smother budding ambitions. A cost system which brings out not merely average costs but the high and low individual costs will bring out possibilities that otherwise might easily become lost in the shuffle.

Cost work is research into both the financial and the productive side of the business. It should enable the superintendent of production to tell whether or not a contemplated change is going to add so much to the overhead charges as to be unprofitable. Every change in manufacturing methods should indicate, through the medium of the cost accountant, the direction in which to go when trying the next experiment.

There is need of more expert work in cost-keeping and more expert advice based on the work of these departments. Just as a research engineer in the mechanical, electrical or chemical laboratory tries out things on a small scale, the cost research man must experiment and deduce from the results of his experiments what will happen when it is tried on a larger scale. The cost expert will not allow his firm to buy an expensive machine which is capable of but one operation on one piece, even though it will save nine-tenths of the time spent on that piece, if it is going to stand idle the larger part of the time. He will help his employer to avoid the use of standard machines when, even with their low overhead expense and power consumption, the labor cost of operating them exceeds that of a special machine that would replace a number of them, because he will have the comparative figures with which to demonstrate.

Stated another way, the cost-keeper of the future must be a man who can figure costs beforehand rather than afterward. Almost any one can have hindsight, but if a man wants to become valuable to any concern he needs foresight and to be able to predict from a study of what has gone before, what is likely to happen when one or more elements of a problem are changed.

The Status of the School Shop

By J. B. Phillips
Instructor in Manual Shop Practice, Los Angeles High School

I would like to suggest for discussion in the *American Machinist* a few questions pertaining to the apprenticeship system and its relation (or lack of relation) to the numerous technical and high schools throughout the land, from which many young men more or less familiar with the fundamentals of machine-shop practice are being graduated.

Technical journals and orators constantly asseverate that the "trades" are disappearing and that learning a trade does not carry with it the prestige that it bore a quarter of a century ago. This statement no doubt has reference to the constantly diminishing circle of activity in which the average industrial worker is engaged and is a natural outgrowth of machinery, organization and economic pressure, but the fact remains that the world today is in greater need of good all-round mechanics than ever before, and to meet this need the schools and colleges of America are spending millions of dollars for buildings, equipment and instructors.

Many graduates of such institutions, having spent from one to three hours a day for a number of years in school shops, find ready acceptance as apprentices in regular shops providing they do not press a claim for time allowance. The tendency to do this, however, keeps many a clever lad from taking up shop work, and ultimately works against the best interest of industry, whether it be from the viewpoint of labor or capital.

A few weeks ago a young ex-soldier who has had five years of consistent school shop practice and who could not readily resume his college career where he left off, desired to enter a large railroad shop as an apprentice provided they would give him a reasonable allowance on his time, but this was refused by the foreman who said that they had tried a great many school shop boys and that about all they knew about a lathe was that it had a pair of centers.

The question is, Was the foreman candid in his assertion or was he biased by craft tradition? It is unquestionably true that in establishing school shops we have too frequently engaged instructors who, while technically qualified, were entirely lacking in practical experience, but this condition is now rapidly disappearing.

In view of the foregoing there are three pertinent questions demanding attention, namely: Should the school shop graduate be credited with a time allowance as an apprentice? On what basis should the time allowance and experience be fixed? Who should establish this standard?

In discussing them, we will encounter the natural antipathy exhibited by the regular apprentice and the traditional journeyman which, out of an experience of thirty years, I believe to be the greatest barrier to a proper solution and this we may help to remove through a liberal educational campaign.

Extracts From Chordal's Letters

Many good mechanics who take pride in their work seem to think there is nothing to be gained by making a study of the technical side of their trade or even reading mechanical journals. In this letter Chordal tells how one mechanic derived some benefit and a great deal of satisfaction from the study of a book on a subject in which he was interested. He also gives an amusing account of "passing the buck" in regard to determining the exact time.

Mr. Editor:

* * * Charlie Gay had finished his apprenticeship and was considered a nice workman. He had sharp points on his fingers and did the fine and delicate work in the shop and today he would be classed as a toolmaker. He lived at home and bummed with the boys, and did very little reading, but he found time to do lots of instructive tinkering at home and his father gave him a nice foot lathe and he had accumulated quite a lot of small tools. He would make things without caring much what he made, but everything he made was nice. Sometimes it would be a set of boxwood chessmen, and sometimes it would be a set of napkin rings for his mother, and sometimes it would be the repair of the sewing machine, but in all this work, which was generally done at night, he had no settled plan of producing anything he could be proud of or anything that called for any originality. He was 18 years old.

* * * Now it happened many years ago that Charlie reached his twenty-second year and got married, and his father gave him as a wedding present a very nice house. Charlie moved into the house, and along with him and his wife went the foot lathe, which was installed in an attic room. For a while he did nothing in his upstairs shop till finally he began to think about what he would make next.

* * * One of his wedding presents, given him by one of the boys of the shop, was a little book, one of Weale's Series, called "Clocks, Watches and Bells," by E. B. Dennison. For the first time in his life he read a book through studiously, and then he read it through again and found out all about clocks, and clock gearing, and pendulums, and escapements, and he mastered what little mathematics was involved in the subject. He was thoroughly interested in the book and he about wore the volume out.

* * * And then a notion struck him. Why not build a clock? He would do it. He planned the thing out and decided that he would have a grandfather's clock of his own fabrication. He made drawings of what he proposed, but put no originality into the affair except that the wooden case would be about five feet high, with the clock movement standing on top and a glass case around the movement, so that he could lift off this glass arrangement and have full access to the clock movement back or front. And he put large doors in the back of the main case and in its sides, as well as its front. This required the proposed clock to stand away from the wall, which was a good idea in its way, for it enabled him to inspect its workings freely.

* * * Mary fell in with his scheme and she got the fever and read Dennison's book, and when Charlie started in on the work Mary was able to follow intelligently every one of his movements, for she knew E. B. Dennison's book by heart.

* * * Then Charlie set to work and he put in nights for about a year making the parts of his clock, and he did most everything himself, even the woodwork of the case. He bought pinion wire for the pinions, but he rigged up his lathe to do all of the gear cutting. He made the hands out of sheet metal and blued them and then became dissatisfied with them and made another pair which suited him. The face, or dial, he had silver plated and he stuck on it gold-plated numerals which he got from the patternmaker. The weights were wound up by pulling on chains like a cuckoo clock, and he made a scientific affair out of the pendulum, with all manner of provision for compensation on account of temperature, and he provided the pendulum bob with an open cup into which he could drop or from which he could remove trifling little weights to alter the rate of the pendulum without stopping it.

* * * Finally all was done and the clock was installed in the presence of Mary and his father and mother and sister, who were very proud of this accomplishment and were anxious to know if the clock would actually run. Charlie and Mary felt no anxiety about the matter for they had both so thoroughly absorbed the teachings of E. B. Dennison's book, and Mary had such confidence in Charlie's mechanical skill, that they felt sure about the thing.

* * * The moment came and Charlie swung the pendulum to one side and let her go, and she continued to go for over forty years, and it went about right. Second after second and year after year the pendulum swung and the tick was all right, and inside of six months the clock had been regulated down to a fine point, and there never was a miss in winding the clock.

* * * A baby took a notion to arrive in the house, and that baby's little heart started on its pulsations without a stop until that baby was grown and was married, and there was another baby and the heart of the first baby slipped a cog and ceased to beat, but Charlie's clock ran on.

* * * Notwithstanding there was nothing more to be done about the clock Charlie and Mary read E. B. Dennison's book through again, and as the book was worn out they got a new one. They had grown into years of close association with E. B. Dennison,

as though he had lived in the house with them, but when they opened this new book they experienced a shock, for it was a new edition of the book, and instead of being by E. B. Dennison it was by Sir Edmund Beckett. This put them on inquiry and they found out that E. B. Dennison was a son of Sir Edmund Beckett Dennison and that when he died in 1874 his son, E. B. Dennison, succeeded to the baronetcy and dropped the Dennison from his name. This knowledge made the new book satisfactory.

* * * The new book was somewhat of an improvement over the old, and Mary and Charlie, who had begun to show gray hairs, read it through two or three times with interest. They wore this book out and nothing would do but Charlie must get another.

* * * Then this third book had another shock for them, for instead of being by E. B. Dennison, or by Sir Edmund Beckett, it was by Lord Grimthorpe. They started their inquiries again and were able to find out that Sir Edmond Beckett was elevated to the peerage in 1886 and took the name of Lord Grimthorpe. They found out that E. Beckett was an authority on clocks and bells and that he had designed the Westminster clock for the Houses of Parliament along in the fifties.

* * * The Westminster clock is the one containing that celebrated bell "Big Ben." The bell is cracked. It was cracked once before and was recast. The new one developed defects, but its sound seems very satisfactory except to its designer Lord Grimthorpe, who died in 1905 with the hope that "the model legislatures of the world, as it is the fashion to call them, may screw up their courage to the undertaking of recasting their own great clock bell."

* * * It thus seems that Charlie's clock has swung its pendulum beat after beat while he and Mary grew old; while their son was born and had a son and died; while E. B. Dennison became Sir Edmund Beckett; while Sir Edmund Beckett become Lord Grimthorpe.

* * * During the numerous readings of the numerous Beckett books by Charlie and Mary they absorbed considerable knowledge, and intelligent knowledge, of the proper shape of gear teeth. And this reminds me that some years ago Mayo had before him a gear problem which stumped him, so, thinking that Gleason could help him out, he rolled up his blueprints and hied himself to Rochester to see Gleason. He called at the office and asked for Mr. Gleason, explaining that he wanted to consult him regarding a rather complicated gear problem. The young lady who happened to respond to his call stated that she could probably attend to the matter for him. Mayo thought not, but he unrolled his blueprints and they started in, and what that young lady was not able to tell Mayo about gearing was not worth asking about. The young lady proved to be Kate Gleason, the secretary of the Gleason Works, an authority on gearing and a member of the American Society of Mechanical Engineers.

* * * And speaking of Big Ben reminds me that Bob and Doc, two young chaps, went over the water, and while in London they frequently heard Big Ben. So one night they determined to take a walk to the Houses of Parliament so as to be on the ground when the clock struck eleven. But then, in their numerous turnings, they found themselves lost until, while in Victoria Street, they saw the sign "The Niles-Bemont-Pond Co." and then Doc says: "Bob, we are no longer lost, we cannot be far from Plainfield."

* * * And this again reminds me that Bob had in his pocket a cheap watch which cost five dollars in Paris. He and Doc one evening while in London took a Thames boat and made a careless and ignorant landing and found themselves at the gate of Greenwich Observatory. They could not pass the gate, but here these two boys unexpectedly found themselves at the center of time. They found themselves at the place that ever since they were children they had seen printed down in the corner of the maps in their geographies. There was a clock at the gate and Doc suggested that they do themselves the rare honor of setting their watches by real Greenwich time. They did so, but it happened that Bob's five-dollar watch was correct to the dot and did not need setting.

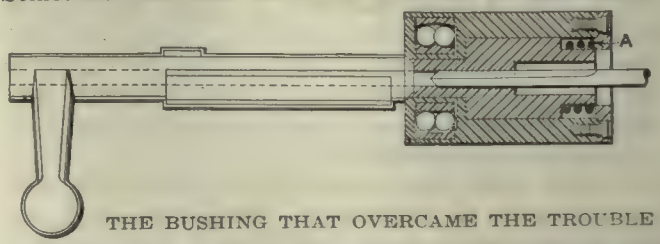
* * * George wanted a little vacation from the drawing room, and he fetched up at Yellowstone Park, where there happened to be a military post where each evening there would be a dress parade, the firing of the evening gun and the lowering of the colors. George got acquainted with one of the officers and explained to him that he was curious to know how they got their time out in that region. The officer explained that there was a jeweler downtown whose regulator was always kept at the correct time and the officers at the post went by that regulator.

* * * But George happened to be downtown and made a call on the jeweler for some purpose, and idly asked the jeweler how he got his time. The jeweler explained that it was simple enough, and that all that he had to do was to listen for the evening gun up At the post. Very respectfully, CHORDAL.

A Bushing For Drilling Breech Bolts

BY JACK FINLAY
New South Wales, Australia

In drilling the firing-pin holes in the breech bolts of service rifles, we have had considerable trouble. In this operation the breech bolt revolves, one end being guided by a countersink in the drill bushing. Sometimes the bolts would run free and at other times



THE BUSHING THAT OVERCAME THE TROUBLE

they would stick or seize in the bushing. The bolts that ran free were glazed or burnished where the chamfered end bore in the countersink of the bushing, leaving a hard skin which quickly dulled the milling cutters used in a later operation.

We overcame this trouble by making a new bushing in which was incorporated an SKF ball bearing, as shown in the illustration. The inner member of the bushing is free to revolve with the breech bolt with which it is kept in contact by the stiff spiral spring *A*. The drilling was done on a Pratt & Whitney deep-hole drilling machine.



HIGH PRODUCTION TOOLING METHODS

AS APPLIED TO THE MACHINE-GUN TRIPOD, MODEL 1918

By

Albert A. Dowd & Donald A. Baker

I. Planning and Organizing

This series of articles takes up the matter of engineering a high-production tooling proposition from start to finish, or in other words, from the planning to the installation of the tools. Furthermore, it shows how such a job can be handled efficiently by an engineering organization specializing on this class of work. Permission has been granted by the Ordnance Department, Washington, D. C., to publish this data.

DURING the war our Government turned over contracts for building military equipment to various manufacturers all over the country. Some of these were well organized and their regular line of manufacturing work compelled them to have excellent engineering organizations of their own which were expanded to suit the abnormal demands of excessively high production along the new lines of manufacture. Others had no engineering and drafting departments and were constrained to organize for the purpose or to have their designing and engineering work done outside of their own factory. Some other firms had a small engineering force and were unable on account of insufficient space, to increase their capacity to an extent great enough to handle the extra work thrust upon them.

The result of this lack of engineering facilities opened up a field for engineering offices, so that various firms who were prepared to do designing and drafting work had an opportunity to get into the game to some extent depending upon their capacity, ability, and the force of men at their command. Ordinarily the manufacturer with his own engineering and drafting organization has found it rather unsatisfactory to have the work done outside. During the war, however, much of the work was handled in this way from force of necessity and in some cases satisfactory results were obtained. Some good work was obtained when the planning of operation was done by the manufacturer to whom the contract had been let. On account of his knowledge of his own equipment of machine tools he was able to lay out operation sheets calling for the various tools needed and turn over the work to an engineering company so that they could design the fixtures for the machine tools as specified in the operation sheets. When this preliminary work was carefully done the results were very satisfactory to the manufacturer, but in some cases the preliminary planning was done hurriedly and the results obtained were not as satisfactory as they should have been.

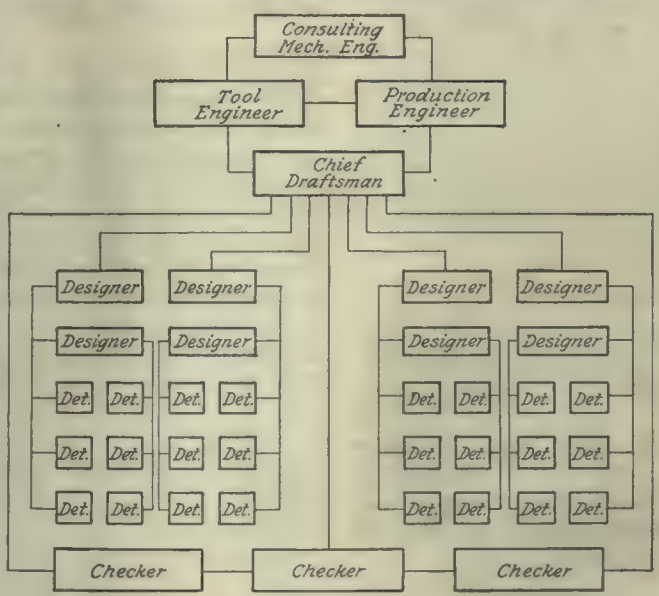


FIG. 1. ORGANIZATION CHART

Some of the best work was done by engineering organizations who were competent to plan the work, establish gaging systems, and design and build the tools. Firms of this kind took over in some cases the entire design of tools and gages for some complete piece of equipment, and carried it through to a successful conclusion. The Service Engineering Co., of 25 Church St., New York, handled a great deal of this work, doing their own planning, designing tools and gages and supervising the building of these tools in various tool shops in and around New York. One of the most interesting propositions handled by this company was the designing of tools, fixtures and gages for the machine-gun tripod, model 1918. It is the purpose of this article to illustrate the methods used and to show how efficiently such an organization can work out and handle a proposition of this kind, finally turning over the tools to the manufacturer ready for use.

It is evident that any engineering organization in handling work for an outside firm is obliged to take the greatest care both in planning and designing, especially when the production runs into a number of thousands of finished pieces. In the case of the machine-gun tripod, 20,000 were to be manufactured and therefore the tools designed were to be of the best. Furthermore, a complete gaging system was required on account of the Government inspection of parts.

As it is evident that maximum efficiency depends

largely upon organization, an organization chart is shown in Fig. 1. A reference to this will make it apparent just how work of this kind can be produced rapidly, and carried through systematically so that the manufacturer commences to get results in a very short time after the order has been placed.

Determining Factors in the Design of Tools

In building a house a man naturally starts at the foundation, and likewise in the design of tools, fundamental points which are determining factors in the design must first be taken into consideration. Starting at the bottom, therefore, any engineering firm which is to handle an outside proposition must know:

(A) Production required.

It is evident that if a small production is needed on any given piece of work the tools should be made as simple as possible in order to make the unit distributed

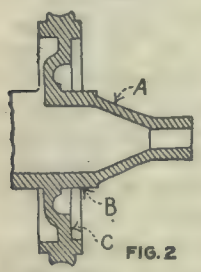


FIG. 2

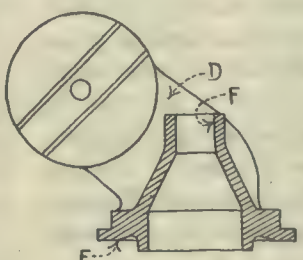


FIG. 3

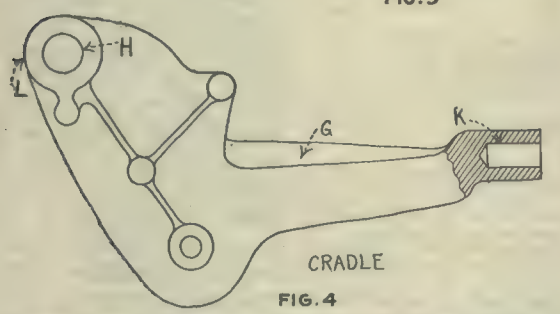


FIG. 4

FIGS. 2 TO 4. SELECTION OF WORKING POINTS
Fig. 2—Pintle. Fig. 3—Head. Fig. 4—Cradle.

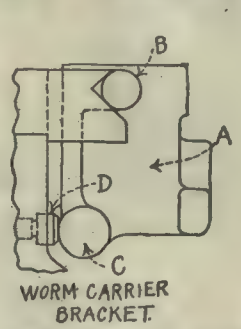
cost as low as possible. On the other hand, if a large production is required, the tools can be much more elaborate and the methods of locating and clamping can be so arranged as to permit the greatest rapidity in handling.

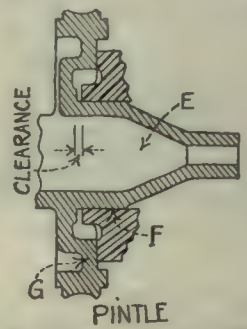
(B) Accuracy desired.

It is obvious that a farm implement, like a mowing machine, does not require so great accuracy in manufacture as a sewing machine, typewriter or something of this kind. In either case, however, it is necessary before going ahead with the design of tools to determine the permissible tolerances on the work so that due precaution can be taken in the design of tools, and to control the size of the work so that it will be manufactured within the required limits. Assuming that certain holes or shafts are to be held within a tolerance of 0.0005 in., in all probability it would be necessary to grind both the hole and the shaft, while if the tolerance were 0.003 in. to 0.005 in. the hole could be reamed and the shaft turned. So it will be seen that the accuracy desired affects both the tool equipment and the machine tools used.

(C) Machine tools available or to be bought.

The machine tools available in different factories have also an important bearing on the work to be produced. Assuming that the machine-tool equipment is modern and well kept up, the manufacturing processes would be much simplified. On the contrary, with antediluvian machine tools and with other equipment of a like nature, it is evident that considerable ingenuity would be





FIGS. 5 AND 6. LOCATION OF WORK IN FIXTURE
Fig. 5—Worm carrier bracket. Fig. 6—Pintle.

necessary in the design of tools to conteract the inaccuracies of the machines.

(D) Human factors used in production.

The workmen who handle the machines affect the design of tools very largely. In a factory where unskilled labor is used, the tools must be designed in such a way that they are strictly foolproof and all kinds of provision must be made to lessen the chance of error resulting from this class of labor.

Fundamental Points Affecting the Design

The four points which have been taken into consideration in the paragraphs just preceding, must be borne in mind throughout the design of tools. In addition to these points there are many others which must be considered for each individual case. Perhaps the best method of indicating what these points are, is to cite them briefly here and then show their application to various conditions when describing the tools illustrated in the body of the article. In the design of the tools for the machine-gun tripod, the production is sufficiently high to warrant a considerable expenditure for this

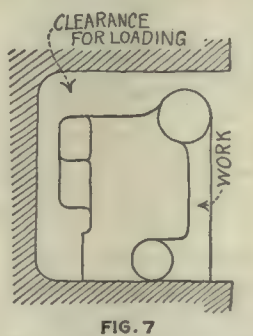


FIG. 7

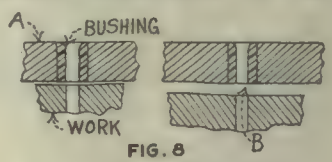


FIG. 8

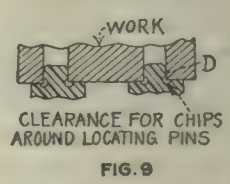


FIG. 9

FIGS. 7 TO 9. CHIP AND LOADING CLEARANCES
Fig. 7—Loading clearance. Fig. 8—Clearances below drill bushings. Fig. 9—Clearances around locating pins.

purpose. We shall, therefore, consider the tools from the viewpoint of those wanted for high production and shall not take up points in design which would be necessitated by low production work. Perhaps the best way to make the matter clear is to make a definite statement that the production required was high; the accuracy required extremely close; the machine-tool equipment of the best and extra machine tools bought when the proper machine was not available; and the human

factor of unskilled labor, both male and female. In many cases girls operated milling machines, light gear cutters and some other machines not requiring hard manual labor.

The selection of working points is of extreme importance and it is advisable to lay out the operations on the work in such a way that after one or more machining operations, it can be located for the remainder of the operations by the same locating points or surfaces. If this is done, there will be little trouble experienced from inaccurate work, but on the other hand, if one working point is used to obtain another surface for subsequent operations, and so on using different working points as the work proceeds, nothing but final disaster can result. If the tools can be so arranged that a surface in one plane and a hole at right angles to it can be machined early in the operations, these can be used to work from throughout the handling of the work with excellent results. This matter will be more fully treated under the description of methods and laying out operations.

Several examples of the selection of working points

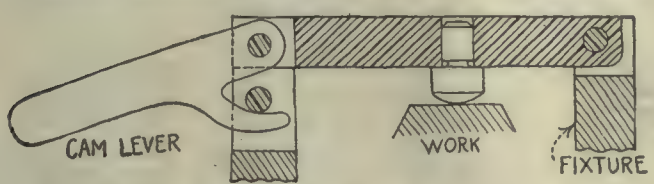


FIG. 10. SINGLE CAM-LEVER FIXTURE

are shown in Figs. 2 to 4. In Fig. 2 which shows the pintle *A* of the machine-gun tripod, the important working surfaces are noted at *B* and *C*. These two surfaces are machined within the limits specified in the first operation and they are used to work from in all subsequent operations. The method of holding for the first operation will be taken up when starting the turret-lathe operations. In Fig. 3 which shows the head *D* of the machine-gun tripod, the surfaces *E* and *F* are used to work from after they have been machined in the first operation on a turret lathe. The method of holding for the first operation will be illustrated when describing the turret-lathe tools. In Fig. 4 showing the cradle *G* of the machine-gun tripod, the working points are the holes *H* and *K* (which, it will be noted, are in two different planes) and in addition thereto, the two milled surfaces between the lugs *L* which are not shown in the illustration. These are used for working points throughout the machining operations.

If the work has had no previous machining operation, it is evident that the locating points must be arranged so as to work from the casting or forging in the rough state. It is well-known by all tool designers that rough castings or forgings must never be located on more than three fixed points. If any others are necessary, they must be made adjustable and provided with an efficient method of locking after adjustment. Locating points must be so arranged that they will strike on clean parts of the casting or forging, so that variations will not be caused by improper location against fins, flashes, gates, or other inequalities on the work. It is very important that all locating points should be readily accessible, so that they can be cleaned without difficulty, in order to make sure that locations will not be affected by dirt or chips accumulating on the points.

Referring to the worm carrier bracket *A* in Fig. 5, the location of the work for the first operation is in V-blocks on the rough bosses *B* and against the lug *C*. It will be noted that both of these lugs would be likely to be free from inequalities which would tend to cause improper location. It is apparent that both the V-block and locating pin *D* should be hardened and so arranged that they can be easily replaced in the event of wear.

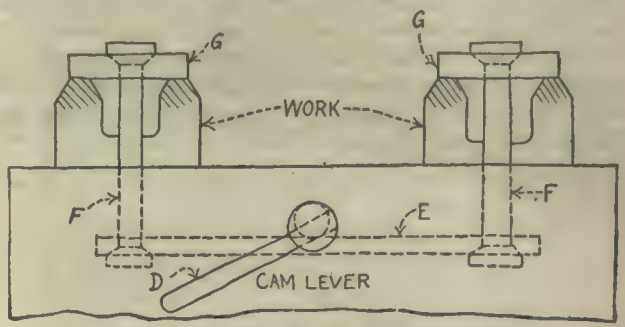
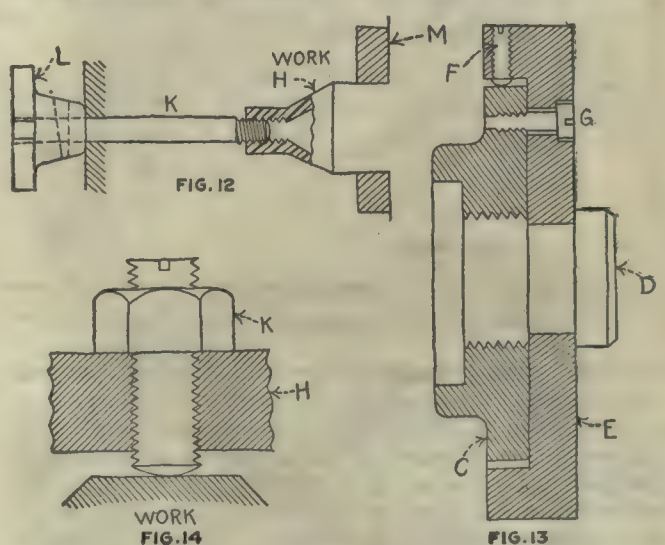


FIG. 11. CAM LEVER FOR TWO PIECES

If the work has been machined in a previous operation, still greater care is necessary to insure correct location of the work on the locating points. In cases of this kind it is unnecessary to have three points of location although this is sometimes desirable, in order to have fewer surfaces to clean. Considerable care must be used, however, in clamping in order not to distort the work or throw it out of position.

An example of this kind is shown in the location of the pintle *E* in Fig. 6, which has been finished in a previous operation as described under the preceding heading. Also as the surface *G* bears a fixed relation to some of the important working parts of the tripod, no better place can be selected from which to work than that indicated. It is evident from the two examples shown that the location of the work on the fixture is



FIGS. 12, 13 AND 14. PROVISIONS FOR UPKEEP OF TOOLS.
Fig. 12—Pull-back device. Fig. 13—Adjustable faceplate.
Fig. 14—Adjustable contact stud

of sufficient importance to merit careful consideration in planning.

The matter of clearances in the fixtures must be considered in order to make sure that there will be plenty of chip room, and that the sides of the fixture do not approach too closely to the work, so that the loading can be readily accomplished. In this connection it should be borne in mind that castings or forgings vary

somewhat in size, and therefore the clearances around the work should be ample to take care of these variations, as indicated in Fig. 7. Plenty of hand clearance must also be provided. The chips which come from a drill or any other tool sometimes cause trouble unless proper provision is made. In the case of drill bushings these should be right down on the work as shown in Fig. 8 at *A*, or should have sufficient clearance between the end of the bushing and the work, as shown at *B*, so that chips will not pack or crowd between work and bushing and cause trouble. When locating pins or studs enter holes in the work, it is necessary to make sure that dirt or chips do not collect at these points. Pins a screw. This sometimes makes it necessary to provide equalizing devices so that a clamp will rock on a rough surface and will, at the same time, carry the work into its proper position against locating points or surfaces.

The matter of rigidity under the pressure of the cut is especially important when milling fixtures are to be designed. Speaking generally, these should be heavy and provided with plenty of backing immediately behind the portion of the work on which the cut is being taken. Turret-lathe fixtures also need to be made so that the work will be very well supported to prevent "chatter." In a drill jig where a thin portion is to be drilled, this portion must be well supported so that the

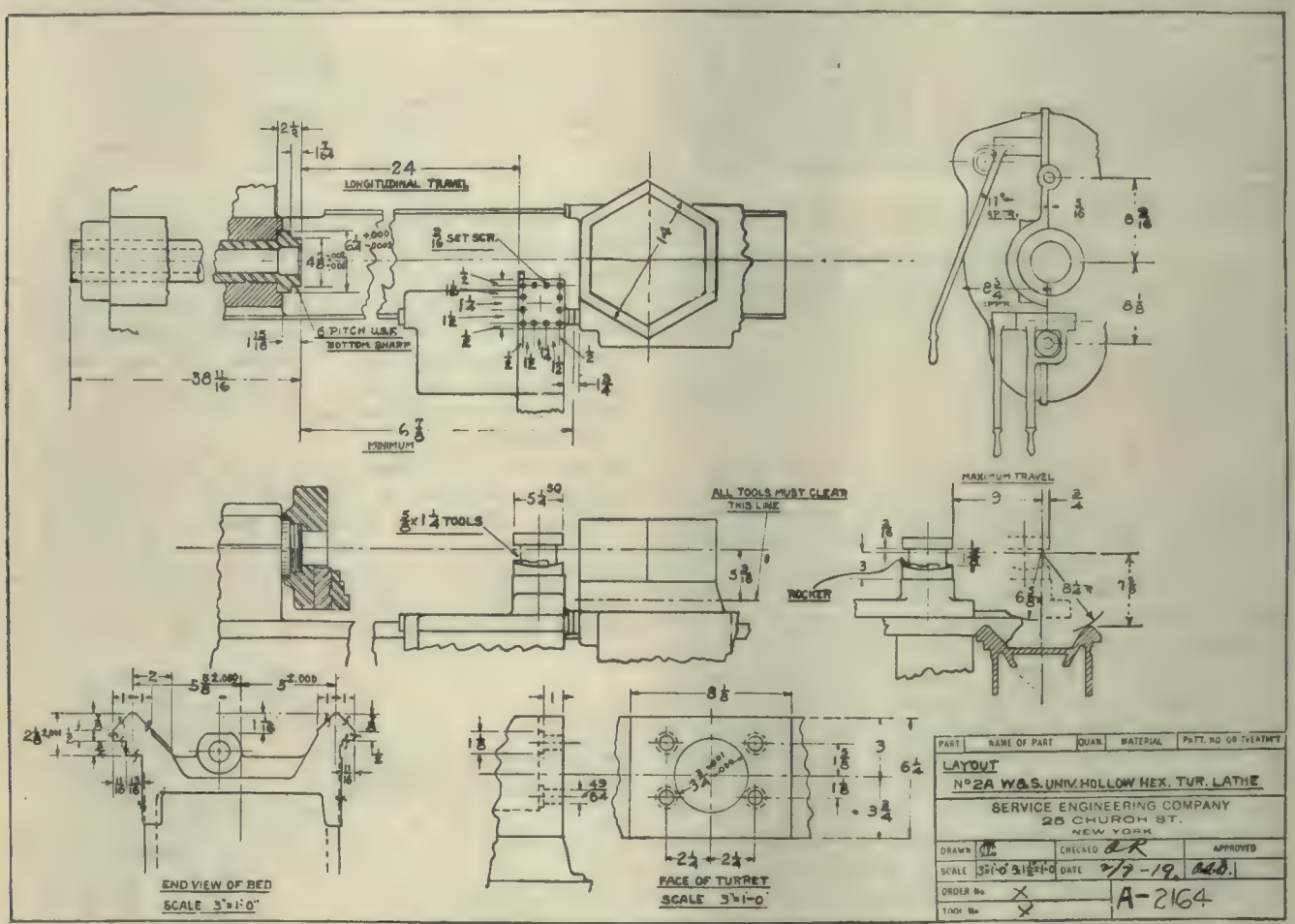


FIG. 15. REFERENCE DATA SHEET

are frequently recessed or grooved for this purpose, as shown in Fig. 9.

The matter of holding the work in position in the fixture is one of the most serious problems which the tool designer has to solve. It is necessary to take into consideration such things as distortion of the work due to an improper method of clamping, improper location caused by the action of the clamps tending to throw the work out of its true position, and one clamp acting against another so that there is a possibility of an error in setting up the work in case one clamp should be tightened before another one.

The matter of making a fixture foolproof so that the work cannot be placed in position wrongly should be given considerable attention. In high-production fixtures it is desirable, if possible, to arrange the clamping system so that the work can be placed in position and held firmly with one movement of a lever or one turn of work will not spring away from the drill during the machining.

Figs. 10, 11 and 12 show several examples of clamping methods in common use. Fig. 10 shows an ordinary type of cam lever and leaf clamp, the action of which is familiar to all tool designers. Fig. 11 shows a method of clamping two pieces at the same time with an equal amount of pressure by using a cam lever *D* operating on a connecting link *E*. The latter in turn pulls down the bolts *F* which operate the clamps *G*. The example shown in Fig. 12 is an ordinary pull-back arrangement frequently used in turret-lathe work to hold a threaded piece back against a faceplate. The work *H* has been previously threaded so that it receives the end of the screw *K*. By the operation of the knob *L*, the work is drawn back against the locating surfaces *M*, as indicated.

The replacement of locating pads, pins, bushings or

S. E. No. 523-A Tool No. E-34498
Customer P. O. No. A-19843
Name of Tool: Special Chuck for holding spindle part # 300-58 on # 2A-W. and S. Turret Lathe.

Date

Designing

Detailing

Checking

Remarks:

FIG. 16. INSTRUCTION CARD

any other parts which are subject to wear, must be provided for. In high-production tools all of these items should be made of hardened steel and so located that they can easily be trued up or replaced by other parts when worn. Provision should be made for driving out locating pins if necessary for replacement. Cutting tools should be so designed that they can be adjusted and reground a number of times.

Referring to Fig. 13 an adapter *C* is shown which screws on the end of a turret-lathe spindle. The work is located on the stud *D*, which is fixed in the faceplate *E*. In order to provide for truing up the faceplate on the machine, it is so mounted that adjustment for concentricity may be made through the screws at *F* and *G*. Another example of provision for the upkeep is shown in the adjustable locating stud in Fig. 14. This stud is screwed into the body of the fixtures *H* and has a locknut at *K*, which holds it in place after it has been adjusted.

Attention must be paid to the operator's safety, and precautions must be taken to prevent accident due to careless handling of the fixtures. Projecting setscrews or lugs on revolving parts should be avoided, and anything which will tend to catch in the operator's clothing must be guarded against. At the present time there are many girls working in machine shops, running milling machines and other tools, and for this class of operators it is particularly desirable to make all possible provisions for safety.

The selection of the machine tools to be used on a given piece of work is of considerable importance. It is usually necessary to have the coöperation of the manufacturer for whom the work is being done, in order

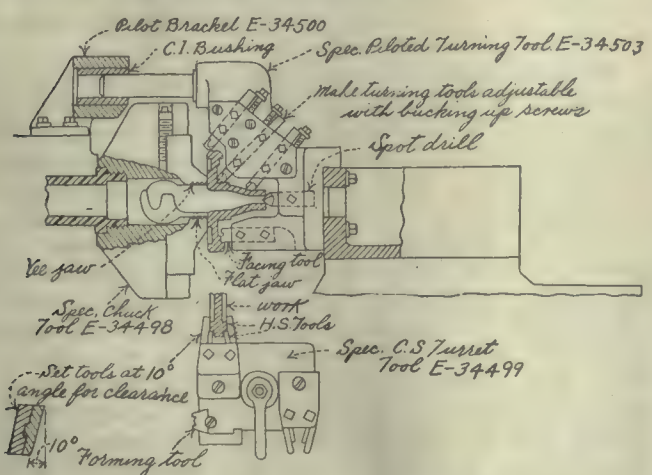


FIG. 17. PRELIMINARY SKETCH

that the machines selected will be such as can be profitably spared from production of any other work which may be in process at the time. Any engineering firm which handles work of this character, must be provided with diagrams and data of all kinds of machines in use. The accumulation of this data and its upkeep is an important factor in the design of tools, because constant reference is made to it during the progress of

SERVICE ENGINEERING CO. TOOL No. 6A-1
CHECKERS SLIP DWG. No. P-41801

✓	Design· change as noted below
✓	Easy and Straight to Read
✓	Each Part Correctly Illustrated
✓	Title ✓ Part No. ✓ Tool No. ✓ Dwg. No. ✓
✓	Stamping
✓	Checking Dimensions see notes
✓	Clearances
✓	Limits
✓	Specifications of Material
✓	Treatment of Material
✓	Pattern Nos.
✓	Finishes
✓	Checking Corrections
✓	Tie up with other Tools none
✓	Review

REMARKS:
(1) Change $4\frac{27}{32}$ to $4\frac{29}{32}$
(2) Make $\frac{7}{16}$ threaded hole ½" std
(3) Increase thickness of wall to $\frac{3}{4}$
(4) Specify thd diam 4 × 5 pc.
(5) Make plug hole so that plug can be easily removed if necessary

DATE 8/24-18 O. K. A.R.

FIG. 18. CHECKER'S SLIP

the design in order to make sure that there are no interferences of any kind with the various parts of the machine when in operation.

An example of one of these sheets is shown in Fig. 15, this being a Warner & Swasey No. 2A turret-lathe. It will be seen that all important data in regard to the maximum and minimum movements of the machine and other points which involve the matter of clearances are specified on the sheets. There is also another sheet (not shown) which gives dimensions of all standard tools, so that adaptations of these can be made when necessary. The sheets mentioned are standard size drawings, which are in loose-leaf form and carefully filed so that they can be referred to at any time.

The System Used in Planning Work

Very few manufacturing organizations would attempt to put through any work in the factory without knowing pretty well how they were going to do it. It is fully as important in an engineering organization

to carry out the various steps logically in order to gain maximum efficiency. Let us assume that the work which is to be done is in the nature of a tooling proposition. Let us take up the steps through which such a proposition is carried to a successful conclusion, using as a basis illustrations of the machine-gun tripod, model 1918. A number of tools and gages used in the production of this mechanism will be shown in this series, and comments made when needful.

The first logical step in the development of a tooling proposition is an open conference of the engineers on the various parts of the mechanism which are to be tooled. At this conference the parts are taken up separately and considered with a view to the best method of handling the various machining propositions. Working points are suggested, and a general attempt is made to see what parts are of the greatest importance and how the operations can be carried through to the best advantage in order to secure the desired production within the required limits of accuracy. It is highly desirable that the rough castings or forgings of the parts should be on hand at this conference and it is a great advantage to the tool engineer to be able to look the parts over when planning the operations. The object of the conference is to concentrate a number of trained mechanical minds on a single proposition and thus take advantage of their specialized experience. Discussions arise as to locating points, working points, and the suitability of various machines for a given piece of work, and it is possible through a conference of this kind to analyze the proposition thoroughly and obtain highly satisfactory results.

At the conference, it is customary to rough out a method of handling for a given part, and the tool and production engineers make notes for their future guidance. These notes of the methods of handling are subject to revision when the work is gone over in detail by the engineers in laying out the operation sheets. As a matter of fact, however, unless the proposition is a very complicated one, the sequence of operations is generally not changed greatly. The memoranda taken at the conference give very good data for a starting point, so that sketches can be rapidly made to put into the drafting room in a short time after the work has been taken over.

In laying out the operation sheets the tool and production engineers work hand in hand, using the data obtained from the conference and afterward gone over carefully to determine whether there are any weak points in the methods or not. Referring to Table I, a completed operation sheet is shown on the pintle for the machine-gun tripod, model 1918. It will be noted that all tools and gages needed on the work are carefully itemized and given a tool number. The work which is to be done and the working points are carefully specified. The various dimensions to which parts are to be finished are also specified. There are no generalities used; everything is definite and to the point. It is by no means necessary for the chief draftsman to have a copy of the operation sheets in detail before he proceeds to hand out the work to his tool designers, but he is frequently called in to a conference with the tool and production engineers so that he understands thoroughly what the sequence operations is. In this way he keeps in touch with the entire proposition as it progresses.

TABLE I—OPERATION SHEET

Oper. No.	Description of Operation and Method of Holding Work	Type of Machine	Tools, Gages and Fixtures	Tool No.	S. E. Co. Order No.
1	Inspect casting				
2	Grind off gates				
3	Sand blast				
4	Hold by outside of segment end in special 2-jaw chuck	No. 2A W. & S. Turret Lathe	Special chuck	6A-1	528-A
	A: Rough turn O. diameter		Multiple turn. head	6A-102	528-B
	Rough turn 2.040 diameter		Bracket on Headstock	6A-102	528-F
	Rough turn 0.915 diameter		Gage for setting tool	6A-102	528-D
	Spot drill end		Spotting drill	6A-102	528-C
	Rough bore and face 4.210		Special C. S. tool block	6A-103	528-E
	Rough face both sides of flange				
	Rough straddle shoulders 0.580				
	B: Finish turn 2.009 diameter		Multiple turn head	6A-102	528-G
	Finish turn 0.885 diameter		Setting gage for tool	6A-102	528-H
	Finish bore and face 4.240		Face mill for end	6A-002	528-I
	Rough face end 0.885 diameter		Spec. C. S. tool block and tools	6A-103	528-E
	Finish face both sides flange				
	Finish straddle 0.560 shoulders				
	C: Size 1.999 diameter		Mult. turn head	6A-102	528-J
	Size 0.8745 diameter		Setting gage for tool	6A-102	528-K
	Size 4.250 diameter		Face mill for end	6A-102	528-I
	Finish face end of 0.875 diameter		Form tool	6A-003	528-E
	Form worm gear blank				
	D: Drill hole for ⅛ in. tap		Drill holder	6A-104	528-L
			Tap drill	6A-104	528-M
	E: Tap ½-13th hole		Tap holder	Std.	
			½-13 thread tap	Std.	
			Gages		
			0.560 snap gage		528-X
			Templet for gear form		528-Y
			5.1726 throat diameter		528-Z
			Recess depth		528-ZA
			4.250 diameter		528-ZB
			1.999 diameter snap		528-ZC
			Bottom of recess to end		528-ZD
			0.8745 snap		528-ZE
5	Straddle mill segment end	No. 4 Cincinnati Milling Mch.	Milling fixture	6A-2	528-N
			Straddle mills	6A-2	528-O
			Gages		
			Gage for relation of side to centerline		528-ZF
6	Stationary drill jig	Drill Press	Drill jig	6A-3	528-P
	Drill and ream ⅝ hole using ⅝ drill and ⅝ reamer		Magic chuck	Std.	
			⅝ drill	Std.	
			⅝ reamer	Std.	
			Gages		
			⅝ plug		528-ZG
7	Mill ratchet teeth on segment end	Plain Milling Mach.	Milling fixture (Index)	6A-7	528-Q
			Formed milling cutter	6A-7	528-R
			Arbor		528-S
			Gages		
			1⅛ radius over top of teeth		528-ZH
8	Drill 0.246 hole	Sensitive Drill	Drill jig	6A-4	528-T
			0.246 (*d*) drills	Std.	
9	Drill 0.128 diameter hole	Sens. drill	Drill jig		528-U
			0.128 (No. 30) drills	Std.	
10	Stamp figures and graduations	Punch press	Punches, dies and holders	6A-5	528-W
11	Hob the worm gear		Hobbing fixture	6A-6	528-W
12	Test worm gear		Testing fixture		528-X
13	Inspect				

While the production engineer is laying out the operation sheets the tool engineer makes sketches on section paper in approximate proportion for the various tools and gages to used in the work, Fig. 17, and at the same time he writes a card, Fig. 16, which gives the draftsman the name of the tool and where it is used. It will be noted that the sketches of the tools are rather rough as they are made somewhat rapidly, but the locating points and general methods of clamping are carefully worked out so that when the tool designer gets the information, the entire matter is very clear to him. The instruction card to the draftsman is so arranged that a record of the time spent on the drawing can be kept on it and filed away for reference. It will be seen that a system of this kind leaves nothing to chance and gives the chief draftsman an opportunity

to select the best man for the various jobs and to plan in advance just how he can put the work through to the best advantage.

The system by which the jigs, fixtures, and gages are designed and detailed is as follows: The chief draftsman hands over the sketch and instruction card to one of his tool designers who has under him three or more detailers. The tool designer works out his design on brown paper, not being very particular as to accurate dimensions, but getting the idea worked up. When the idea has reached a stage so that it can be criticized the chief draftsman makes any suggestons that he may find advisable, and after these suggestions have been embodied in the design, the rough layout is handed over to one of the detailers who works up the design carefully on tracing paper. When this is completed the detailer draws up the various details so that the work can be placed in the shop.

If the work is being done subject to approval by the chief engineer of the concern for whom the work is being done, it is the custom to submit a rough design to him for approval before handing it over to the detailers. This process is of course unnecessary when the responsibility is entirely assumed by an engineering concern.

After the tools have been designed and detailed, they are ready for the checking and are set aside for this purpose, subject to the checker's requirements. In checking over the drawings it is advisable to use a checker's slip as shown in Fig. 18. It will be noted that this slip specifies certain things which are to be checked on all drawings and leaves a space for other corrections and remarks. These sheets are made so that they can be filed in a loose-leaf book and safely kept for future reference in the event of any controversy in regard to changes in design or corrections. Sometimes there are several of these slips on a single drawing, and it will be noted that the corrections are given a number so that quick reference may be made to each one by the draftsman who makes the corrections. A system of this kind in checking eliminates the possibility of an omission on the part of the checker and provides a permanent record of the thoroughness with which the drawing has been checked. After the corrections have been made, the drawings are blueprinted and are ready to send to the pattern shop and toolroom.

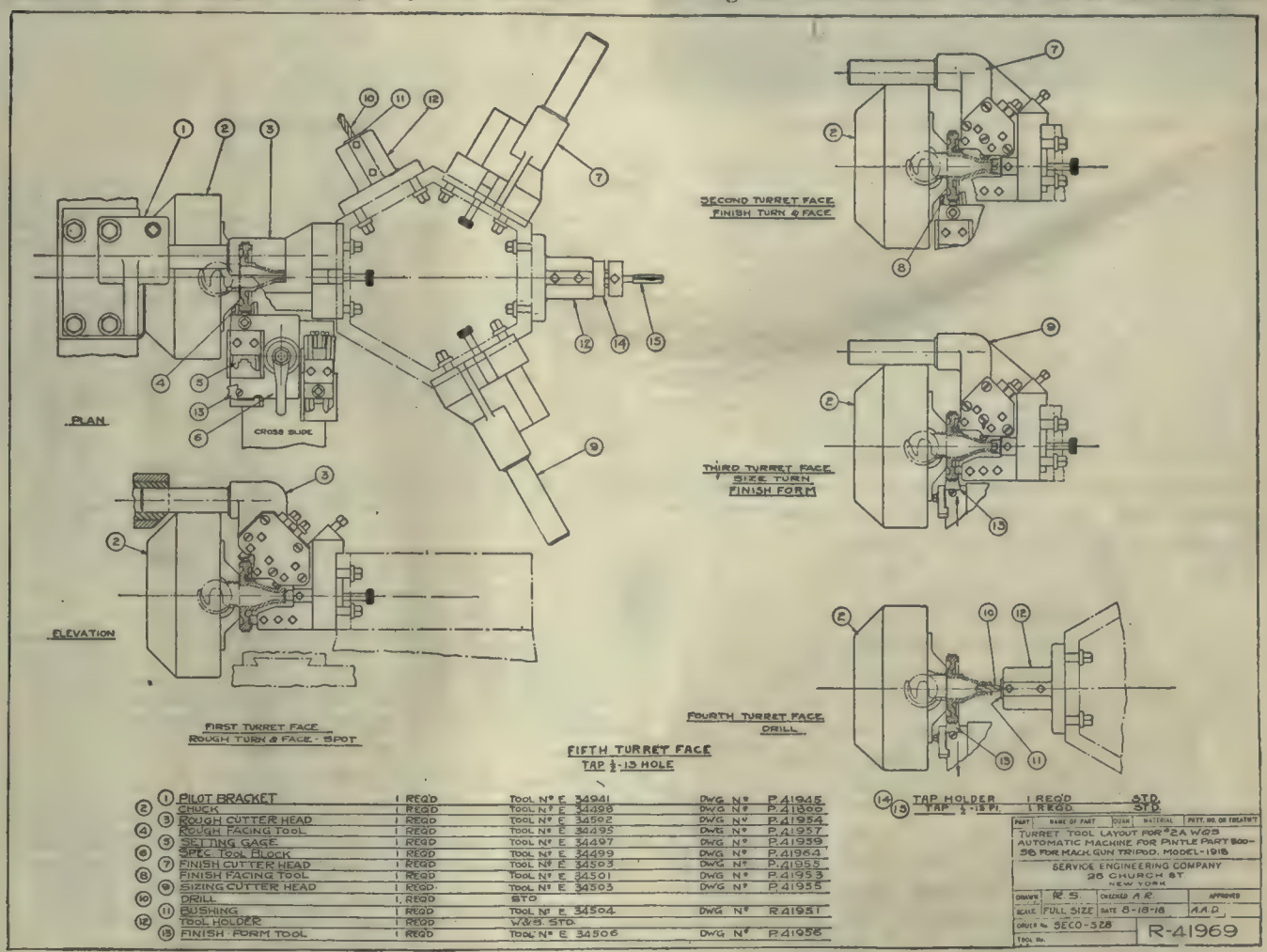


FIG. 19. TOOL LAYOUT FOR TURRET-LATHE WORK

It is very desirable in any work of an important nature to lay out the various operations to scale in order to show the tooling set-up, so that the workman in the factory can understand exactly how the various tools are to be used. An example of a turret-lathe layout for the pintle of the machine-gun tripod is shown in Fig. 19, and it will be noted that all of the tools are shown in position and that the various operations on the work are illustrated diagrammatically. The actual job is shown in Fig. 20. In addition to this data a complete record of the tools themselves with the tool numbers is given at the bottom of the sheet. When a system like this is used, it is a simple matter for the workmen to grasp the method of handling on a given piece of work and

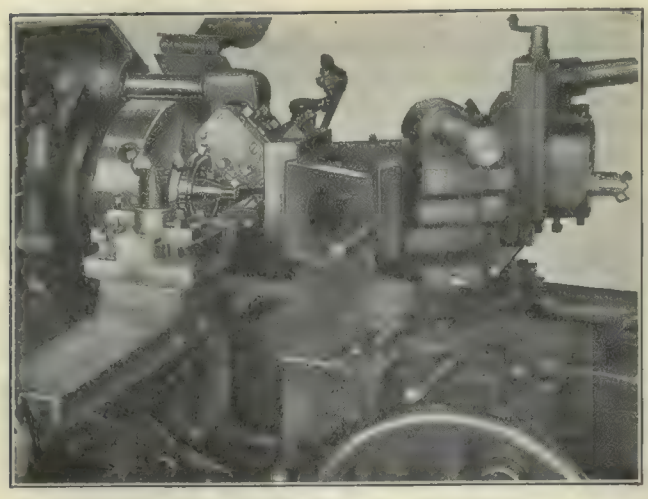


FIG. 20. TOOL SET-UP FOR TURRET-LATHE

set up his tooling equipment without making use of the "cut and try" methods.

A reproduction of the first sheet of workmen's instruction cards is shown in Fig. 21 for the tool layout which has been mentioned. A reference to this figure will disclose at the upper left-hand corner a partial drawing of the work, giving only the dimensions to which the piece is machined in the operation specified. A general description of the operation is given at the right and the remainder of the card specifies in detail just how the operation is to be performed, the tools required, and the tool numbers. The cutting speed in feet per minute together with the revolutions per minute and the feed are also specified.

It is possible for a workman to take this card to the tool crib when starting in on a given piece of work, determine from it just what tools he needs and then place them in position on the machine by referring to the tool layout. He can then go ahead with his production, being governed as regards his cutting speed by the instructions on his card. If, after this, production does not reach the amount desired, or if he finds that he cannot run at the specified speeds, he must consult with his foreman who will take it up with the production engineer and see where the trouble lies. It is entirely possible, however, to specify this work so carefully that changes are seldom found necessary in either the set-up or in the time specified for the work. There are, of course, cases when the castings are particularly hard and the cutting speeds called for cannot be used, but in the majority of cases this matter can be remedied by more careful attention on the part of the foundry man.

In building the jigs, fixtures, and other tools used, the most careful supervision must be exercised in order that no mistakes can occur which will tend to make the work inaccurate. Proper toolmaking methods together with good supervision, and machine tools of up-to-date character operated by workmen of ability, insure that the tools will be in accord with the drawings and leave little chance for argument on the part of the inspector after they are finished.

Factory Coöperation Necessary

Coöperation with the factory for whom the tools are made by assisting to start production after the tools have been designed and built, and the following up of the design and building of tools with their proper installation, are valuable factors in the services rendered.

The next article of the series takes up the design of tools in detail.

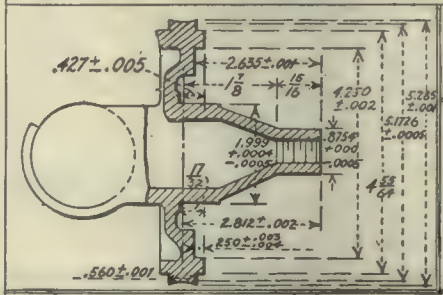
Rate of Depreciation of Office Equipment

By Robert L. Avery

In computing the depreciation on "furniture and fixtures"; that is, on office equipment such as furniture, filing cases, typewriters and the like, it is customary to assume that it depreciates at the rate of 10 to 20 per cent. per year. In the Milwaukee three-cent case, one of the experts retained assumed a depreciation rate of 12½ per cent. on furniture and fixtures, while three others assumed a rate of 20 per cent. Probably a 15 per cent. rate would be a fair average value for usual conditions.

WORKMAN'S INSTRUCTION CARD 1/5

NAME OF FIRM Nelson Blower & Furnace Co.



Oper No. 4 Part No. T-18-6A

Name Pintle

Mach. #2A W & S Turret Lathe No.

GENERAL DESCRIPTION of OPERATION

Finish turn, form and face worm gear blank; finish bore and face recess; finish turn and face .8745 diam. finish turn 1.999 diam. drill and tap 1/2-13 hole.

Item	Description of Operation and Setting up Instructions	Tools Required	TOOL NUMBER	Cutting Speed Ft/Min.	R.P.M.	Feed	Time Req- Min.	Prod. Per Hour
	Place work in chuck. Hold by outside of segment end (with open side toward movable jaw) in special 2 jaw chuck.	2 jaw chuck	6A-1				1/2	
	Set various tools to dimensions specified. Lock carriage in position. Set working stops and feed knockoffs.	(3) Setting Gages	6A-102					
1	Bring up turret and throw in feed specified						1/8	
	Turn O.D. to 5-5/16	Mult. Turn. Head	6A-102	110	78	34	1/2	
	Turn 2.040 diam.							
	" .915 diam.	Bracket on Head-stock	6A-102					
	Spot drill end	Spotting Drill	6A-102	Tools working at same time				
	Bore and face recess to 4.210 diam. .240 deep							
2	After starting turret feed bring up C.S. and throw in feed specified	Spec. C.S. tool block and tools	6A-103	110	78	34	1/8 1/2	
	Face both sides flange							
	Straddle face shoulders .580						1 1/4	

FIG. 21. WORKMEN'S INSTRUCTION CARD

Computation of Earnings

By CHESLA C. SHERLOCK

Perhaps the knottiest problem in arriving at a fair compensation for injury to a workman is in determining what should constitute the average annual earnings for the year preceding the accident. The man may have worked only a part of a year with his present employer or he may have lost considerable time from unavoidable causes. Should he receive the same amount as one who has faithfully put in full time or should he be classed with the man who is a part-time worker from choice? Then too what is to be done in the case of a workman in a seasonal occupation such as canning?

PROBABLY there is no subject under the workmen's compensation acts which is so fruitful of dispute between employers and workmen as the computation of earnings. The compensation acts attempt to reimburse an injured workman for his loss of earning power or efficiency by the payment of weekly compensation based on an average percentage of his annual earnings for the year next preceding the date of injury. The percentage of compensation payable varies in the respective jurisdictions where the system is in force, running all the way from 50 to 75 per cent. of the workman's earnings.

The difficulty is in reaching the amount of the workman's "average annual earnings" for the year next preceding the date of injury. If a workman has been employed only a short time or has been employed for a full year, but has been absent from work for a long period during that year, he objects most strenuously to the annual basis of computation and contends for a weekly basis.

As an illustration of the difficulty let us suppose that John Smith has been employed for more than one year in a factory at a weekly wage of $18 but has not been regular in his work, laying off from time to time for various causes. On receiving a compensable injury he contends that since the law in his state allows him 50 per cent. of his average weekly wages he is entitled to $9 compensation. The employer does not agree as that has not been the average weekly wage of Smith for the "year next preceding the date of the injury." The employer produces his books and shows Smith that he has worked only 250 days of the year preceding the date of the injury.

Smith was a six-day worker and earned $3 a day, which multiplied by 250, the number of working days he had been on duty, and divided by 52, the number of weeks in the year, shows his average weekly earnings for the year preceding the date of injury to have been slightly less than $14.50. The employer offers compensation of $7.25, which Smith refuses.

This is a typical problem arising in the computation of compensation and is doubtless experienced by employers in nearly every line of industrial activity. There is merit on both sides, but the matter cannot be definitely settled until the courts have acted on the matter and laid down rules of interpretation which are fairly well understood.

Employers as a rule consider the expression of the statutes upon the subject of computation, "the average annual earnings," to mean the actual earnings of the workman for the year prior to his injury. They advance the theory that there is no better way of compensating a man for what he has lost than by taking his actual yearly earnings and dividing his loss with him on the percentage named by the statute.

This probably sounds fair to all. Why should a worker, who while physically possessed of the means of earning a living has earned at the rate of only $14.50 a week for the year preceding the date of injury, be compensated as if he had been fruitful and diligent and had earned $18 a week? If he was a faithful, hard-working fellow this theory would compensate him the more for his industry, while if he was lazy or indifferent and could lay off from time to time and still collect as much compensation as the diligent workman it would tend to demoralize industry and place an unequal burden on the employer and on the faithful workman.

This is doubtless a true conception of the basic principles of the compensation system, and it would obtain more universally if all workmen could be considered justly as belonging to the same class. But the theory fails in the estimation of the courts because it does not present a solution applicable to all workmen alike.

An Illustration

Let me illustrate. Suppose that John Smith, instead of working a full year for his employer prior to the injury, had worked for the said employer only two weeks before he received the accident which destroyed his earning power or impaired his efficiency. On what basis under this system would the employer compute the compensation due?

In this case Smith has no annual earnings that can be ascertained. The employer does not know whether he is a steady fellow or not. He might be faithful and at the end of the year show a steady income of $18 a week or he might find one excuse or another to lay off and decrease his yearly earnings because he preferred to rest rather than work steadily. It is obvious that the theory of computation advanced above would fail to take care of all workmen who had worked for their employers for less than a full year preceding the date of injury.

And another situation arises which demonstrates the injustice of the theory mentioned. A workman might be absent from work so as to materially reduce his average yearly income through reasons which in no way reflect on his ability and faithfulness as a worker. He might have had sickness in the family; he might have been ill himself or have been kept from his work by other legitimate causes. But under this theory he would be classed with the lazy, shiftless, floater type of workman. The latter class might actually have no greater earning power than was reflected in their wages for the

year preceding the injury, while the first type of workman might have all the actual earning power of a workman who had remained at his bench every working day of the year had unforeseen events not intervened.

In instances where the workman has been employed for less than a full year at the time of his injury it is naturally necessary to ascertain his "average annual earnings" by taking the daily wage and multiplying it by the average number of working days in that particular employment. Very often the statutes specify this method, fixing the average number of working days for all average employments and making provision for a special number being used in case the occupation affords only seasonal or limited employment throughout the year.

The average number of working days in one year in the average employment is generally placed at 300 days. If the statute allows compensation at the rate of one-half of the average weekly wages the compensation due such a workman is ascertained by multiplying the daily wage by 300 and dividing the result by 104, or by 52 and again by 2.

While this method may be criticised by some, it is the only method which can be adopted to cover all cases. It is just to the man who has worked for a full year because it is seldom that a workman, however diligent and steady he may be, works over 300 days in one year. If the workman is only a five-day worker it may appear to work a hardship on him, but it is generally the case that five-day workers receive a slightly higher daily wage than six-day workers in the same employment, so that the higher daily wage will serve to take care of them. It does work a hardship on the seven-day workers, but provision is generally made to take them outside the operation of the 300-day rule.

The Iowa Supreme Court Decision

It has fallen to the lot of the Iowa Supreme Court to decide a case which is generally considered the leading case on the subject of computation. The state of facts center around a miner, and while mining is slightly foreign to the machinery trade the case is valuable to all employers because of the decision reached.

Said the court: "During a year beginning in June, 1914, and ending in June, 1915, the appellant worked 224 days and his gross earnings were $970.66. The tribunals below awarded him a weekly compensation of $8.48. This was arrived at by deducting from the said gross earnings an expenditure for powder and another for blacksmithing, and dividing the amount of earnings remaining after such deductions by 52. The appellant contends, first, that these deductions should not have been made; second, that the average daily earnings on the basis of having earned $970.66 in 224 days should have been multiplied by 300, the sum thus found divided by 52. The method of computation approved below resulted in said weekly award of $8.48. The method contended for by appellant would yield $12.50."

After examining the state statute at some length the court continued: " . . . It appears clearly, without aid from reasoning or case law, that the applicant was entitled by statute to receive 50 per cent. of the average weekly wages received at the time of the injury; that in computing he should be dealt with as one having annual earnings, and that his award should be fixed by taking 300 times his daily earnings in the year preceding and dividing the sum so arrived at by 104."

This decision was much criticised at the time it was rendered because the court decided for something which was not contended for by either party, but the decision was well taken because it declared for a position which has been taken by most of the courts of other states who have examined the subject of computation of compensation.

Decisions in Other States

In a California case the commission took the decedent's daily wage of $2.75 and multiplied it by 300, finding his average annual earnings to be $825. It was contended that as the decedent had not been employed to exceed 225 days at $2.75 his average annual earnings would be $618.25. Said the court: "In such case the commission is authorized to make an award based upon a computation whereby the actual daily wages shown by the evidence to have been paid the deceased as an employee in the class to which he belonged was multiplied by 300, or approximately, if not actually, the number of working days in a year."

In a Massachusetts case a deceased workman had been employed about two months at a weekly wage of $12. The court found that the average weekly wages of the deceased employee were $12. The Massachusetts act defines "average weekly wages" to "mean the earnings of the injured employee during the period of 12 calendar months immediately preceding the date of injury, divided by 52." The court disapproved of this definition for uncertainty.

The day rule is recognized and is in force in Illinois.

In a Michigan case the court said: "We are of the opinion that the legislature had in mind that in every employment the employees work more or less irregularly, and that the annual earnings of any employee shall be determined by taking 300 times the average daily wage or salary which the employee has earned in such employment during the days so employed. This was undoubtedly the best method that could be provided for compensating a person; for if the employee does not work often enough to satisfy his employer the employer has the option to discharge him. We see no error in the method adopted by the board in measuring the compensation."

Seasonal Occupations

Of course there are plausible points of criticism in this 300-day rule. The greatest criticism comes from employers who are engaged in operating their plants only for two or three months of the year, or in what is often termed seasonal employment.

Certain factories fall into this class and they can do business, due to the nature of the business itself, only for a portion of the time or at certain seasons. I might mention several of these "seasonal" occupations, but perhaps the best illustration that could be given is the canning industry. Canning factories, according to statistics, do not operate on the average more than 90 days in the year, and the great majority of them confine their activities to 60 days.

Should workmen in these occupations, in case of injury, be compensated according to the rate of having worked 300 days in the year? This would manifestly

be unfair to the employer, for he would oftentimes be called upon to pay as much in compensation under such a plan as he would ordinarily pay in wages.

The 300-day rule does not generally apply to this class of workmen, although it does by inference and direct decision in a few states. Many of the courts have said that a man working at a seasonal occupation shall be compensated upon the basis of the average weekly wages for the period actually employed, or that his average daily wages should be multiplied by the average number of working days in his employment and the result divided by 52 in order to find his average weekly wages throughout the year.

The matter is handled by many of the acts themselves in which it is provided that if a man works less than 300 days in the year, but not less than 200 days, that his working days shall be deemed to have been 300; that if he works less than 200 days that his working days shall be deemed to be 200 unless recognized to be less and the yearly earnings based on that figure although he does not in fact work that many days during each year.

It is a proposition which calls for a great deal of thought and consideration on the part of all concerned. The courts have, I think, struck a medium between two extremes which is as fair as any system that could be devised. The 300-day rule is the rule applying to 90 per cent. of the cases, and most computation should be based on it unless there is an express provision of the statute or of the courts to the contrary.

Good and Bad Features of System

By J. B. GRAY

It is of course self-evident that no one system can fit all conditions. In a good workable system every feature is interdependent upon every other feature, so that in modifying or rebuilding a system that has been found acceptable in one shop to fit another, especial care must be taken that the changed portions do not nullify or antagonize the original intent.

THE Taylor system has been widely criticised, but from the viewpoint of the shop it has many redeeming features. Many shops have adopted it, and while some have later discarded it, others have retained it. Because of these conditions it might be well to adopt a critical and speculative attitude toward systems in general until we get the opinions of the firms that continue to use them.

So far as my observations go, the principal objection in the shop seems to be over-systematization—a complex and intensive employment of symbols that the man in the shop cannot grasp. The fact that many large plants continue to use the Taylor system, and many others employ a modified form of this system, would indicate that it has many points of merit.

Many plants—some of them of international reputation—have endeavored to readjust and modify the Taylor system to make it apply to their particular shops with a minimum of additional clerical work and with the least friction with the shop, but in this modification they have discarded the really valuable and convenient features and retained only that to which the shopman objects; viz., the extensive system of symbolization. Moreover, as might be expected when such a system is readjusted by others than experts, it is quite likely to become unwieldy.

Symbols can easily be made intelligible to the shopman and at very slight expense; very much less than the cost of turning the man loose and leaving him to find out for himself. A real machinist, whether he be a specialist or an all-round man, finds no comfort in the "I should worry" idea until he has fallen down flat and hard in his endeavor to understand the system; even then, many mechanics will quit rather than struggle along with something that is entirely beyond their comprehension.

Again, when an attempt is made to remodel an extensive system, there appears to be a disposition on the part of the managers and other high officials to add a little here and there to what was originally intended. Of course each succeeding manager, etc., must add his bit—if only his initials—and as these officials are not in a position to see the matter from the viewpoint of the shop, these additions occur on the clerical end of the system. The result is eventually a system of symbols that even the superintendent himself cannot understand without constantly referring to his index.

When a system is remade to suit the real or fancied requirements of a certain shop by some one in the management, there is very apt to be a tendency to favor some departments with an oversupply of system while others are neglected to the point of having scarcely enough. As a result we have an unbalanced condition that can never be as efficient as it should be. For this reason we of the shops would prefer to see the Taylor or some other established system used in preference to any home-made substitute, provided there could be a modification and a clarification of the symbolical part.

A home-rebuilt system sometimes produces queer results and some large plants appear to be at one and the same time over-systematized and practically without system. I have in mind a large plant which will serve to show the fearful results of taking a perfectly good system and tinkering it up with the evident idea of transferring everything requiring any thought at all to the office, and attempting to make mere automatons of the men.

A board was ripped off the Taylor system here and there, and with this armful of second-hand lumber a raft was constructed upon which the firm embarked upon the troubled waters of business in search of the haven of efficiency. They soon discovered, however, that in the Taylor system every feature is dependent upon something else, but instead of throwing the whole make-shift on the scrap heap and starting over again, everybody concerned threw in a handful of symbols, and—perhaps in order to add a touch of color to life—there appeared cards of more colors than Joseph's coat

ever had. So complete did the system eventually become and so evidently unnecessary was the greater part of its provisions that neither men nor foremen were constrained to pay much attention to the rules and regulations.

On the part of the men this negligence was due to the same old over-symbolization to which I have referred before, while the foremen found it a physical impossibility to comply with all the requirements and have any time left to do anything else. The work comes to the departments in boxes, barrels or on trucks, accompanied by a white, a red, or a green card. A white card means "full order" and also gives the part number, number of pieces, order number, a description of the various operations, and the department numbers; everything being written in a more or less legible hand. A red card means that the accompanying pieces form only part of the quantity and gives the same information as the white card but in checking out the stock the white card must also be made out and the number of pieces actually sent through under the red card must be deducted from the full amount of the order on the white card. This last card is retained by the stores department until the order is completed, when the white card is sent along with the final section.

The Clerical and Shop Viewpoints

All this looks quite simple from a clerical viewpoint, doesn't it? And so it is; but let's look at it from the shop viewpoint:

A department may have 50 or 60 orders on hand, in barrels, boxes, and on trucks, and the first thing that meets the eye is a wilderness of cards; white, light red, dark red, light brown, green, etc. Before any work can be started every one of the white cards must be inspected to determine if it is a new order or the final section of some previous one. If the former, the work could be started anywhere, while if the white card indicates the final section of an earlier order it might be advisable to have it follow the first part of the order on a certain machine.

Having straightened out our white cards the next step is to count the pieces in each lot and O.K. the number. Should this count fail to agree with the number written on the job card, all work on this order must be stopped, the work reboxed, or rebarreled and returned to the preceding department for correction. This must be done no matter what the result may be on production, and no matter how badly the work is needed. "Them's orders."

But suppose the amount is found to be correct and the work is started; after a time it becomes necessary to move those parts that lathe No. 1 has finished to lathe No. 2 to begin the next operation. Before you move one of those pieces to lathe No. 2, you will kindly comply with the following regulations: A red card must be made out for lathe No. 2. This card will indicate the number of pieces transferred to No. 2 and will specify the part number, full number of pieces in the order, shop order number, the operation to be performed on lathe No. 2, and the department number; then, and not until then, can No. 2 go ahead.

Now, having disposed of our white cards, you may think we are ready to get under way; but not yet. Before all our machines are tied up, those red cards must be inspected to ascertain whether the card signifies the first part of an order that is urgently needed, or spoiled work that is to go to the reclaiming department, or defective material for the inspection department, or if it indicates spoiled work that is to be moved to the inspection department for final disposition. Having determined the foregoing points we can then get under way—but not before then, inasmuch as the orders are, literally, "system first; production next."

Those who think in a hurry may conclude from the foregoing that I include the system and management of this shop in a general condemnation, but such is far from the intent of this letter; we have better and infinitely more important things to consider. When a lathe is not delivering its quota of production should I rush to my desk, write a treatise on how to run a lathe, send it to the office to have it O.K.'d and deliver it to the lathe hand a few days later? Would it not be better to deal directly with the lathe hand and concern myself immediately with the incoming of raw material and delivery of the finished product to the shipping room? Is there no virtue in deducing the cause from the effect and going direct to the lathe hand, investigating the difficulty in a frank way, and by making his problems mine induce him to make my difficulties his?

Confidence is and always will be the foundation stone of business; we can do nothing at all except we trust and depend upon someone, and it will injure me not at all to explain to John why I want that drill-jig in a hurry; if I want James to put through several lots of work in the least possible time, I would devote more attention to his speeds and feeds rather than try to mystify him with a mass of formulæ and I could—I think—indicate the succession of work and the order of operations in a way which he could readily understand.

Mystifying and puzzling men with complexities and symbolization will tend to create confusion; elaborate systems are apt to be the harbinger of chaos.

Of course since we must have system we must accept and use its symbols; but as in algebraic formulæ, the value of a character is given so why not expend a little time and a little money in educating the men of the shop to the value of each symbol in the system, as an intelligent business proposition, tending to draw men and management a step closer to that condition of mutual consideration and coöperation that would enable us to meet competition secure in the conviction that our men are behind us, beside us and all around us, every ready to lend a hand where it will do the most good.

Money is not everything. I have found that the shops having the smallest labor turnover are not at all the shops paying the highest wages, but rather the shops that have really and honestly tried to understand the men and succeeded in so doing. Some of these shops are high-speed system shops too.

How Would You Prevent This Grinding Trouble?

By A. E. Robinson

In reply to the query of John Vernon on page 705 of the *American Machinist*, I would suggest that he cut the cold-rolled steel into suitable lengths and heat them slowly to incandescence (just under the scaling point) and let them cool slowly. Assemble the parts as usual, taking care to avoid peening action when riveting on the bracket, and grind the surface on a wet grinding machine.

ARMY ORDNANCE NEWS

The Manufacture of Semi-steel Shells

By E. A. Suverkrop
Associate Editor *American Machinist*

EARLY in the world war Germany began to use cast-iron shells for war purposes. Many fragments and whole shells were collected by the Allies, and if my memory is correct an article was published in a British technical journal early in 1916, giving a detailed account of these German cast-iron shells together with their analysis. In that same year photographs were brought to this country, and published in the *American Machinist*, which showed some of the manufacturing operations on German cast-iron shells. As every one knows, semi-steel is pig iron with a percentage of machinery or structural steel scrap. The resultant metal to the layman looks like ordinary cast iron. Practical foundrymen differ widely in their opinions of it. Averaging up statements made to me by a number of competent men, semi-steel, if properly mixed and poured, has greater tensile strength than ordinary cast iron but in structure both are so similar that they cannot be easily distinguished from each other.

Machine chips from semi-steel seem to be a little tougher and to have a little more "curl" to them than ordinary cast-iron chips. In one large shop where lathe castings are made of cast iron with an addition of about 20 per cent. of low-carbon steel, the planing machines are run at 50 ft. cutting speed, and the only noticeable difference on the finished work is that it is not so dark in color as ordinary cast iron. Tools used on these semi-steel castings require regrinding about as often as they would on cast iron. According to "Kent's Mechanical Engineers' Pocket Book," "Semi-steel is a trade name given by some founders to castings made from pig iron melted in the cupola with additions of from 20 to 30 per cent. of steel scrap. Ferro-manganese is also added either in the cupola or in the ladle. The addition of the steel dilutes the silicon of the pig iron and changes some of the carbon from graphitic to combined carbon, but the total carbon is unchanged, for any

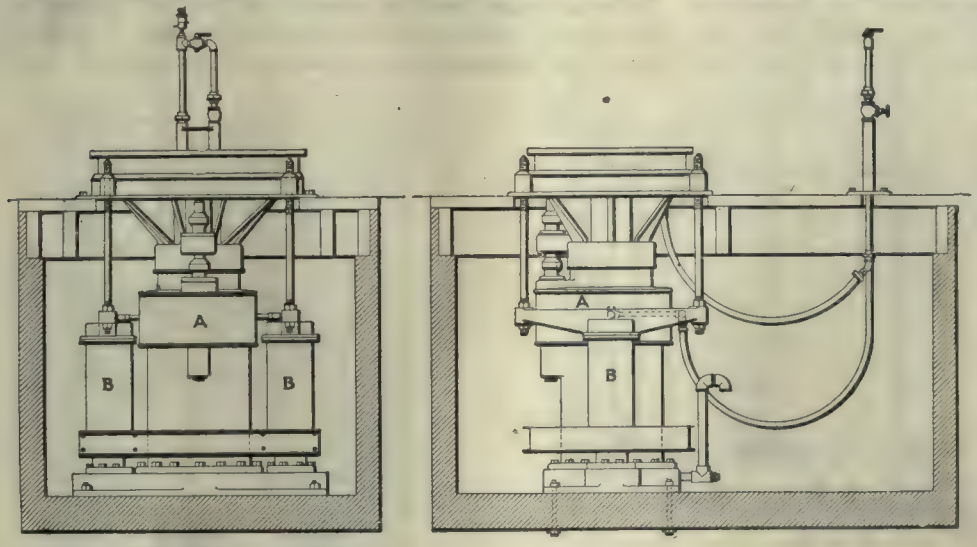


FIG. 1. SHOCKLESS JARRING MACHINE ADAPTED FOR MOLDING SHELLS

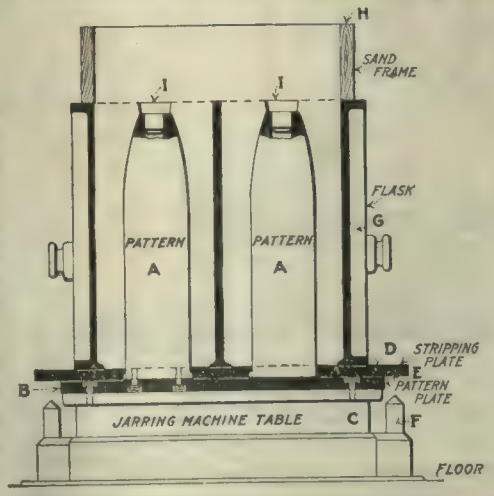


FIG. 2. MOLD READY FOR JARRING

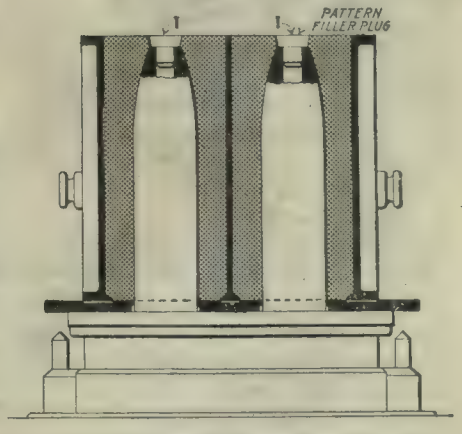


FIG. 3. MOLD "STRUCK OFF" (AFTER JARRING)

ARMY ORDNANCE NEWS

reduction made by the steel is balanced by absorption of carbon from the fuel. Semi-steel therefore is nothing more than a strong cast iron, low in silicon and containing some manganese, and the name is a misnomer."

Up to the present no data are available as to its strength under compression, but cast iron has a strength of about 80,000 lb. per sq.in. as opposed to 60,000 lb. for structural steel. This being the case, there is no reason why semi-steel or even good cast iron should not be used for projectiles, for the stresses to which the projectile is subjected by the propulsive charge are compressive. Practice shells of cast iron have been used by the United States Army for many years. These were cast in comparatively small quantities by ordinary foundry methods in a three-part mold, i.e., cope, cheek and drag. This was perfectly satisfactory for the small numbers of shells required for practice, but when it came to supplying them by the million there were and are not enough skilled molders to supply the molds. Appreciating this and the fact that the molder abhors a three-part mold the Tabor Manufacturing Co., Philadelphia, Penn., has devised a method whereby these shells can be turned out in large quantities by a machine-molding process which at most requires only the services of semi-skilled help. Further, this method discards the cope and drag of the objectionable three-part mold and retains the cheek only. Regarding the speed of production it is estimated that two or at most three men with one of these machines can put up 175 flasks of four molds each a day.

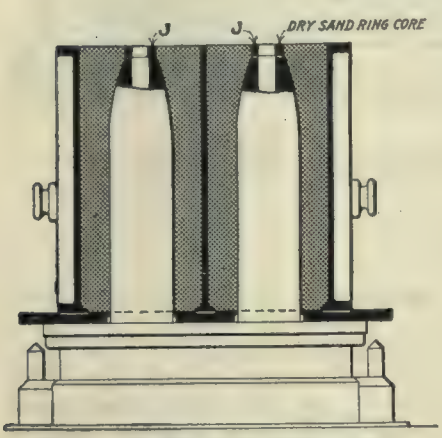


FIG. 4. PLUGS REMOVED, RING CORE SET

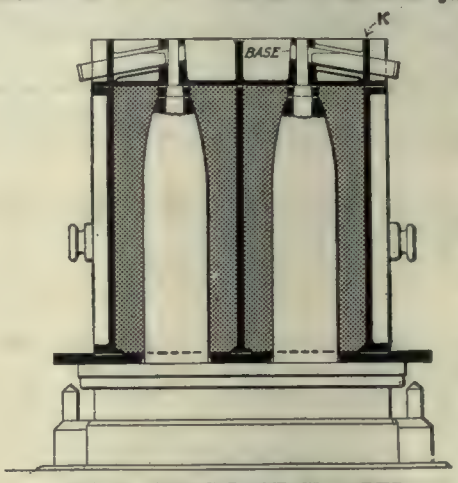


FIG. 5. DRAG BASE CLAMPED ON FLASK

Fig. 1 shows two views of the machine. At *A* is a standard shockless jarring machine. At *B* on each side of it are the pattern-stripping cylinders the piston rods of which raise the flask after it has been rammed and strip the molds from the four patterns. The operations necessary for molding four shells are illustrated in Figs. 2 to 9. Referring to Fig. 2, the four patterns *A*, only two of which are shown, are secured with capscrews to the pattern plate *B*, which is firmly bolted to the jarring machine table *C*. On top of the pattern plate is the stripping plate *D* which embraces the patterns *A*. At each corner of the stripping plate and on the under side of it is a conical depression *E* to center the conical ends *F* of the piston rods of the stripping cylinders. With the patterns and stripping plate in place wooden plugs *I* are placed in the holes in the tops of the patterns, the flask *G* is positioned as indicated, and on top of it the wooden sand

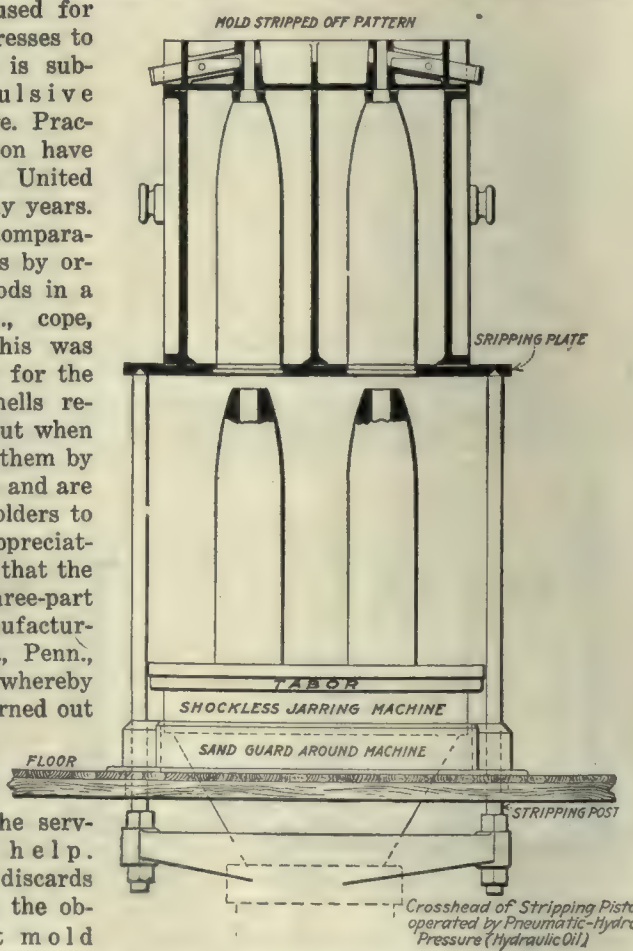


FIG. 6. MOLD STRIPPED OFF PATTERN

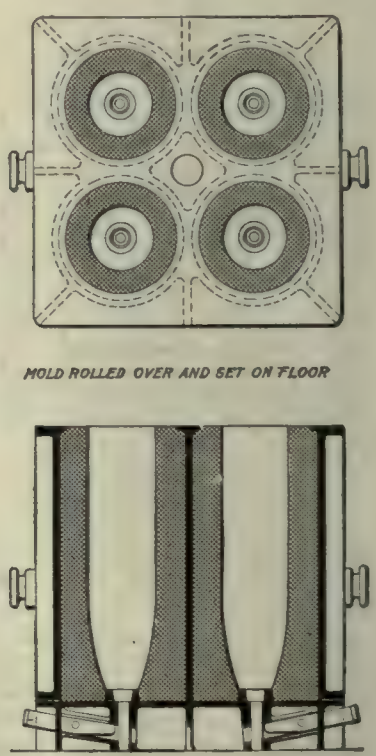


FIG. 7. MOLD ROLLED OVER AND SET ON FLOOR

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frame *H*. Molding sand is then shoveled in and the jarring machine started, after which the sand frame is removed and the top of the mold struck off as shown in Fig. 3. The wooden plugs are then removed and in their places are put the dry sand-ring cores *J*, Fig. 4. With these in place the drag base *K*, Fig. 5, is clamped on the flask, the stripping mechanism is operated and the flask, molds and stripping plate pushed up clear of the patterns as shown in Fig. 6.

The mold is then rolled over as illustrated in Fig. 7 with the drag base *K* down. In the meantime the cores *L*, Fig. 8, have been prepared. They are made around a central pipe, which is provided with perforations and has a piece of burlap wrapped around it. The cores are set as shown in Fig. 8. At the lower end the core rests on a collar *M*, the machined face of which rests on the machined face of the drag base. These collars are forced to a secure seat by means of the wedges *N* entering the slots in the central pipe on which the core is formed. A single tap with a hammer secures each core.

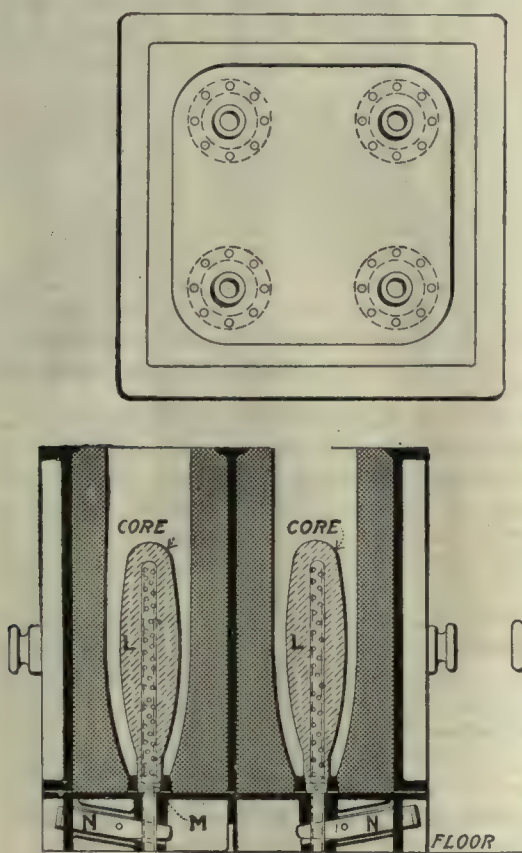


FIG. 8. CORES SET AND ARBOR WEDGED IN BASE

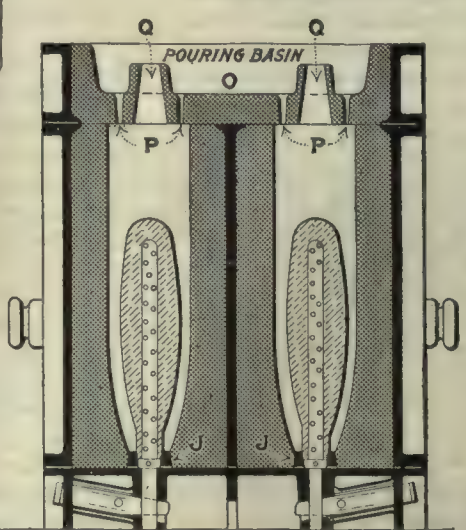


FIG. 9. MOLD READY FOR POURING

With the cores set, the pouring basin *O*, Fig. 9, is placed. The clean metal enters the molds through the small openings *P*. Falling to the bottom of the mold it strikes the dry sand-ring cores *J*, which, because of their hardness (as compared with green sand), hold their shape. The pourer watches through the holes *Q*, and when the metal is about an inch from the top of the cheek no more metal is poured into the pouring basin; thus there are no sprues to cut off.

The Government specifies the mixture that shall be used and also the depth of metal that shall be cast above the top of the core. The reason for having such a thick base on the shells is to assure sound metal at this point, so that there will be no pipe or other fissure through which the fire from the propulsive charge can be communicated to the explosive charge contained in the cored center of the projectile.

PERSONALS

Maj. Charles B. Going was discharged on his return from France after 18 months service. During his entire service he has done editorial work on the Ordnance Encyclopedia and on various histories of the Ordnance Department in the A. E. F. He is a graduate of Columbia University and before entering the service edited and managed the magazine and book publications of the Engineering Magazine Co. His permanent address is Salmagundi Club, New York City.

* * *

Col. John R. Simpson, 278 Waverly Ave., Newton, Mass., has returned to civil life after about 22 months of service, both in the United States and with the A. E. F. While with the A. E. F. he was in charge of liquidation of Ordnance Department contracts in Great Britain, and during the last month of his service, was a member of the Board of Liquidation for the A. E. F. He is a graduate of Williams University and before entering the service was with William Filene's Sons Co., Boston, Mass.

* * *

Lieut.-Col. Jess C. Jurgenson, 1733 Q St., N. W., Washington, D. C., has been discharged. While in the service Colonel Jurgenson was in charge of the Instrument, Machinery and Container Branch, Inspection Division. He attended the Danish Royal Technical Institute for four years. Previous to entering the service he was general mechanical superintendent and purchasing agent for five mills of the United Piece Dye Works, Lodi, N. J.

* * *

Lieut.-Col. Seth K. Chase was discharged on his return from France. He was appointed Major in January, 1918. Colonel Chase has been Assistant to the Head of Aircraft Armament Section, O. D. He will be associated with the Peoples Gas Light and Coke Co., Chicago, Ill., as he was before entering the service. His permanent address is 122 South Michigan Ave., Chicago, Ill.

Proposed Increased Efficiency in Patent Office

SPECIAL CORRESPONDENCE

Nearly one million, three hundred thousand patents have been granted by the United States Government through the patent office. Imagine if you can the tremendous amount of documents that must be looked over by the examiners before they can decide whether the inventions upon which applications for letters patent are before them are new and patentable, and whether there are other applications on file or patents in existence that will interfere with them. For many years the patent office has been notorious for its inefficiency, and any reforms that will put it on an efficient basis will be welcomed by all having to do with patents.

EMPLOYEES of the United States Patent Office have organized under the name of the Patent Office Society for the purpose of advocating certain reforms in the administrative branches of the department, which, it is claimed, will bring about a higher efficiency in the system. Committees on legislation and publicity have been appointed with the view of educating the public to the necessity for an immediate improvement of the present patent-office system and to push Congressional enactment to broaden the scope of the department.

What the Plan Includes

The plan includes the separation of the patent office from the Department of the Interior and provides for an executive officer who shall be an industrial and efficiency expert, the position to eventually be that of a Cabinet officer when the department shall have assumed the proportions to warrant such a distinction. The main contention is that the patent office is distinct from the Department of the Interior in its administration and functions and that no progress can be made until a separation is effected. A lack of close affiliation appears, it is claimed, from which the patent office must necessarily suffer in matters of proper appropriation for maintenance and expansion, and for many other reasons.

The views of the society have been set forth by James H. Lightfoot, the examiner of the patent office, in papers presented by him before the examining corps of the department. Mr. Lightfoot makes the following assertions regarding the inefficiency of the present patent system:

1.—That all patents granted are still merely prima-facie evidence of the rights of inventors to their invention, whereas the grant itself and the Constitution provide for the grant of unconditional, secure and exclusive rights.

2.—That although the statute (4886) requires, as a condition precedent to the grant, that the alleged invention sought to be patented must have been in fact invented, patents have been granted and are still granted for things not invented because of insufficient time and inadequate facilities for the proper consideration of this important question, and patents have been and are still refused because of the want of the proper system requiring the presentation of practical evidence indicating invention, for the consideration of the examiner.

3.—That although the statute requires, as a condition precedent to the grant, that the alleged invention sought to be patented must be new, patents have been granted and are still granted for things not new.

4.—That although the statute requires, as a condition precedent to the grant, that the subject matter sought to be patented must be useful, and under statute (4893) that it must be "sufficiently useful and important," patents are still granted for theoretical and sometimes practically useless alleged inventions, which have later constituted bars to the grant of patents to inventors of real inventions that would have practically promoted the industrial arts.

5.—That although the statute (4886) requires, as conditions precedent to the grant, (a) that the alleged invention must not have been known or used by others in this country before the applicant's invention or discovery thereof; (b) that the alleged invention must not have been in public use or on sale in this country for more than two years prior to the application; (c) and that the alleged invention must not have become abandoned. Patents have been generally granted without any investigation of these important questions affecting validity.

6.—That although the revised statute (4903) requires that helpful information be furnished to applicants to aid them in obtaining proper protection, patents are still granted the claims of which are so limited in scope as to be valueless to the inventor for want of a uniform standardized system of examining the applications.

7.—Although the provisions of the revised statute (4904) provide for notice in all cases of interfering applications and patents, patents are still granted which are rendered practically valueless and the industries based thereon practically ruined by the subsequent issuance of interfering patents granted on copending applications of which the former patentees had no statutory notice during the copendency of such applications.

8.—That patents are still litigated in courts which, with some few able exceptions, are not specially qualified promptly and properly to determine the technical questions arising under the patent laws.

In order to remedy these defects in the patent system, it is necessary, according to the Patent Office Society, that the patent office, which is charged with the duty of providing safe and sound titles to industrial property, must be given the status of an independent, enlarged, modernized, industrially efficient institution in order that it may perform its work thoroughly and yet with a promptness that will be of benefit during the reconstruction period. Under the present system, it is stated, the development of inventions and industries based thereon is stagnated.

Mr. Lightfoot recommends in the reorganization of the patent office the establishment of five bureaus, namely, Bureau of Information and Education, Bureau of Patents and Publications, Bureau of Utility, Bureau of Validity Examinations, and Bureau of Priority of

Inventions. These recommendations have been approved by the Patent Office Society.

The functions of these bureaus are described by Mr. Lightfoot as follows:

The Bureau of Information and Education should be equipped with men and full facilities for promoting the dissemination of knowledge of the true meaning and provisions of the patent system. Especially is this essential because in its most fundamental sense the patent system is an industrial educational system and it constitutes one of our most glaring national errors that the public in whose interests the patent system was established has been kept in ignorance of its true meaning and intent.

This educational bureau should be charged with the duty of establishing a system to instruct the inventing public as to how to prepare to make inventions, how to invent in the interest of the public and with profit to themselves, what to invent, how to avoid losses through abandonment or want of knowledge as to how to proceed after conception or reduction to practice to avoid complications, how to obtain patents of value, how to study the prior arts before inventing, how to select competent attorneys; in fact everything connected with making, patenting and marketing inventions, just as the Department of Agriculture has, through bulletins, publications and field agents, instructed the farmer in all respects how to prepare to produce crops, how to produce them, how to protect and conserve them when produced and how to market them in the most efficient way.

A Great Need of Educational Work

The incalculable values in time, money and energy that have been wasted in inventing useless things, in reinventing things that have been shown to be old, and the great values in inventions lost to the nation because the inventors have not known how to properly develop them to material form and how to have them properly disclosed and protected in letters patent, clearly indicate the great need of educational work along these lines.

Included in this educational bureau may be a corps of patent field agents, just as there are agricultural, land and pension field agents, who in coöperation with inventors, attorneys, manufacturers and capitalists, should seek to aid, in every possible way, the interests of inventors and manufacturers, because in this way the public interests will best be subserved.

The Bureau of Patents and Publications should have an able staff of men to establish and maintain an efficient classification of patents and an efficient classified library of all statutory publications relating to the industrial arts. This staff of specialists should properly digest publications for quick and thorough search purposes. It should by a regular standardized system seek to procure industrial literature from manufacturers and from all other sources and should classify and systematize them for ready research purposes.

The Bureau of Utility should be equipped with laboratories, and all necessary equipment and competent workmen who will coöperate with the examiners in accurately determining, before patents are granted, the practicability and operativeness of alleged inventions under consideration.

The Bureau of Validity Examinations should be fully equipped with well-qualified men, including an additional grade of reëxaminers to reëxamine claims held allowable by other assistant examiners this new grade ranking between the first assistant and principal examiner. The work of this corps of specialists should be so systematized and arranged that each should have full time and facilities to examine the subject-matter of each application under his consideration thoroughly, from the standpoint of the public, so that, when granted, patents may afford the inventors full protection and be essentially valid. This would constitute a safe and sound basis for the establishment of industries, and safe and secure investments for the capitalists who may promote the establishment thereof.

The present divisions of interference should be expanded into a Bureau of Priority for the full, complete and final determination of the question of priority between copending applications and patents containing common patentable subject-matter. It is essential to the establishment of safe and secure rights that the question of priority be promptly, thoroughly and finally determined within the bureau, and that this question be not extended through various appeals in the patent office and then further and indefinitely extended through various appeals in the courts. With a competent and efficient Bureau of Priority the questions at issue may be fairly and finally determined by judicial officers within the bureau, it being a matter of much importance that the patents when granted be free from further complications if they are to constitute bases for the establishment of industries, or if they be importantly involved in an industry already established.

The injury to established industry and the discouragement to inventors, manufacturers and investors due to the subsequent grant of patents that dominate or invalidate patents formerly granted on copending interfering applications without notice, have created a condition so obviously violative of the grant of secure and exclusive rights that distinct reforms should be effected. As it is essential to a safe and sound industrial system that patents be granted that are essentially valid in view of the prior published arts, so it is also equally if not more essential to such safe and sound industrial system that patents, when granted, be free from further interference by domination or invalidation by copending later granted patents of which the former patentees had no notice while their cases were pending.

This greater and broader department of invention and discovery may possibly also include a Bureau of Licenses and Sales, just as the Department of Agriculture has a Bureau of Markets.

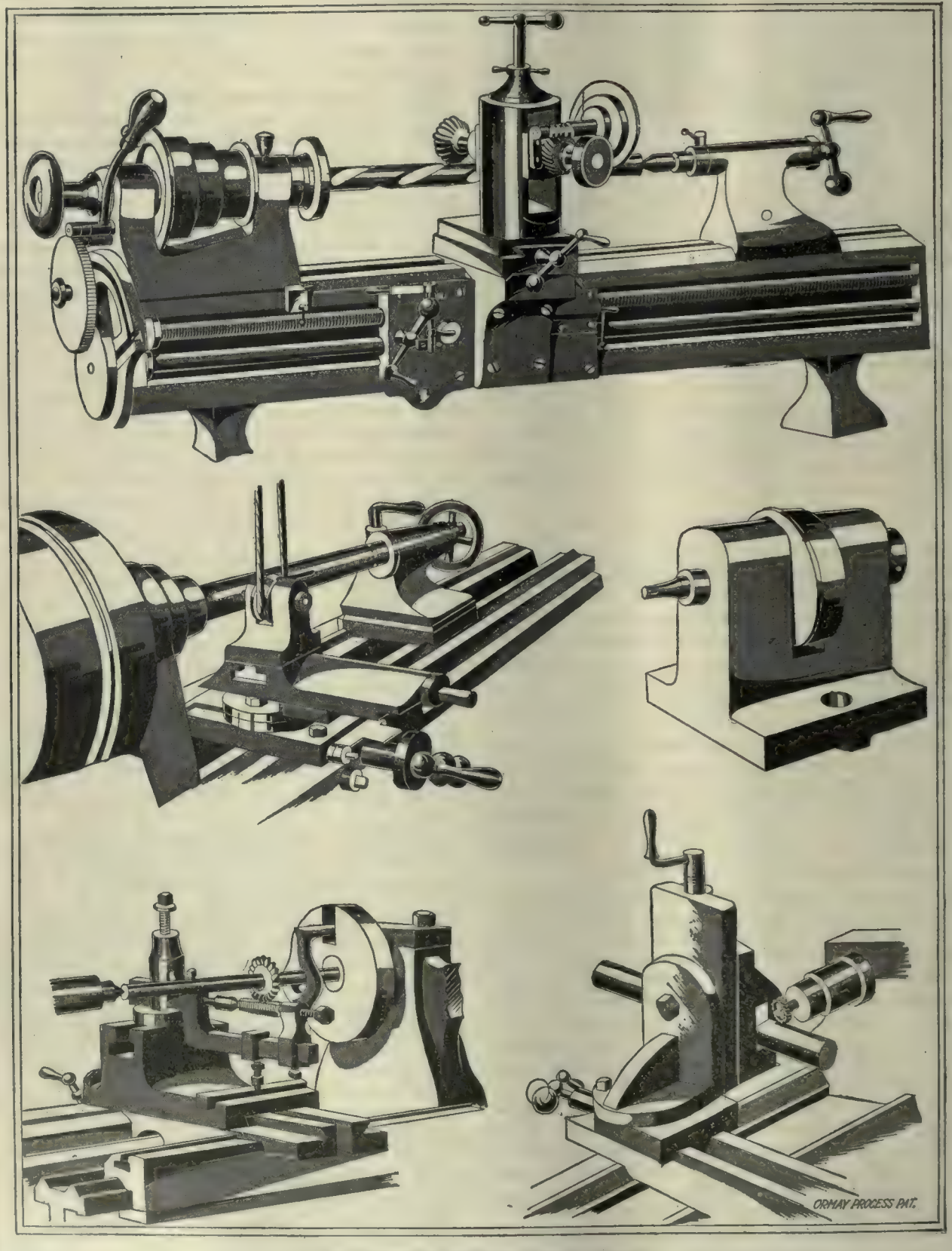
It was explained by the members of the Patent Office Society that the patent office is an independent bureau, and, backed by the interests of the country, could obtain a million-dollar appropriation from Congress where now the commissioner acting alone and given a merely perfunctory hearing as one of the bureau chiefs, can obtain an appropriation of but a few thousand dollars or none at all.

The society is publishing a monthly journal in the interests of the principles being advocated in the reorganization of the patent office.

The officers of the society are as follows: President, M. H. Coulston; vice president, J. H. Lightfoot; secretary, Bert Russell; treasurer, W. F. Avery; executive committee, A. W. Cowles, E. S. Glascock, G. A. Lovett, C. H. Pierce, M. E. Porter, E. D. Sewall, W. L. Thurber, W. J. Wesseler. The business manager of the journal is W. J. Wesseler.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



MILLING ATTACHMENTS FOR LATHES

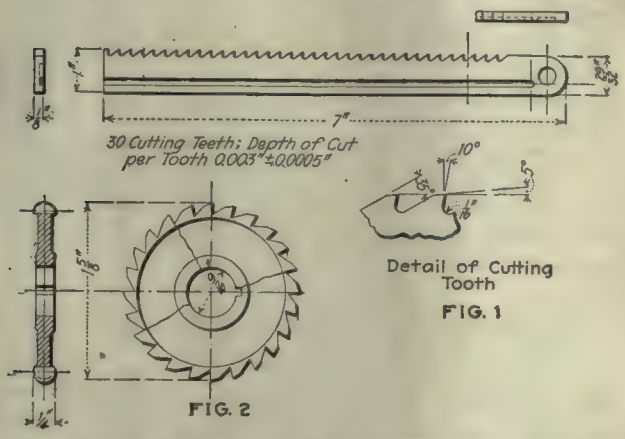


Hardening Broaches and Cutters

By J. B. Gray

Sometimes it happens that a departure from the standard methods of hardening can be used to advantage—in fact, it is necessary. The two sketches illustrate instances where the old principles of even heating and cooling were disregarded to our very great advantage.

Fig. 1 shows one of a set of six broaches used to produce a slot $\frac{1}{8}$ in. wide by nearly 1 in. deep. After



FIGS. 1 AND 2. BROACH AND CUTTER FOR KEYWAYS
Fig. 1—The broach. Fig. 2—Cutter for circular keyway

the slotting is completed, the piece is hammered around a "formed piece" under a power hammer, producing finally a slot about $\frac{1}{32}$ in. wide, and of irregular contour, somewhat similar to the keyhole in a Yale lock. The vital part of the broach is the groove shown at *A* which acts as a guide and obviously must be fairly true.

We had much difficulty for a while to harden broaches of this type satisfactorily, as they would spring despite the utmost precautions, even when we tried a steel of low-carbon content, and resorted to pack-hardening. Grinding to correct errors due to hardening is impractical, owing to the size and the length of the groove, although the cutting teeth must be ground. We found the best method of hardening was to harden only the cutting teeth, and to leave the rest of the broach soft. This was done by placing the broach in a roll of fireclay about 2 in. in diameter and allowing only the teeth to be exposed. After heating, the whole affair was placed in the quenching bath where the fireclay kept the water from contact with the broach except at the cutting edge. The broach was kept in this bath until quite cold, no attempt being made to "draw" the teeth.

The cutter in Fig. 2 presents quite a different proposition; this is known as a "gashing cutter" and is used to mill a keyway in a ball yoke, to receive a circular wire key for retaining the journal bushing used in motor-truck manufacturing. The cut is straight in, and is very similar to "sinking" a keyway for a Woodruff key. This imposed a great strain on the cutter and the usual breakage averaged about 10 or 12 a day, and since these cutters cost about $3.75 each, we thought the situation sufficiently serious to warrant us in trying to find a solution.

In the first place, the operation is in steel drop-forgings. We found that the density of the metal varied through forging after the piece became too cold or showed hard spots because the piece was thrown out on the damp ground while still hot. As it was practically impossible to eliminate these conditions, we tried grinding the cutters in various ways, such as staggering the teeth; shearing alternate teeth; undercutting the radial faces and back-raking the same faces, but failed to obtain satisfactory results, as the cutters continued to break. Usually the fracture would be as shown in Fig. 2, but sometimes the break would occur through an entirely different part of the cutter and then it might develop anywhere.

It was this "across center" breaking that gave us an idea, so after hardening we tried heating a piece of rod to a yellow heat and placing the cutter on it; proceeding to draw the hub to a dark straw color, and quenching it as a straw color appeared on the sides of the cutting teeth. This effectively put a stop to the breaking, and one cutter, so treated, has run for three or four days and milled from 400 to 600 pieces before being scrapped.

With the center and web so drawn the worst we have to contend with, when we get a hard or "spotted" piece, is a broken tooth or two, or a dulled cutter, where formerly we lost the cutter altogether.

A Power-Driven Revolving Table for a Milling Machine

By J. V. Hunter

In the shops of the Cincinnati Planer Co., Cincinnati, Ohio, is a large Landis vertical-column milling machine which is extensively used for boring large bearings in heavy housing castings. As these bearings are bored at right angles to one another, it was necessary to shift these heavy castings after the first set-up and reset them at 90 deg. from the original position in order to make the second boring. Since the shifting required considerable time, a special motor-driven re-



REVOLVING TABLE PROVIDED FOR A MILLING MACHINE

volving table was built and set on the main bedplate of the Landis milling machine in order that the castings could be turned at right angles without necessitating re-setting and leveling.

The revolving table *A*, shown in the illustration, is plentifully supplied with T-slots for holding down bolts in its top surface, and is webbed and of sufficient depth to afford ample stiffness. The table revolves on the special base *B*, which is keyed to the main base of the milling machine in the slot *C*, in order to prevent shifting during the various operations. The upper table can also be clamped to the flange of the base by means of the clamps at *D*, and means are provided so that the workman can determine when the table is revolved to the required position. The reversible motor *E* furnishes the power for revolving the table. This motor is geared to the connecting shaft *F* and has a drive pinion which runs inside of the internal spur gear *G*. The connecting shaft is provided with two universal joints and one expansion slip joint.

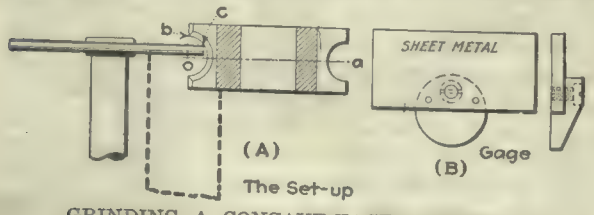
The table is revolved by means of a worm-gear drive and is provided with wide bearing surfaces situated near the outside edge. A center-bearing pivot sleeve is also provided as a long bearing through the center of the base housing.

Grinding a Half-Round Concave Milling Cutter

By Adolph Moses

Any one who has read the catalogs furnished by the makers of radius-cutter grinding machines has had their attention arrested by the fact that in giving the capacity of such machines it is stated that they will grind somewhat less than a semicircle on concave cutters. It is for this reason that the usual method of making a concave-faced cutter to embrace a full half-circle is to make it in two interlocking parts. Now it is ordinarily quite a feat to grind the halves of an interlocking cutter so that when they are placed together they will cut a true semicircle, but the use of the following method makes the job fairly easy:

Place the cutter on the grinding arbor and set the machine so that the wheel will occupy the position as shown at *A* in the cut, with the wheel just off the center line *oa*. If an interlocking cutter is to be ground, whatever packing may be necessary is put in place and the two halves fastened together, it being treated thereafter as a single cutter. It will now be easy to grind more than a quarter of a circle on each tooth starting from the point *b* and using the surface *c* of the wheel to do the grinding.



GRINDING A CONCAVE-FACED CUTTER

Next shift the wheel to the opposite side of the line *oa* till it just touches a part of the radius already ground and complete the semicircle on all the teeth. It will be very convenient to use a small gage like that shown at *B* to insure accurate results. As a true semicircle is our goal, care should be taken to see that the radial face of the tooth being ground is level, the desired clearance being obtained by having the face of the tooth the proper distance below the center of the wheel.

A point that should be kept in mind in all radius grinding is that there are two essentials; first, to locate the center about which the radius is ground; and second, to get the radius of the correct length. In the sketch the point *o* is the axis about which the cutter swings, thus it is the center about which the radius is ground. It is located properly by moving the cutter with respect to this point.

The second requirement of getting the correct radius is satisfied by moving the wheel with respect to the axis *o;* the farther the cutting edge of the wheel is from this axis the longer the radius. To put it briefly, the degree of curvature is varied by moving the wheel with respect to the axis *oa*, while the location of the curve is varied by moving the cutter with respect to the center *o* about which it swings while being ground.

Laying Out Intermittent Gears

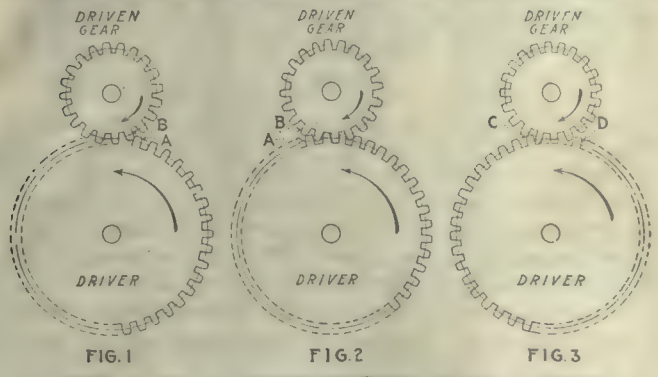
By S. H. Yorks

The design of intermittent gearing presents some peculiarities that are not met with in ordinary gear problems and which must be taken into consideration in order to obtain the desired results. For instance, in an ordinary gear train where it is desired to rotate the driven gear a given number of turns for each revolution of the driver, the relative numbers of teeth in the gears are proportional to the number of revolutions. This does not hold true with intermittent gearing.

A common form of intermittent gearing illustrating this point is where the driven gear is rotated through one complete turn during a part of a revolution of the driver. A pair of gears laid out to give this effect is shown in the accompanying illustrations. It would appear at first glance that in this case the two gears would have the same number of teeth, but on actually laying them out it becomes apparent that the driver must have less teeth than the driven gear.

Starting with Fig. 1, the first tooth *a* of the driver which is shown coming into mesh with the teeth of the driven gear after a period of rest continues in mesh until it reaches the position shown in Fig. 2. In other words, this tooth has the effect of carrying the tooth *b* of the driven gear through a distance equal to three times the circular pitch. This action of each tooth on the driver in carrying the driven gear through a distance greater than one circular pitch must

be taken into account in determining the relative number of teeth of the gears. In the example shown, the number of teeth on the driver must be two less than the number on the driven gear, in order to rotate the latter through one revolution. This point will become apparent by reference to Fig. 3, which shows the last tooth *c* of the driver coming out of mesh with the teeth of the driven



FIGS. 1 TO 3. INTERMITTENT GEAR LAYOUT
Fig. 1—First tooth engaging. Fig. 2—First tooth leaving. Fig. 3—Last tooth leaving

gear. The effect of this tooth has continued from the position *d* through three circular pitches to its final position *c*, making it necessary to have two less teeth on the driver than on the driven gear.

In designing gearing of this type, the exact number of teeth required on the driver must be determined by laying out the gears in the various positions indicated. In cases where the pitch chosen is such that the result is a fractional number of teeth in the driver, the pitch must be changed until one is found that will give a whole number of teeth.

Sifting Out Bone Ash

By Peter F. O'Shea

A sifter used in the hardening room of the Greenfield Tap and Die Corporation for saving bone ash after carbonizing is shown in the illustration. The top is a screen made from ¼-in. iron rods in parallel rows, fastened through supports at each end. A diagonal partition made of a strip of iron makes two compartments on the screen, each of which narrows down to a throat so as to act as a chute for the bolts or screws that are dumped into a box after the ash has passed from them.



DEVICE FOR REMOVING AND CATCHING BONE ASH

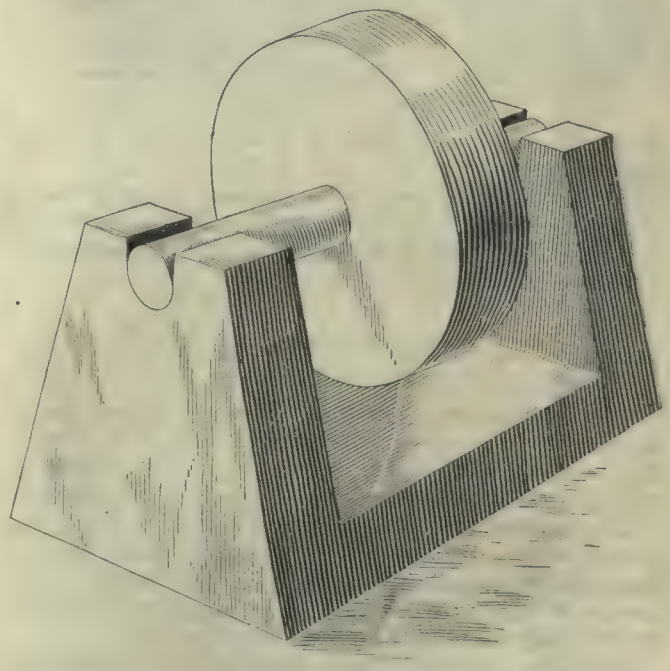
Below the sifter is an iron coal chute leading down to a box that is to catch the bone ash. This is found to be much better than letting the ash go through on to the floor where a breeze may blow it about and spread it everywhere. Hot bone ash or dust on the floor heats up everyone's feet, especially in summer, and those who have experienced it know that the worst heat in a hardening room is that which comes from the floor through the soles of one's shoes.

The bone ash, after it is entirely used up for carbonizing purposes and has begun to turn white again, is collected and sold back to the firm from which the fresh bone ash was purchased. The salvage price is now $20 a ton, which is one-third the price for new bone. This is a large percentage of salvage, but the manufacturer is glad to get back the material for use in making fertilizer.

Standard-Size Blocks vs. Limit Gages

By F. C. Hudson

In spite of the increasing use of limit gages there are a number of factories who still use the micrometer, believing that it has many advantages aside from the decreased cost. One of the great objections to the limit gage is that the operator has no warning



STANDARD SIZE BLOCK FOR SETTING "MIKES"

as to how much material is to be removed, as with the use of the micrometer or the spring caliper.

One concern which is noted for high-grade automobile work uses standard-gage, or caliper-setting blocks, as shown in connection with micrometers for many of their parts.

These standard-size blocks are mounted in the frame, and checked out from the tool crib by the operator, to be used in setting his micrometer. This does away with any inherent inaccuracy in the micrometer, or, if need be, allows the use of spring calipers, as the measurement in any case depends upon the sense of feeling.

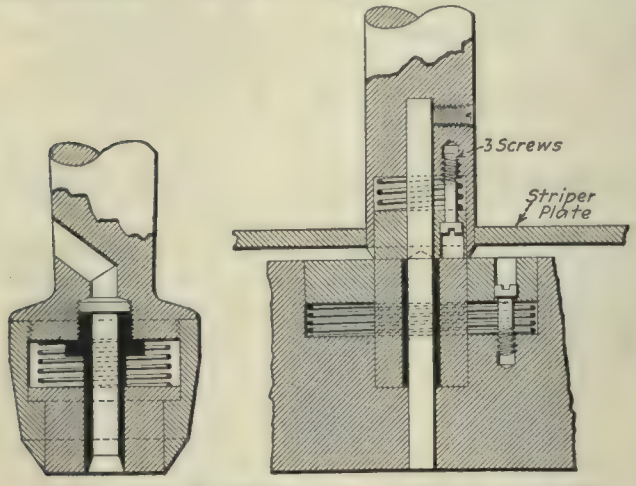
Another objection to the use of snap gages is that

they are apt to be sprung by different operators and the use of standard blocks and micrometers has been found much more satisfactory. There is evidently much to be said on both sides, and it is quite probable that the character of the work must also be considered in determining when limit gages are to be used.

A Hand and a Power Punch for Rubber Disks

By S. B. Royal

The illustrations show two excellent forms of punches for blanking rubber disks with a hole in the center in one operation. One is for a power press and the other



TOOLS FOR BLANKING AND PIERCING RUBBER

is a hand punch to be used on a wood, leather or other suitable block.

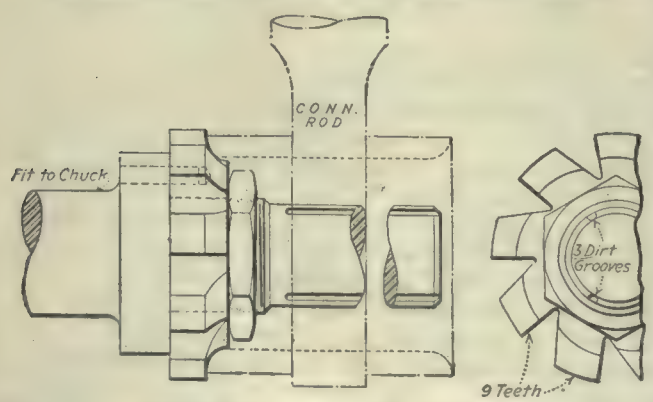
The method of operation is obvious. Rubber should always be worked wet either with water or preferably with some thin cutting compound of such nature as will not cause the tools to rust.

A Corner-Rounding Tool

By C. H. Dengler

The accompanying drawing represents a tool that is as practical in application as it is unique in design. Its function is to round the corner of the babbitt in the connecting-rod of an airplane engine. Formerly a single inserted blade was used but this type of tool required constant attention or the corner would lose its shape and interfere with the fillet on the crankpin; then trouble would begin. This tool maintains a true form, as grinding the tooth face does not affect it.

The construction is simple. It is held in a chuck and



TOOL FOR ROUNDING CORNERS

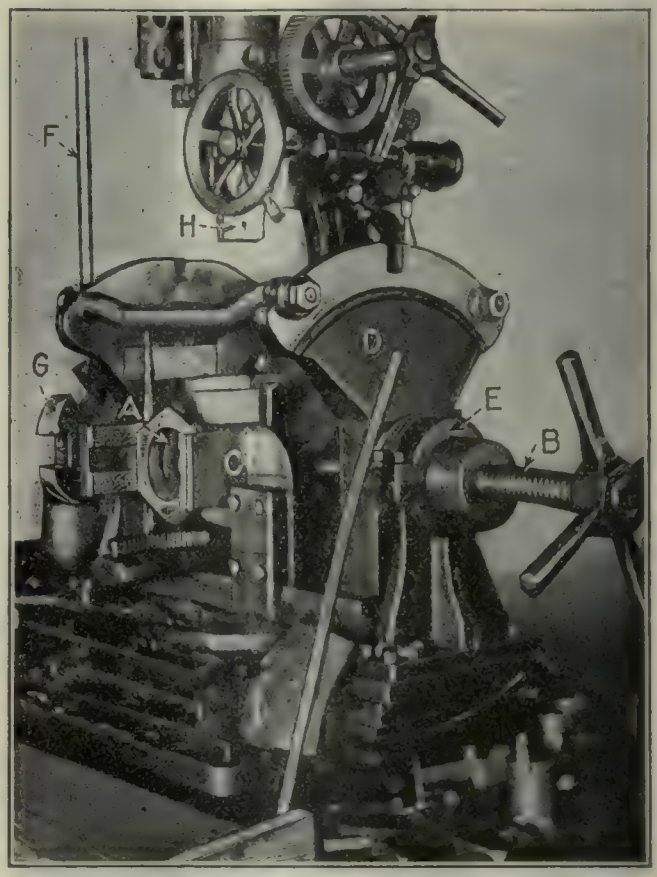
piloted by a bushing in the fixture that holds the connecting-rod. An adjustable stop is provided in the fixture, which operates on the ground end of the pilot. The body of the tool is of machine steel, pack-hardened and ground. Three grooves are provided in the pilot for chips and cutting fluid. The cutter is of high-speed steel with nine teeth; the form being cut with a tool with relieving attachment. The cutter is driven by a pin and is held in place by a check nut.

A Drilling and Tapping Jig for Large Pipe Fittings

By H. J. Ventner

Some of the large pipe fittings made by the Jarecki Manufacturing Co., Erie, Penn., are drilled and tapped in the indexing jig as shown. The jig is mounted on the table of a large vertical drilling machine.

In the illustration the large tee *A* is shown in place in the jig for the purpose of machining and is ready



INDEXING FIXTURE FOR DRILLING AND TAPPING LARGE PIPE FITTINGS

to be tapped. It is clamped in the jig by means of the screw and handwheel *B* and special jaws *C*.

After drilling and tapping one side the body of the jig *D* is turned about the trunnions *E* and is indexed at 90 deg. The handle *F* locks into the notched plate *G* at the left of the jig and insures that the openings in the fitting will be in alignment and at the correct angle. No special fixtures are used for holding the large taps, other than the hollow sleeve *H*, to fit a square shank tap. On these large fittings the spindle revolves quite slowly, and when the tap has reached the required depth the operator reverses the machine. In this way he is able to gage the depth of the threaded portion within a small fraction of a turn.

Government Tax on Western Machine Shops

BEGINNING with July 1, every subscriber to the *American Machinist* who lives west of the Mississippi must pay $1 per year to Uncle Sam for the privilege.

On July 1, 1918, Congress put a seventeen million dollar tax on intelligence and sectionalized this country by instituting the zone system on second-class postage, under which our newspapers and periodicals are carried. Ninety per cent. of the information and instruction of those who read comes to them through newspapers and periodicals under this classification.

Our War Congress decided that there should be no distinction between information and merchandise and it divided the reading public of America into eight different classes depending on geographical location. It decided that the people who live in the Atlantic Coast zones, where most of the national publishing houses are located, shall get their customary reading matter quite easily, but that the people who live further west shall be progressively penalized according to distance up to the point where it becomes prohibitive in cost to read anything except the county paper. One concession was made by these law-makers; they agreed to apply this increase over a period of three years so that the maximum comes in 1921.

Much as this statement sounds like an exaggeration it is absolutely borne out by the facts. In 1917, it cost $1.19 for postage to mail a single year's subscription of the *American Machinist* to any part of our country. This was at a flat rate of one cent per pound. The following table shows what it costs in 1919, for postage to the various zones and what it will cost in 1920 and in 1921, for postage on a single year's subscription to the *American Machinist.*

POSTAGE COST

What the Government does tax and will tax our readers for postage on a year's subscription. The following table shows the postage under the old law (1917) and that under the zone law.

Zone	1917	1918	1919	1920	1921
1—2	$1.19	$1.40	$1.68	$1.93	$2.17
3	1.19	1.65	2.17	2.67	3.15
4	1.19	2.14	3.15	4.13	5.11
5	1.19	2.38	3.64	4.87	6.09
6	1.19	2.62	4.13	6.60	7.07
7	1.19	3.12	5.11	7.07	9.03
8	1.19	3.36	5.60	7.81	10.01

Note that on July 1 the postage alone on a subscription mailed to the seventh and eighth zones (which includes the territory west of the Rocky Mountains) will be over $5—*more than the subscription price of the paper.* Also note that in 1921, the postage on a subscription to California will cost over $10. This zone system on reading matter actually erects a Chinese wall in the form of prohibitive postage around each zone with the effect of keeping out information from another zone.

We looked upon this unheard of taxation on intellect as a *war* measure, particularly as it was a part of the War Revenue Bill. We did not believe nor did other publishers or readers of publications believe that this discrimination in favor of illiteracy would be seriously considered after the war emergency had passed. And rather than impose upon our readers the increased burden of what we thought was to be a temporary tax, we paid this ourselves and looked forward hopefully to the repeal of this legislation.

Now we find, to our astonishment, that it is proposed to perpetuate this monumental piece of class legislation.

For the reader's sake we were willing to bear the whole of this burden of taxation during the war. But it is obvious to anyone who studies the above table that no publisher can continue this as a permanent expenditure and so, beginning July 1, subscribers to the *American Machinist* who live west of the Mississippi River must add $1 for extra postage on their year's subscription.

In making this $1 increase we are by no means putting the total burden even of the present year's postal increase upon our western readers. Theoretically we should have a graduated subscription price to meet this iniquitous postal arrangement. This is a practical impossibility at present, and so, until we are able to develop a method of bookkeeping which will apply this burden equitably, we must use the Mississippi River as a natural dividing line and apply the increase equally over the western zones.

We are indeed ashamed that in this enlightened age of free schools and education it is possible to find men able and willing to sectionalize this country, to discriminate against the man who must get his education through reading and to make the mechanic and the engineer pay, in the form of postage on his technical paper, for the free distribution of the farmer's seeds.

The inevitable result, unless this unwise and unjust legislation is repealed, will be to put the distribution of all periodicals on the basis that existed fifty years ago when readers paid a flat subscription price "plus the postage."

It is beyond belief that when the representatives of our western states learn the sentiments of the reading public they will tolerate the continuance of this injurious discrimination against their constituents.

Frederick Holz

Frederick Holz of Cincinnati, formerly president of the Cincinnati Milling Machine Co., died at his home in Cincinnati on Monday, May 12, 1919, in his sixty-seventh year.

Mr. Holz was born at Erbach-bei-Ulm, Germany, on Apr. 23, 1853, and attended school at that place. He



FREDERICK HOLZ

left school to become an apprentice machinist at Vienna and came to this country at the age of 19, finding employment with a model maker named Loutenschlager in Cincinnati.

In 1880, he and George Mueller of Cincinnati entered into partnership and operated a small shop on upper Vine St. where they did model, repair and experimental work. They also built paper-bag machinery and later undertook the manufacture of screws and taps.

As the partners were too poor to buy a milling machine for fluting their taps Mr. Holz made one with a wooden base. In 1884 they were incorporated as the Cincinnati Screw and Tap Co. with Mr. Holz as president, and continued under this name until 1889 when the screw and tap part of the business was sold and the company was re-incorporated as the Cincinnati Milling Machine Co. Mr. Holz was president of this new company until he disposed of his interests in 1905.

Mr. Holz is survived by his widow, a daughter and four sons. He was a 32nd-deg. mason, a member of Syrian Temple, A. A. O. N. M. S., North Cincinnati Gymnasium, Federated Improvement Association, Cincinnati Metal Trades Association, and of the board of the Old Men's Home of Cincinnati.

He was among the first to appreciate the value of proper shop equipment and introduced high-grade work benches and iron bench blocks in the early days. He is credited with being the first man in Cincinnati to dip finished parts in gasoline before assembling. He was an early advocate of grinding all parts and fully appreciated the need for good gages.

Mr. Holz was the first to use a milling cutter for threading taps, to install the positive feed drive, angular shaft for elevating the knee and centralized control of levers in milling machines and was the pioneer designer of the modern universal center and tool grinder. He also made many improvements in universal indexing heads for milling machines.

He possessed a very positive character which was one of the secrets of his success. He combined with it a strict honesty which was observed toward his employees as well as his business associates.

Hand Versus Power Feed in Grinding

By C. Ontario

The articles on surface grinding on page 901, Vol. 49, by Donald Baker, page 10, Vol. 50, by Harry Senior, and page 356 of the same volume by A. W. Suiter are sure proof that all toolmakers do not think alike.

I do not think the feed should be used all the time and on all work; neither do I think all grinding should be done by hand. Judgment should be used, and if the toolmaker is not up to the mark the foreman should instruct him.

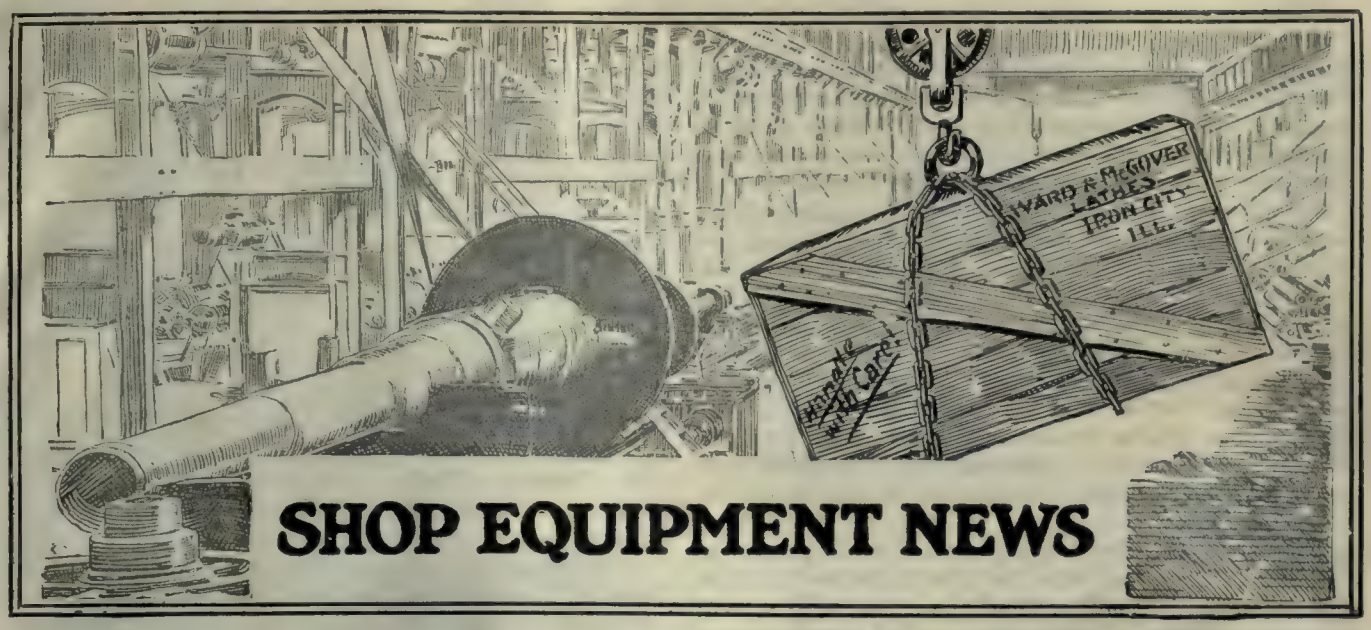
Recently we had a die of 8 x 14-in. surface which, because of an accident to its cutting edge, required to have about $\frac{1}{8}$ in. ground off. This was some job to do by hand, also rather a long job for a high-priced man to sit on a stool while it was being done, and as we have but one machine we could not tie it up long enough to do the work at one setting, consequently the work was done in several stages to allow other work to be done which was urgently needed. While the machine was running the man who was looking after it (in this case it was the foreman) was also busy with other work.

Most of our work is done with the power feed while the man who is looking after it is busy with other work, and we think we get our grinding done about as cheaply as possible. We certainly would not want the power feed dismantled as we think we have sufficient intelligence to know whether to use it or not.

Mr. Suiter says if your grinding machine is connected with an exhaust fan and you are supplied with proper wheels the only thing that will make it a disagreeable machine to run is a failure to keep it clean. Well, I have seen such machines connected to a fan that practically had no suction; the pipe had so many openings in it between the machine and the fan that the latter was practically useless, but the manager had complied with the law and he was not interested enough in the employees to know that he would get better results if conditions were better.

There are many such employers in business and as long as you are in such a shop you have to do the best you can under the conditions as you find them. I think I hear some one say they would not work in such a shop; let me say that very often for reasons over which you have practically no control you have to put up with undesirable conditions for a longer period than you care to.

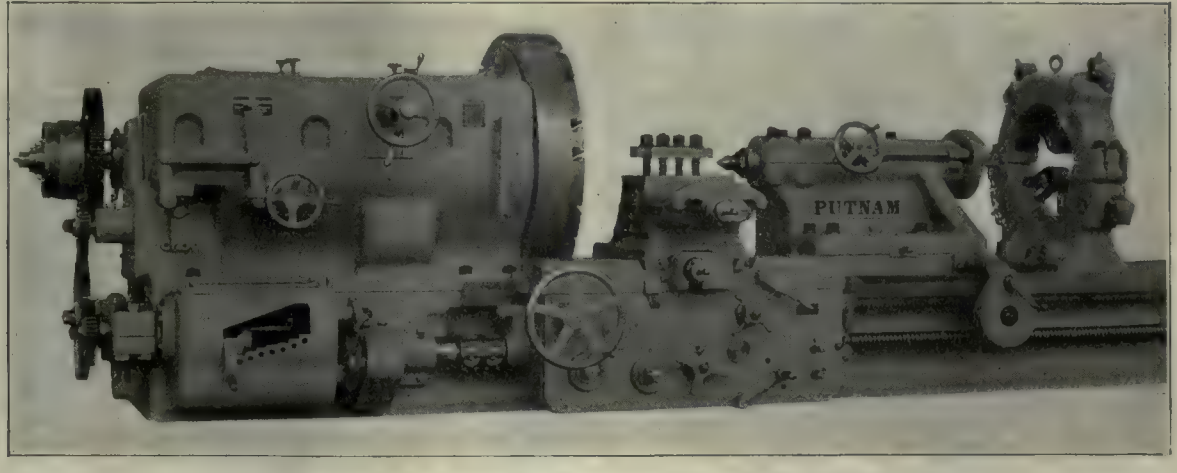
In conclusion let me say that it is up to the intelligence of those who have charge of the work whether or not the power feed is used. Some work is done by hand in some shops that would be done with the power feed in others; there is no universal way. The nature of the work, the class of machines, the conditions under which the work is done, and the kind of men available are all factors in reaching a decision.



Putnam 54-Inch Geared-Head Engine Lathe for Heavy-Duty Work

A 54-in. geared-head engine lathe that has been built for heavy-duty service is shown in the illustration. This machine is a product of the Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., and it is stated that the design of the parts is such that they will transmit 40 hp. without vibration or without causing any strain. While the regular swing of the machine is slightly over 54 in., the construction is such that the head, etc., can be easily raised on blocks where a greater swing is needed for an emergency job, a swinging link being provided at the left end so that the gearing can be kept in mesh.

The headstock is of the inclosed all-geared type giving 18 spindle speeds with a constant-speed initial drive shaft. The bearings are bronze bushed and are carried in the lower half of the headstock so that the cap can be removed for inspection purposes without disturbing any of the bearings or other parts. The machine can be furnished for either belt or motor drive, a friction clutch combined with a brake allowing the machine to be stopped or started without stopping the motor, or in the case of a belt drive this feature allows the machine to be belted directly from the lineshaft. When a motor is used it is mounted on top of the headstock at the rear, the section of the cap carrying the motor being a separate part, so that the motor does not have to be removed in case it is necessary to lift the cap for any reason. The cap is provided with two large openings that serve for any ordinary inspection purposes, these openings being closed with swinging covers to prevent the entrance of any foreign material.



PUTNAM 54-INCH GEARED-HEAD ENGINE LATHE

Width of bed on top, 53 in.; depth of bed, 24¼ in.; actual swing over ways, 56⅜ in.; actual swing over compound rest, 38¾ in.; actual swing over taper attachment, 35 in.; distance between centers with 22-ft. bed, tail flush, 9 ft. 11 in.; distance between centers with 22-ft. bed with overhang, 10 ft. 8 in.; front spindle bearing, 8¾ in. in diameter, 16 in. long; rear spindle bearing, 7 in. in diameter, 13 in. long; spindle nose, faceplate keyed on; centers, Morse taper No. 7; spindle speeds, 18, with two sets of back gears, 2.715 to 154.05 r.p.m.; number of gears in headstock, 16; diameter of driving pulley, 36 in.; width of driving belt, 6 in.; motor recommended, 40-hp. constant-speed; length of power feed of compound rest, on angular travel at one setting, 15 in.; number of changes through quick-change gear box for screw cutting and feed, 40; range for screw cutting, ½ to 14 threads per in.; longitudinal feeds, 0.016 to 0.444 in. per spindle revolution; range of crossfeeds, 0.019 to 0.543 in. per spindle revolution; travel of tailstock spindle, 26 in.; maximum travel at one setting of taper attachment, 42 in.; range of taper attachment, up to 10 deg. or 4 in. taper per ft.; minimum capacity of center rest, 5 in.; maximum capacity of center rest, 27 in.; weight with 22-ft. bed, 68,300 lb.; additional weight for each foot additional of bed, 1000 lb.; floor space without taper attachment, 25 ft. 9 in. by 9 ft. 10 in.; floor space with taper attachment, 25 ft. 9 in. by 12 ft. 6 in.

The 18 spindle speeds are controlled by the two handwheels and the lever at the right end of the head, while the lever at the left operates the friction clutch and brake. An arrangement is provided so that it is impossible to shift gears while the friction clutch is engaged. Releasing the friction clutch also engages a Raybestos lined brake for stopping the spindle.

The transmission gears with the exception of the very largest are of chrome-nickel steel heat-treated, and in fact all other gears in the machine except a few used in the apron for friction are heat-treated. The spindle thrust is carried on alternate steel and bronze washers and lubrication is by an oil bath. Lubrication of the head is a particular feature of the machine. A gear pump, located at the rear of the head, pumps a continuous stream of oil to all bearings and a telltale is provided so that it is possible for the operator to see at all times whether or not the lubrication system is in operation.

The gears have been kept as near uniform size as possible and the bearings are close together in order to insure rigidity. The speed changes are by means of selective-type sliding gears. The headstock is secured to the bed by means of six bolts. The gear box located at the left provides a wide range of speeds for thread cutting.

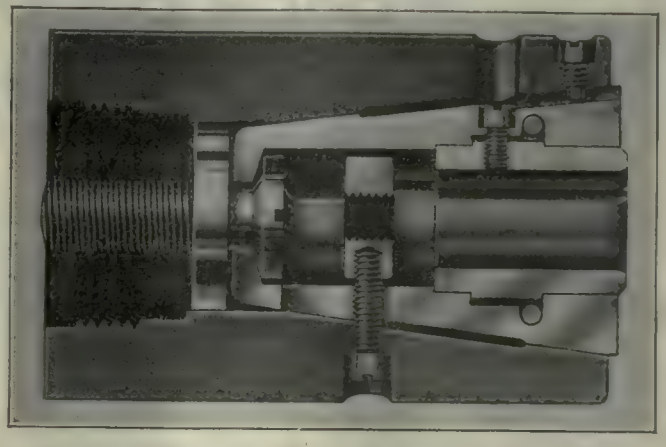
The apron is of the double-wall or box type, all gear shafts being supported on both ends. The front of the apron is removable and all studs and gears, except those located at the rear of the apron connecting to the lead screw, can be removed without removing the carriage from the bed. A throw-out is provided for the carriage handwheel. The feed rack is made of 50-point carbon steel and has teeth of stub form, 3-pitch.

The longitudinal and crossfeeds are operated by friction and are reversed in the apron. The safety device prevents an engagement of the nut for screw cutting while the feeds are engaged. The carriage has three bearings on the bed, two on raised ways in the front and back and one on the flat inside front way, this giving support directly beneath the cutting tool. Oil pipes for lubricating the carriage bearings are brought out under a small cover located on the front of the carriage. The compound rest has a square base giving a large clamping surface, and is provided with power cross, and angular feeds. These may be used independently or combined as desired. The top of the rest is provided with two large key slots and the tool-holding bolts are fitted with T-shaped spacing bars which keep them the proper distance apart at all times.

The tailstock is of the set-over type and is clamped to the bed by six bolts. It is provided with a brace that engages a rack in the bed, this feature preventing any slipping due to heavy cuts. The sections of rack are located in the center of the bed but can be taken out to facilitate the removal of chips. The tailstock center may be moved by a crank on the square at the rear end, or may be moved by the handwheel at the center of the tailstock, this wheel being brought forward to this point for the convenience of the operator. A particular feature is that all the squared shafts on the machine are the same size and all the clamping bolts are of the same size, this feature making only two wrenches necessary for the operation of all of these parts. The centers are of Morse No. 7 taper and are withdrawn by means of hexagonal nuts screwed on the front end. The tailstock is moved along the bed by the side bracket and compound gearing. The steadyrest is of the five-jaw type, the jaws being provided with removable bronze tips. The regular length of bed is 22 ft. but other lengths can be furnished if desired.

"Logan" Air-Operated Compensating Collet Chuck

The "Logan" air-operated compensating collet chuck shown in cross-section in the illustration is being manufactured by the Logansport Machine Co., Logansport, Ind., and sold by the Frank G. Payson Co., 9 South Clinton St., Chicago, Ill. The chuck housing or body is of hardened steel, ground, the taper seat for the collet jaw being a part of the housing, giving the advantage of one-piece construction to the body and reducing the number of parts. The jaws are not hinged or fastened together in any manner, but are simply set



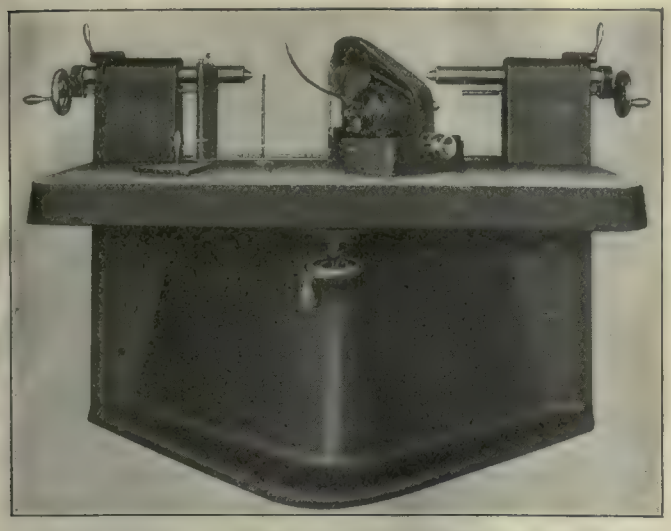
CROSS-SECTION OF "LOGAN" AIR-OPERATED COMPENSATING COLLET CHUCK

loosely into the body and held in position at the draw-rod end by the taper on the draw-rod connecting screw and held expanded at the front end by means of a spring. This floating type of jaw construction allows the jaws to adapt themselves for work of different diameters and allows an equal and positive grip the entire length of the work. The jaws have a maximum travel of $\frac{5}{8}$ in. when operated at full stroke, but this can be reduced if desired. The long, slow taper gives a powerful grip and allows a smaller air cylinder to be used, with consequent saving in air consumption. The chucks are regularly supplied in the two- and three-jaw type, with master collet jaws to which false jaw blocks for holding various sizes can be fitted, and in $1\frac{1}{2}$-, $2\frac{1}{2}$-, 4- and 6-in. sizes.

Barnes Precision Cutter Grinding Machine

William O. Barnes, Leominster, Mass., has recently placed on the market the No. 2040 precision cutter grinding machine shown which is for grinding gang milling cutters. It is stated that this machine provides a means for the grinding of any milling cutter within its range, whether a single cutter of simple shape or a large complicated gang with either straight or curved contours, and that the operation becomes one of precision and free from errors customarily due to the lack of skill on the part of the operator.

Gangs can be ground on their own arbors at a single



BARNES NO. 2040 PRECISION CUTTER GRINDING MACHINE

Capacity, cutters up to 20 in. in diameter and 40 in. between columns; floor space, 100 x 31 in. over-all; weight, 2250 lb.

setting and clearance can be given to side and peripheral teeth. The cutter or gang while still on its arbor is placed on centers carried by the two columns of the machine, and a flat templet having the desired contour is laid on the ledge that may be seen at the back of the table. This templet is then slid along the ledge until the cylindrical try square shows it to be in correct longitudinal position with regard to the cutter, after which it is clamped in position by turning the socket screws shown in the front of the table. The hand-wheel beneath the table is then turned until the try square shows the templet to be in correct transverse relation with the cutter.

The grinding wheel is motor driven and is mounted on a carrier that is equipped with a former pin and a tooth rest, and is adapted to slide freely over the surface of the table. Means are provided for so truing the wheel that its periphery at the top of the rest is in exact vertical alignment with the surface of the former pin, so that to grind the cutter the different teeth are simply placed in contact with the top of the rest and the carrier slid along the table, keeping the former pin in contact with the templet, while the grinding wheel shapes the cutter tooth to the same line. The top of the rest for the cutter teeth is made conical in order to permit the grinding of both straight and spiral teeth.

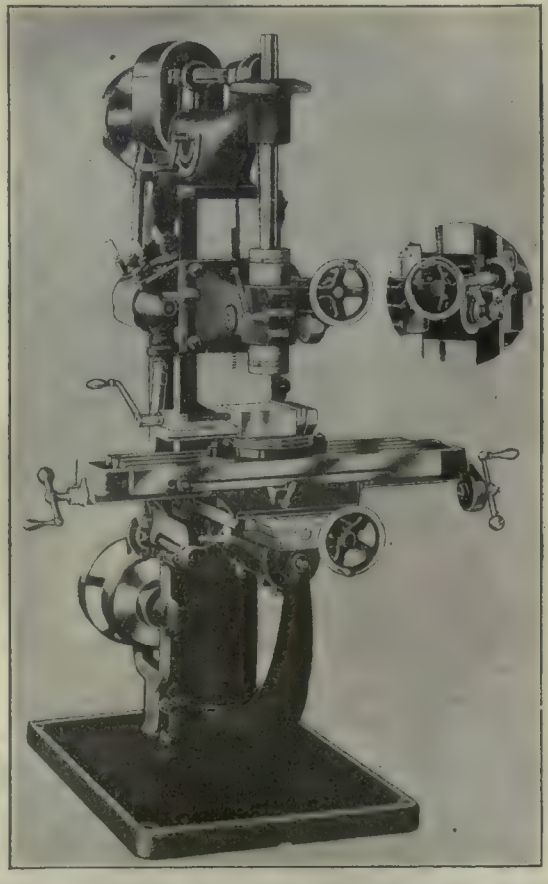
Knight No. 3 Milling and Drilling Machine

A larger machine as an addition to their general line has been brought out by the W. B. Knight Machinery Co., St. Louis, Mo., which has been designated as the No. 3 Knight milling and drilling machine, and is similar in design to the other machines of this line, but embraces several new features.

This new machine which is shown in the illustration is considerably heavier than those previously built, and is intended to handle a heavier class of work, being designed with the intention of having it rigid enough to obtain accurate results on any work within its range. The working surface of the table has been increased and all other dimensions increased proportionately.

The spindle, forged from 60-point carbon steel, has been accurately ground to size and is made large and of ample proportions to give rigidity and strength. It runs in a solid bronze bushing 11 in. long, and this bushing is tapered and may be adjusted longitudinally to take up wear by simply loosening one nut and tightening another. The thrust washers are made of bronze and hardened steel, all grooved and ground, and all these points are planned to insure accuracy and preservation of the alignment of the spindle. The distance from the center of the spindle to the column is 10 in., and the spindle head is adjustable, which in connection with the vertical feed of the table gives a maximum distance from the spindle to the table of 18 in.

A vertical feed of 6 in. on the spindle is one of the new features with which the No. 3 machine has been provided, and is an addition to the longitudinal and crossfeeds provided on the previous machines. This new feed feature will be of particular advantage in boring work and in drilling to a certain depth, and the various feeds of this vertical movement bear the same ratio as those of the table. This vertical feed is also provided with an automatic throw-out which may be regulated in either direction by means of a graduated set collar. In addition to this there is a positive



THE NO. 3 KNIGHT MILLING AND DRILLING MACHINE

Floor space, 72 x 62 in.; height, 85 in.; weight, 2700 lb.; diameter of countershaft pulley, 14 in.; belt face, 3 in.; speed of countershaft pulley, 300 r.p.m.

throw-out which prevents the spindle from traveling beyond its limit in either direction.

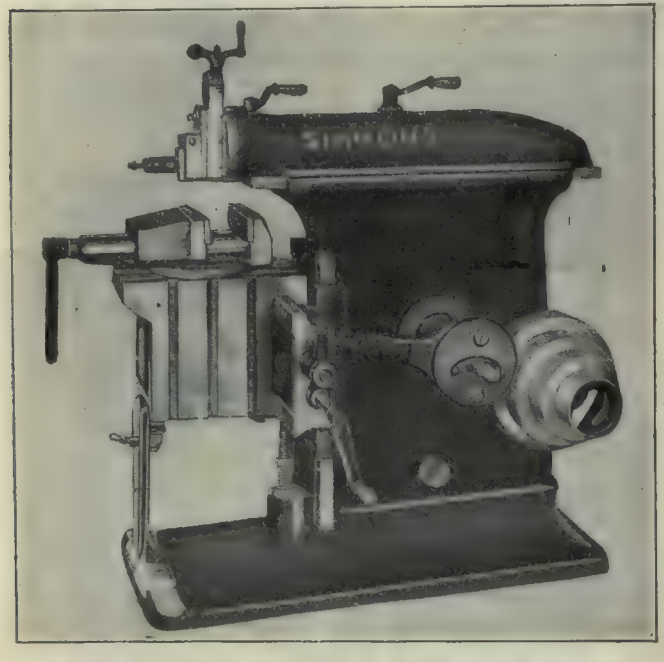
The table is designed with a view to obtaining great rigidity and resistance to distortion, and at the same time to be of convenience to the operator in handling the work. The working surface is 8½ x 33 in. and has three T-slots ⅝ in. wide, which are made of generous depth to insure against breaking out of the metal

around the clamping bolt. The table tilts and may be set to any angle within a range of 70 deg. by means of a graduated dial provided on the projecting arm which carries the knee. The table may also be pivoted about the column. It is claimed that these two features have proved themselves to be great time and labor savers. The longitudinal feed of the table is 24 in. and the crossfeed is 10½ inches.

The spindle is provided with eight speed changes ranging from 25 to 300 r.p.m., and eight feed changes ranging from 0.008 to 0.060 in. per revolution of spindle. There are also eight changes on both of the table feeds which have the same range. All gears have a large face and are cut with a heavy pitch.

Simmons Crank Shaping Machine

The Simmons Machine Co., Inc., Albany, N. Y., is now marketing the 17-in. single-geared, crank shaping machine shown in the illustration, this being designed to meet the demand for a medium-duty machine for general manufacturing work. Work may be attached to either the top or the side of the table, which is provided with T-slots and also an automatic horizontal feed of 13 in. The elevating screw is of the double-screw type operated by a crank mechanism. An outside knee support is provided.



SIMMONS 17-INCH SINGLE-GEARED CRANK SHAPER

Stroke, 17 in.; table, 10 x 13 in.; head graduated; keyseating capacity, up 3 in. in diameter; swivel vise graduated; elevating screw, double, knee support being also provided; cone pulleys, four step for 2½-in. belt; automatic horizontal feed, 13 in.; weight, 1700 lb.

Shehan Automatic Die Heads

The Shehan Tool Co., 321 Frankfort Ave., Cleveland, Ohio, has recently placed on the market a line of automatic self-opening adjustable die heads, one of which is shown in the illustration. Fig. 1 shows the assembled head, while Fig. 2 shows the device disassembled to illustrate the various parts. The particular feature of this line of die heads is the use of double-ended chasers having cutting edges on both ends. These chasers can be supplied with duplicate threads on both ends or with different diameters and pitches on the two ends as desired. This feature is said to greatly lower the operating cost of the heads. All parts except the shank are hardened and ground and the parts are interchangeable. The heads are made on the round construction principle throughout making possible the elimination of cams and other such parts. It is stated that the heads have a comparative few number of parts, that they are very easy to adjust, that they are very quickly assembled and that the outside diameters are less than those of any other type head on the market. The four operating shafts that oscillate the chasers have teeth that engage the chasers their full cutting length, giving a perfectly distributed bearing that is said to add much to the accuracy and life of the cutting points, and make it impossible for the chasers to tip, or cut tapers. The adjusting ring is mounted on the shank proper, two adjusting screws fitting into recesses, the ends of these screws resting upon the two driving pins. The adjustment is accomplished by means of a screwdriver. The operating ring is mounted on the chaser head, and has four hardened pins engaging the adjusting ring, the reverse side being recessed to contain the compression springs that control the chaser movement. In locking position the adjusting ring is engaged at four points. The head can be cleaned by simply removing the faceplate with a screwdriver.

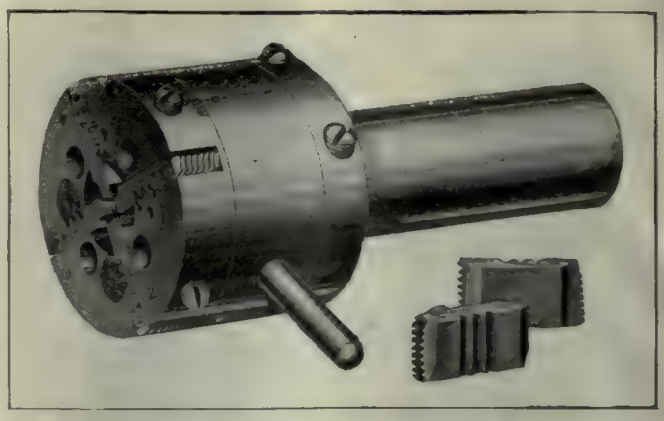


FIG. 1. SHEHAN AUTOMATIC SELF-OPENING ADJUSTABLE DIE HEAD

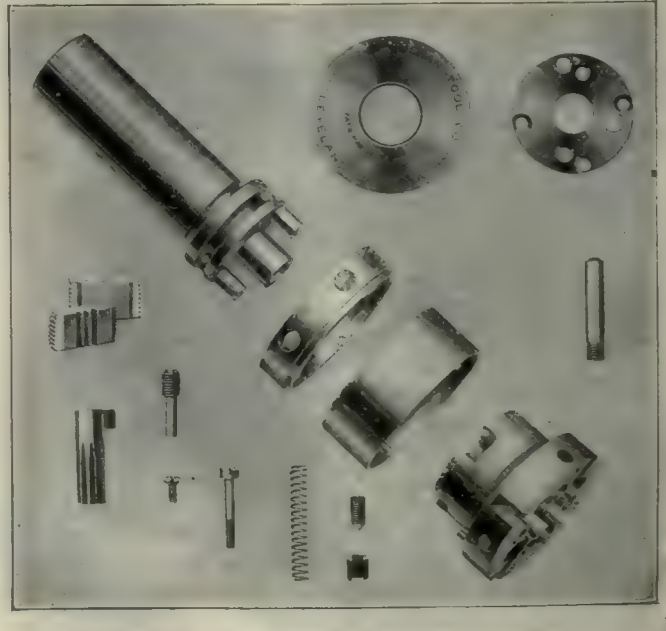
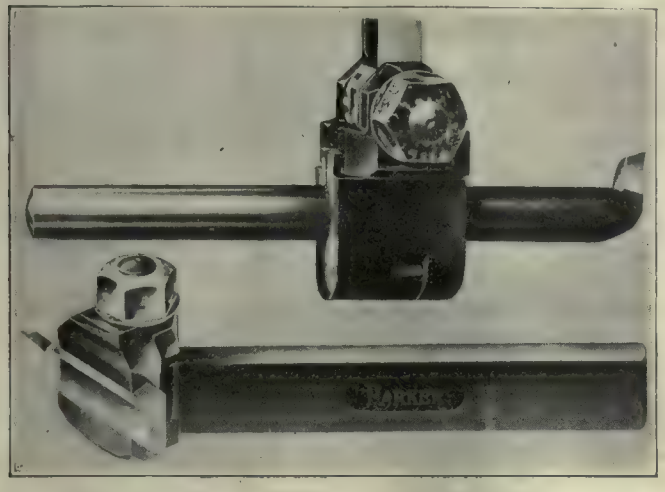


FIG. 2. A DIE HEAD DISASSEMBLED

Parker Universal Toolholder

The illustration shows a universal toolholder that is being manufactured by the Parker Machine Co., Boston, Mass. The holder is universal and reversible with a positive locking device for each one of the five positions obtainable, it being possible to use any type of bar-stock cutters, either flat, square, or round, and also special shaped cutters. It is claimed that more work can be produced with this holder than with a complete set of

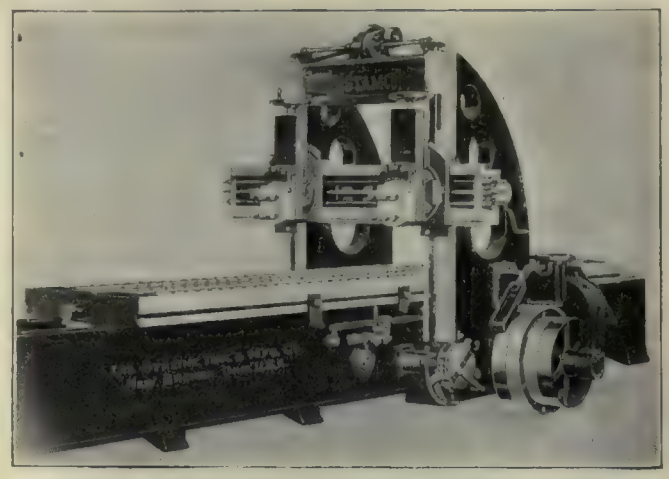


PARKER UNIVERSAL TOOLHOLDER

single-purpose holders and that the breakage of high-speed-steel tool bits and setscrews is eliminated. The illustration shows the toolholder with a rough-turning cutter in place and also with an internal boring tool ready for work. The holder is supplied with 15 cutters and forms a complete outfit in itself.

"Stamco" Heavy-Duty Planing Machines

The Streine Tool and Manufacturing Co., New Bremen, Ohio, has just placed on the market a new line of extra-heavy-duty planing machines that are built in five sizes, 36 x 36 in., 42 x 36 in., 42 x 42 in., 48 x 42 in. and 48 x 48 in. The bed is of box-type construction with a diaphragm extending across the entire top except where the opening for the gears is necessary. The table slides on V-ways, and is said to be unusually wide and well ribbed, being provided with ledges to protect the V-tracks from dust and chips. The rack for driving is set into the table and fastened in place with capscrews and steel taper pins, the rack teeth being 2½ in. diametral pitch. Box-type construction is used for the housings which are bolted and pinned to the bed, and are planed and finished for the application of the side heads. The crossrail is heavy, with a large bearing surface, the rail screws and rail rod as well as the rail elevating screws being fitted with ball-thrust bearings, micrometer collars being provided for the rail screws. The heads are fitted with taper gibs, and the slide screws have micrometer collars and ball-thrust bearings. The side heads are counterbalanced, are fitted with automatic feeds and can be run down below the level of the table when not in use. All gears except the main drive pinion are of semi-steel, this particular one being machined from a steel forging. The power elevating device is located on the top brace, and is operated through a clutch so made that it will immediately disengage on



"STAMCO" EXTRA-HEAVY-DUTY PLANING MACHINE

Made in 5 sizes: 36 x 36 in., 42 x 36 in., 42 x 42 in., 48 x 42 in., 48 x 48 in. Specifications for 42 x 42-in. machine: Width of work planed, 43 in.; height of work planed, 43 in.; width of platen, 39 in.; thickness of platen, 7 in.; distance between V's, 24 in.; depth of bed, 25 in.; face of housing, 9 in.; face of crossrail, 16 in.; length of saddle bearing on rail, 17½ in.; length of rail-head down feed, 15 in.; face of bull wheel, 7¾ in.; diametral pitch of bull wheel, 2½ in.; width of cutting belt, 3¾ in.; diameter of cutting pulley, 30 in.; diameter of return pulley, 24 in.; width of countershaft belt, 6 in.; diameter of countershaft pulley, 18 in.; height, 105 in.; width, 92 in.; countershaft speed, 350 r.p.m.; horsepower required for 50-ft. cutting speed of platen, 25.

encountering any obstruction. The bull gear shaft is stationary and is supported in the bed. All running shafts are fitted in special bushings while the pulley shaft is mounted in heavy-duty Hyatt roller bearings. The driving pulleys are of aluminum cast on a semi-steel chill to reduce momentum to a minimum. The shifting mechanism can be operated from either side of the bed, and the table is provided with dogs on both sides. A safety locking pin is provided for each belt shifter. The countershaft is also mounted in Hyatt roller bearings, a heavy flywheel pulley being provided.

Bilton Swivel Machine Vise

The Bilton Machine Tool Co., Bridgeport, Conn., has recently placed on the market the swivel-base machine vise shown in the illustration. This vise has been designed for heavy work, the sliding jaw being pulled up against the work. This jaw is gibbed to the base in order to prevent it from rising when pressure is applied, the design also tending to hold the jaw on the base. The stationary jaw is of box-form construction, is keyed to the base and wholly incloses the operating screw, the

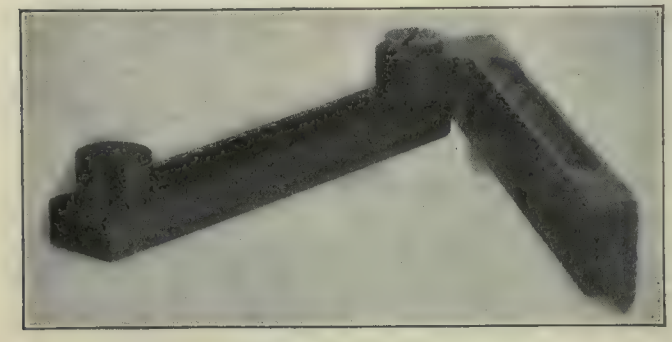


BILTON MILLING VISE

end of which bears just back of the face of the jaw. The removable face of the stationary jaw is held in place by two screws, the heads of which are made long and project through to the back in order that the face may be conveniently removed. It will be noticed that the screw and operating mechanism of the vise are wholly inclosed in the box-type stationary jaw, so that dirt and chips are absolutely excluded.

Simplex Sine Bar

The sine bar illustrated is the product of the Simplex Tool Co., Woonsocket, R. I. This is a 5-in. bar, is mounted on a base and can be set either by measuring over the bottom of the base and the button with a micrometer, or between the top of the base and the button with blocks. With the swinging construction used it is only necessary to set one end of the bar.

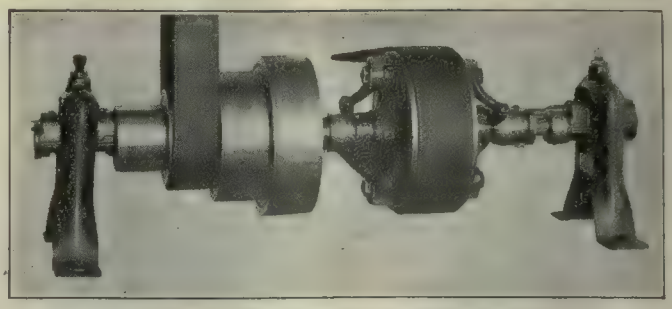


SIMPLEX SINE BAR

The device may be used against an angle plate or laid flat upon its side as desired, as the side of the base and side of the bar are in one plane. The bar itself is of channel construction and in some cases small work can be clamped directly to it. The clamping device for the bar is said to be entirely new, and capable of locking the bar to the base with a very powerful and centralized grip, at the same time eliminating the tendency to spring or move the bar. A special steel is used in the construction of the device which is hardened and ground all over. Gage blocks for setting common angles without figuring can be furnished if desired, the outfit when so ordered being packed in a hardwood box.

"Abitz" Reversible Countershaft

The "Abitz" reversible countershaft is a recent product of the Rockford Metal Specialty Co., 720 South Main St., Rockford, Ill. The countershaft is arranged to give forward, neutral and reverse speeds, and makes use of a planetary-gear mechanism to accomplish these results. A clutch at the right fixed to the shaft engages the pulley, while a stationary clutch at the left loosely mounted on the shaft engages the idling drum, and acts as a brake. Two spools fixed to one shifter arm are provided to expand the clutches. If the shifter arm is thrown to the left, the right clutch is expanded, engaging the pulley and driving the shaft in the same direction, the whole mechanism revolving as one unit; while if the shifter is thrown to the right, expanding the left clutch the idling drum will remain stationary, forcing the pinion to drive the gear fixed to the shaft in the opposite direction or reverse. This construction gives forward, neutral and reverse, the belt running



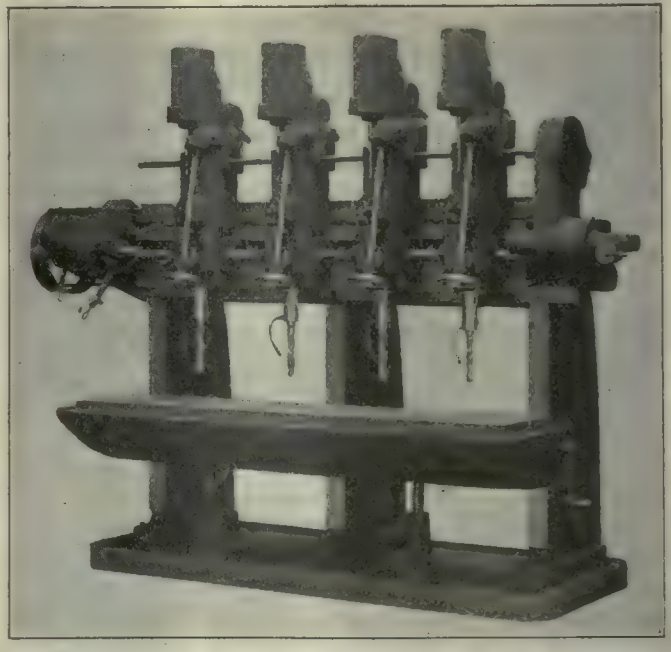
"ABITZ" REVERSIBLE COUNTERSHAFT

in one direction, through the control of one lever. The gears are working only when the countershaft is in reverse; when the shaft is at rest these gears merely idling around in their planetary path.

Defiance No. 23 Independent-Feed Rail Drilling Machine

The No. 23 independent-feed rail drilling machine, with No. 33 independent heads, is a recent product of the Defiance Machine Works, Defiance, Ohio. This is a heavy-service production tool, and especially intended for use in locomotive, railway, gas-engine, automobile, or other shops where the work includes heavy gang or heavy jigged drilling.

The speed mechanism is attached to the upper end of the upright at the left end of the frame, and consists of two cones of hardened-steel gears, back gears, and a hardened roll-in gear. The cones consist of three gears each, thus providing three different gear ratios which, when used in conjunction with the back gears, give six speed changes. The shafts in the speed box



DEFIANCE NO. 23 INDEPENDENT-FEED RAIL DRILLING MACHINE

Capacity in solid steel, 2 in.; maximum distance, nose of spindle to top of table, 32 in.; distance from center of spindles to face of column, 12¼ in.; minimum distance center to center of spindles, 8 in.; maximum distance center to center of outside spindles, 78 in.; length of power feed, 12 in.; working surface of table, 20 x 98 in.; vertical adjustment of table, 12 in.; speed changes, six, 25 to 186 r.p.m.; feed changes, three, 0.006, 0.009 and 0.014 in. per spindle revolution; diameter of spindle nose, 3 in.; diameter at driving point, 3 in.; diameter of spindle sleeve, 4 in.; Morse taper in spindle, No. 5; drive pulley, 20 x 5¼ in.; speed of drive pulley, 350 r.p.m.; horsepower required, 10; floor space, 56 x 144 in.; net weight, 12,180 lb.

rotate in Hyatt roller bearings, and the drive shaft which transmits the power from the speed mechanism to the spindle turns in combined radial and thrust ball bearings. The speed box receives its power from a constant-speed pulley, a Johnson friction clutch being used.

The feed mechanism is inclosed and carried at the upper end of the upright at the right end of the frame, the feed changes being obtained through two cones of gears driven by the spindle drive shaft. These gear cones give three changes of feed for each spindle speed, the feed changes being effected by a slip key operated by a hand lever. The feed is transmitted from the two gear cones to the feed shaft by the gears and a worm and worm gear, the end thrusts being carried by ball bearings. A handwheel is provided for advancing or returning each spindle rapidly.

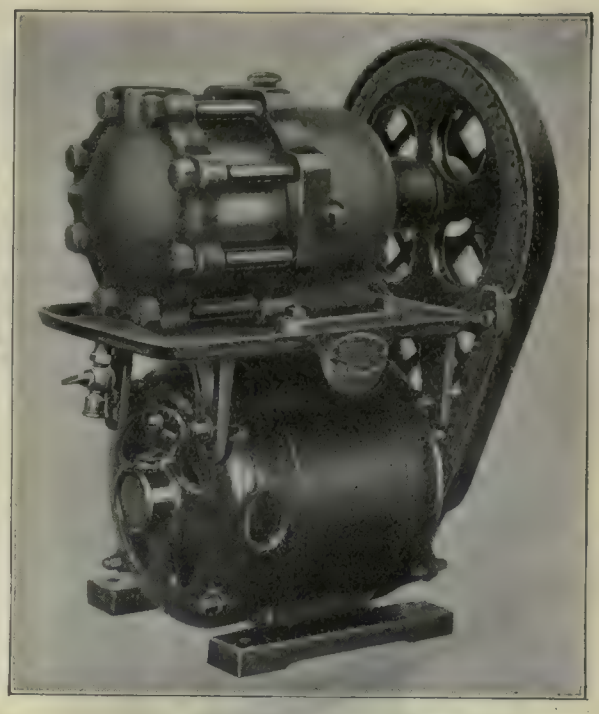
The dove-tail method is used to gib the spindle head to the crossrail, each head being a self-contained unit that may be adjusted longitudinally along the rail by means of a crank handle operating through a rack-and-pinion mechanism. The spindles themselves are of forged high-carbon steel driven by spiral gears with two keys extending from the gear through the sleeve and into ways in the spindle. The end thrust on these keys and the spiral gear is taken by a ball bearing, while the spindle thrust is taken on SKF ball bearings. This drive is located in the lower end of the head, a feature that reduces torque in the spindle to a minimum. Each spindle is counterbalanced, and is independent of the rest. The levers used to apply the feed and drive to each spindle are interlocking, so that power feed cannot be engaged while the spindle is not being driven. Adjustable stops are provided for drilling to a given depth.

The table is a box type casting and is adjusted vertically by means of a crank-operated mechanism connecting to the two jackscrews through a worm and worm gear. The jackscrews are located in the center line of the spindles. A cored section of the table serves as a reservoir, and the table casting is shaped on all four sides so as to form a trough into which the cutting compound flows before passing to the reservoir. The pump for circulating the cutting compound is fastened to the upright at the left end of the frame and driven from the countershaft.

Lubrication is by a force-feed, gravity-flow and splash system combined, made possible by the all-inclosed unit construction. The speed mechanism, feed mechanism and each of the spindle heads are provided with independent and self-contained oiling systems, the contents of each unit being partly submerged in a bath of oil, while the bearings are lubricated by force feed through individual leads which carry a sufficient flow of oil to flush all inclosed parts on its return to the reservoir.

Utility Pressure and Vacuum Pump

The Utility Compressor Co., Detroit, Mich., has recently placed on the market a number of models of the pressure and vacuum pump shown in the illustration, Fig. 1. Fig. 2 shows a cross-section view of a different model but indicates the general construction. The rotary motion of the pump shaft is converted into a reciprocatory motion of the eight pistons by a connecting-rod rocker pivoted on a universal joint. The connecting-rod rocker is engaged in the crankshaft at a proper distance to give a stroke of $1\frac{5}{16}$ in. The circular or wave-



UTILITY PRESSURE AND VACUUM PUMP

Number of cylinders, 8; bore of cylinders, 1 in.; stroke, $1\frac{5}{16}$ in.; speed, 420 r.p.m.; capacity, 2.1 cu.ft. of free air per minute; lubrication, splash system; height over-all, 17 in.; width, 15 in.; depth, $9\frac{1}{2}$ in.; pressure pumped, up to 300 lb. per sq.in.; vacuums pumped, as high as $28\frac{1}{2}$ in. of mercury.

like motion of the rocker delivers the power in turn to each of the pistons, there being $\frac{1}{4}$-in. lead between the pistons which insures a continuous flow of air and a steady pull on the driving arm. The driving arm of the crankshaft is counterbalanced and a small blade attached to the crankshaft splashes oil on the various parts. One discharge valve is used for each cylinder and all of the eight are mounted in one plate. The valves are made of brass, cylindrical in shape, giving a soft face against a hard seat and are peened. An arrangement is incorporated to prevent rotation. It is stated that in operation the valves lift only about 0.01 in. off their seats, a feature that gives quiet running. The cylinders are cast en bloc and the intake is through a stationary port cut in each cylinder. The crankshaft, connecting-rod rocker, and pistons are of open-hearth steel, the first two being forged, heat-treated, and tempered. Each piston carries two cast-iron rings and is fitted with oil grooves. The crankshaft has a die-cast, nickel-bronze, removable bushing. The connecting-rods are $2\frac{1}{16}$ in. long and have a $\frac{5}{8}$-in. hardened-steel ball at each end. The motor furnished is either for alternating or direct current as desired and the

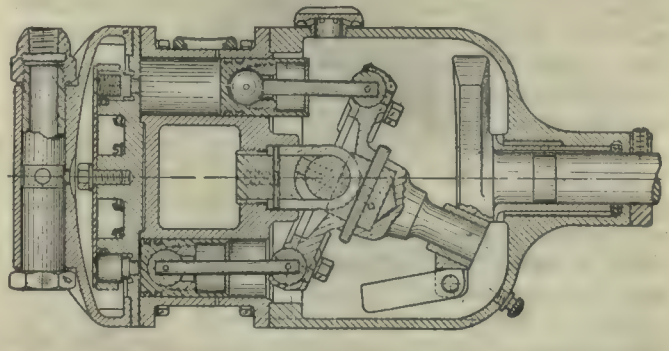
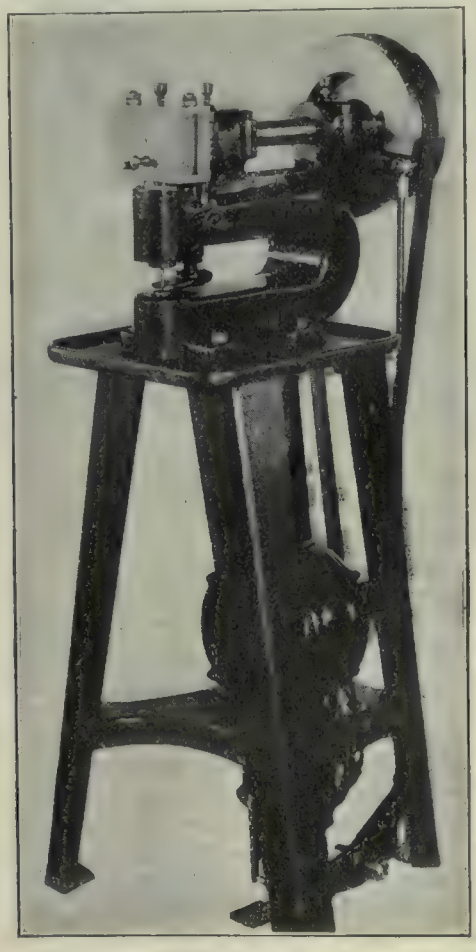


FIG. 2. A CROSS-SECTION SHOWING THE CONSTRUCTION

drive is by means of a silent chain protected by an aluminum chain guard. The capacity of the compressor is $2\frac{1}{10}$ cu.ft. of free air per min. and pressures up to 300 lb. or vacuums as high $28\frac{1}{2}$ in. of mercury.

Oliver Profiler

The profiler shown in the illustration is a recent product of the Oliver Instrument Co., Adrian, Mich., and is used for the production of duplicate irregular parts from sheet metal up to $\frac{5}{32}$ in. thick. The machine is built with a deep throat and a short stroke, the punch used being round in section, and having a heel



OLIVER PROFILER

on the back which does not raise out of the die when the machine is in operation. There is an eccentric bearing on the head by means of which the punch can be raised $\frac{3}{8}$ in. in order that the work may be passed under the punch when it is desired to work out a hole in a piece of metal. A templet is first made to the exact shape of the part desired, this templet being doweled to the work. The stroke is proportioned so that the punch clears the stock only and cuts into the metal until the templet rubs against the body of the punch; the work being guided by hand. It is impossible to over-run the finished outline, and the work comes from the machine practically finished, it being simply necessary to remove with a file any small scallops left by the punch. The machine is motor driven and has an interlocking switch and brake arrangement so that the machine only runs as long as the foot pedal is depressed. The speed is 250 strokes per minute and the stroke $\frac{1}{4}$ in. The total weight is 601 lb.

Grand Rapids Casting Grinding Machine

The Grand Rapids Grinding Machine Co., Grand Rapids, Mich., has recently placed on the market the casting grinding machine shown in the illustration. This machine is intended for use in the foundry or machine shop for the grinding of gates, sprues, fins, rough places, etc. or for the grinding of the surface of castings preparatory to filling and painting. The base casting has three feet in order that it may be mounted on rough flooring, and carries the main spindle in ring oiled bearings. The spindle is of the hollow type in



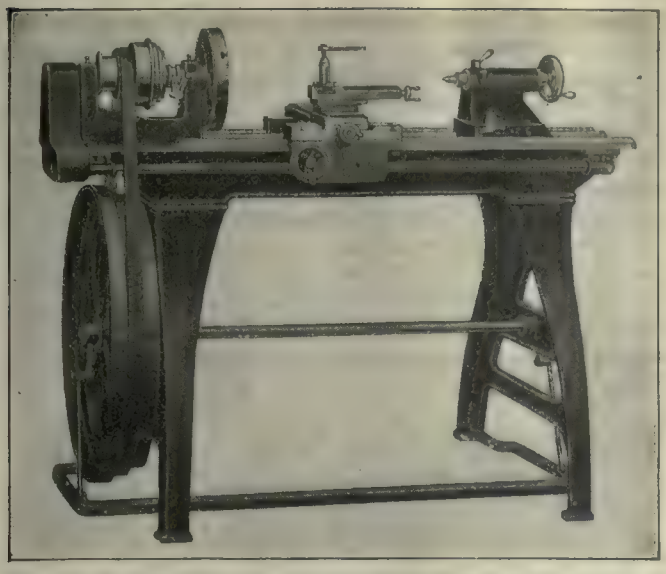
GRAND RAPIDS CASTING GRINDING MACHINE

the form of a heavy steel sleeve. The key extends through from the pulley into a long feathered keyway on the internal shaft which slides longitudinally inside of this hollow spindle. To the outer end of this spindle shaft is fitted a universal joint and to this joint in turn is fastened the long rigid shaft which carries the grinding wheel. This construction allows the grinding wheel to be moved up and down or sideways, and also in and out to a given extent, thus covering considerable area without the necessity for moving the casting.

The machine regularly carries a 12-in. grinding wheel with $1\frac{1}{2}$-in. face, but smaller wheels can be quickly fitted. The machine is driven by a 3-in. double belt and from 5 to 10 hp. are recommended. The wheel shaft is inclosed in a pipe the entire length and the wheel itself is provided with a guard. Standard equipment includes the machine complete with countershaft, counterweight, $\frac{3}{8}$-in. steel rope for counterweight, swivelsheave pulleys, clamps for rope, wheel guard, etc., but does not include the belting, grinding wheel or casting carrier which can be supplied as extras.

"Sterling" Foot-Power Lathe

The Shepard Lathe Co., Canal and Jackson Sts., Cincinnati, Ohio, has just placed on the market the "Sterling" 11-in., cone-head, back-geared, screw-cutting, foot-power lathe shown in the illustration. The lathe can also be furnished with countershaft for power drive if desired. The headstock is provided with a hollow spindle of high-carbon steel, running in white-bronze bearings, the front bearing being tapered to allow adjustment for wear. The cone pulley is three-step for a $1\frac{1}{2}$-in. belt. The back gearing is of the



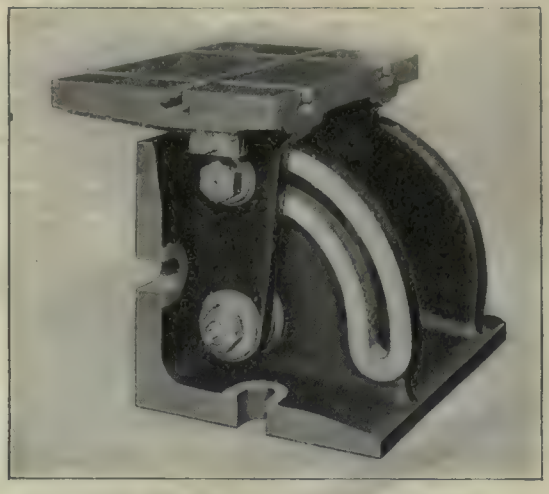
"STERLING" 11-IN. FOOT-POWER ENGINE LATHE

Actual swing over bed, 11¼ in.; hole through spindle, ⅛ in.; spindle nose, 1½ in. in diameter threaded, 19 pitch; front spindle bearing, 1⅛ x 2½ in.; rear spindle bearing, 1⅛ x 2½ in.; diameters of cone pulley, 3, 4⅜ and 6½ in.; width of belt, 1½ in.; ratio of back gears, 4 to 1, diameter of tail spindle, 1¼ in., diameter of lead screw, ⅜ in.; length of carriage on bed, 11 in.; size of tools, ⅜ x 1 in.; threads cut, 3 to 40; distance between centers, 24 and 36 in. with 4- and 5-ft. beds respectively; net weight, 500 lb.

planetary type and is located on the inside of the cone pulley. This construction allows the spindle to be thrown in direct or back gear without stopping the spindle, the movement being accomplished by means of the clutch handle located near the front spindle bearing. Either a compound or a plain rest may be furnished at the option of the purchaser, all rests being gibbed throughout and provided with micrometer collars on the feed wheels. The tailstock is of the set-over type for taper turning, the spindle being 1¼ in. in diameter, and graduated in sixteenths of an inch for drilling to a given depth. Power longitudinal feed is furnished as standard equipment and power crossfeed can be furnished at a slight additional cost. A chasing dial is arranged in connection with the apron handwheel to simplify the chasing of threads. A notable feature is that the bar foot treadle runs the whole length of the lathe, enabling the operator to drive the lathe from any point along the bed.

Taft-Peirce Toolmaker's Knee

The illustration shows an improved form of toolmaker's knee recently placed on the market by the Taft-Peirce Manufacturing Co., Woonsocket, R. I. In the new device a second measuring plug has been substituted for the hole in the table, the distance between the two measuring plugs being 5 in. This arrangement facilitates the manipulation of the tool when making accurate measurements and also reduces the calculation necessary to set for any given angle. The outer measuring plug, instead of being inserted in the edge of the table, is mounted in an adjustable plate held in position by two dowel pins. This construction is used so that in case it is ever necessary to repair the knee the plate can be readjusted and redoweled without undue trouble. The base of the knee is finished on two right-angle faces which permit it to be set at any angle from zero to 90 deg. and yet make the measurement on an angle of 45 deg. or less, which gives the greatest degree of accuracy in observation. Another feature of the knee is the location of one of the measuring plugs in the center of rotation, this feature eliminating considerable measuring, as it does not change its position when setting the table. Both measuring plugs are protected from damage by parts of the knee which ex-

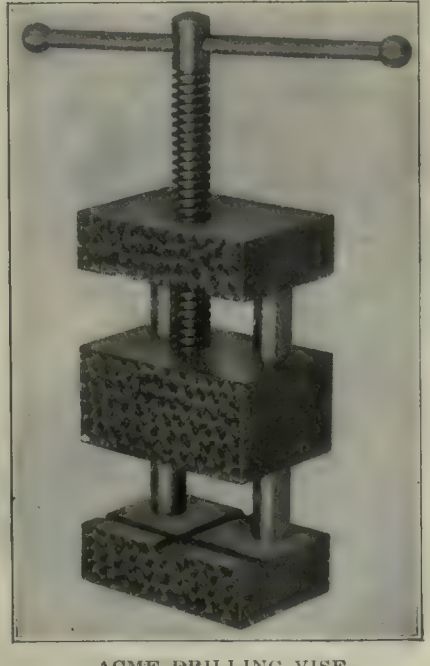


TAFT-PEIRCE TOOLMAKER'S KNEE

tend beyond them. The knee is also made with a vernier reading angles of 5 min. in place of the measuring plugs if desired.

Acme Drilling Vise

The Acme Tool Co., 143 West Water St., Milwaukee, Wis., has recently placed on the market the drilling vise shown in the illustration. This device is of open-work construction so that holes may be drilled completely through a piece of work, and two V-grooves are placed in one of the jaws so that cylindrical work can be conveniently held. The tool is made of semi-steel and the sides and edges are made at right angles so that after a piece of work is once clamped holes can be conveniently drilled at right angles without moving the work in the vise. The screw is 1 in. in diameter with an Acme

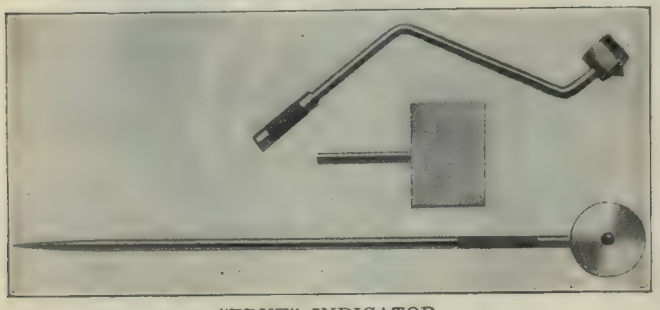


ACME DRILLING VISE

thread. The vise is 5½ in. wide, 3¾ in. high and 10½ in. long, having a maximum opening between the jaws of 4½ in. The sliding jaw moves on two cylindrical ways that are securely fastened at the ends to the stationary jaw and the block carrying the screw, these ways being of suitable size to give rigidity.

The "True" Indicator

Osberg & Johanson, 206 Boston St., Dorchester, Mass., has recently placed on the market the "True" indicator, or wiggler, shown in the illustration. This device requires no elaborate setting up on account of its simple construction, and has no delicate springs, levers or other

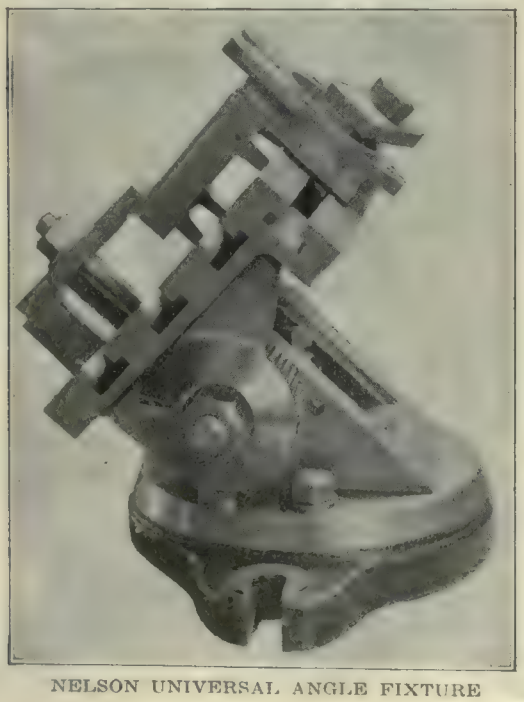


"TRUE" INDICATOR

small parts to get out of order. The outfit consists of a set of two centers and a scale that can be used for indicating motions of the pointer; this scale being held in an ordinary surface gage when in use. The device can be used for truing up center marks in work to be bored out, for testing lathe centers, aligning the headstocks and tailstocks of lathes, and other similar center jobs.

Nelson Universal Angle Fixture

The universal angle fixture illustrated is a recent product of the Nelson Tool and Machine Co., 253 Norfolk St., Newark, N. J., and is made in three sizes. The smallest size, 3 x 3⅝ in., is made with a plain base only, while the two larger sizes, 6 x 9 and 9 x 12 in., are made with either plain or swivel bases as desired. The



NELSON UNIVERSAL ANGLE FIXTURE

swivel-base fixture illustrated can be adjusted to any angle horizontally and can be adjusted to 90 deg. in a vertical direction without the necessity of resetting the work being held. Adjustments in the vertical plane are made by a gear and pinion wrench that has a sufficiently large ratio to permit fine adjustment. After being adjusted to the desired position the table can be securely clamped. The swivel head is locked to the base by two bolts that prevent any possibility of lifting. Another feature is the construction of the top plate, which has three T-slots in the top and one on the edge, this being said to be advantageous where work of L-shape, such as the work shown clamped in position, is being handled.

What Is the Matter With the Machine-Tool Business?

By W. D. Forbes

The growl of Entropy, made manifest on page 645 of *American Machinist*, is deserving of comment.

It may be divided into four parts: First, the query as to why men go into the machine-tool business, and once in, how do they stay in? second, his implication that all buyers of machine tools are bone-heads; third, that machine-tool builders are a timid, non-progressive lot, and fourth, that it is time to find some new expressions to use when selling tools.

Let us consider these statements in order: Men go into the machine-tool business because it can be made to pay, and they stay in it because it does pay. This is proven by the fact that the advertising pages of *American Machinist* carry the names of many tool builders, not a few of them having been represented there throughout the already long life of that estimable journal. If the business did not pay, these names would have dropped out of sight long ago.

I have personally assisted at the founding of several tool-building firms that have made money after the second year and are now rated high in the business world even though they have never done anything but build and sell machine tools. I have known, too, of a lot of people who have started in this line of business and failed; but such a condition will be found in all classes of trade.

Regarding the allegation that forms the second part of Entropy's disquisition: I have sold machine tools to many persons and firms and as a rule I have not found them bone-heads. I have often found that a buyer did not agree with me as to the value and utility of a tool and have sometimes been brought to change my views to accord with his, but have more often been able to convert him to my way of thinking. I have sold tools to people who would have liked to buy lathes and planers of a higher grade than those that I sold them, but lack of funds made it simply a question of buying what they could pay for or go without.

Most tool buyers want to get the best there is and all of them want to be shown why it is best; they will not pay for it unless its ability to do what is claimed for it is demonstrated. Often a customer will send me a blueprint of a piece which is now being machined on a certain tool in so many hours with speeds, feeds, etc., designated, and ask me if I know of any machine which will do better; if I do, I can make a sale. When a customer wants a standard tool he usually orders direct from the maker.

The foregoing would seem to indicate that Entropy's idea of the bone-head buyer is not substantiated, at least in so far as my customers are concerned.

Now about timidity and lack of progress: His reference to a designer from the back-hills but thinly veils the remarkable achievement of Mr. Harkness—the flat-turret lathe, a monument to him far greater than any of hewn stone or beaten brass—to whom the mechanical world owes much for his successful endeavor to overcome timidity in machine design.

Fellows, too, from the backwoods of Vermont, brought forth something in the way of gear-making machinery that can scarcely be called unprogressive; some years ago a man named Fox produced a lathe that was a departure from fixed ideas; the Lo-Swing lathe might be considered as a show of boldness, and Gisholt also has done some things other than change the size of oil-cups on his product.

Then we have the geared-head lathe, and the draw-in chuck for large sizes. The little box of quick-shift gears does not seem to please Entropy; neither did it please me at first, but I was soon converted and this is how it came about:

I had bought four small non-screw-cutting lathes, having a lot of work just suited to their capacity, but my foreman never ceased to growl and mutter about them, as he seemed to find jobs for them that required the cutting of threads.

One day he got a better job and I put one of the toolmakers in his place. Not hearing any growls from the new incumbent I went out into the shop to investigate and found these lathes being worked to the limit of their capacity on straight valve-stems which had three shoulders of different diameters to be threaded.

New Foreman Has Better Way

My new foreman had arranged to pass these pieces on, as soon as they were ready for threading, to a lathe which was equipped with the quick-shift gear, and each stem was finished at one dogging so far as the threads were concerned. The machinist cut the smallest thread first, changed the gears to the required pitch for the second size and dropped a proper-sized spacing block back of the stop-screw, changing again and substituting a larger spacing block for the largest thread. These shifts took but a moment each and thus served to give maximum of output with the least possible loss of time.

The quick-shift gear box is more than a talking point. As to scraped fits, ground spindles, and other talk considered by Entropy to be thread-bare, he should remember that to many others it is new; that there is a prospective machinist born every hour, who has to learn the value of these fine points. A good salesman talks to the man to whom he wishes to make a sale according to the latter's years and experience, and the observant seller soon knows what points will be most interesting to the prospective buyer.

The two-chuck and two-table idea for planing machines did not work out well because nothing was saved by it. In lathe work two chucks are handy only when a job comes along that must be done at once and the only available lathe is one in which a piece of work is already chucked that could not be re-set.

Taking it altogether it seems to me that we have advanced to a considerable degree in tool design since the civil war, and to my mind the 100 per cent. gain in machine work lies rather in the direction of trying to handle efficiently the tools which we now have rather than in searching for radical improvements.

A Universal Drill Jig Operated by Compressed Air

By Raymond Grant

The idea of a drilling jig that should be adaptable to different jobs by making for each job a pair of false jaws that could be used in the jig, I first worked out by a fixture in which the upper false jaw served as a guide bushing for the drill helping to locate the work, while the lower jaw was worked out to suit the job in hand and was raised by a lever-operated cam to clamp the work up against the upper jaw while drilling. The work to be drilled consisted mainly of small brass parts requiring one or more holes to be drilled with a considerable degree of accuracy.

In a later development the lower jaw was actuated by a foot pedal, leaving one hand free to put work into the jig and the other to feed the drill. This latter form worked so successfully both in respect to accuracy of product and speed of operation that I decided to substitute an air cylinder for the foot pedal, thus relieving the operator from the strain of holding the work under pressure while drilling. A double-acting air cylinder was placed on a bracket below the table of the drilling machine, and by means of a suitable coupling the fixture could be taken from the machine when not needed without disconnecting the air pipes. The plunger that carries the lower jaw and the bushing in which it slides were of tool steel, hardened, ground and lapped.

The exhaust air from the cylinder was piped up to where it could help blow the chips away, and an additional jet was provided which on most jobs would blow the work out of lower jaw as soon as it was released. Sheet-iron hoppers and spouts were provided to catch and convey the work to a box on the floor. These fixtures proved entirely satisfactory, being very rapid in action, and were steady producers. They were used on Henry & Wright machines, but can easily be adapted to any similar machine.

In pre-war days the prices on work up to about $\frac{5}{8}$ in. in diameter with drills up to $\frac{1}{4}$ in. in diameter averaged about 4c. a gross, with an occasional exceptional job as low as 2c. a gross and others as high as 8 or 10c.

I believe that there is no cheaper or more rapid way than this of doing this class of work and it would seem that the principle might be applicable to other classes of work.

Milling Cutter for a Thread Tool

By John H. Blackman

On page 419 of the *American Machinist* is an article describing a thread tool made out of a milling cutter. As the correct width of a cutter for square threads is measured on a line parallel to the length of the work, it will be seen that the space between threads is not the same for single as for double threads and that it also varies for different diameters. It would seem that a cutter like the one described for square threads would be right only for some certain size work.



Sparks from the

American Tools Wanted In England

Captain Taylor of England Speaking at Convention in Atlantic City Said American Machine Tools Stand in Great Favor

Capt. William T. Taylor, M. A. Soc. M. E., who is in this country on behalf of the Lord Roberts Memorial Workshops, gave a talk at the convention of the National Machine Tool Builders' Association held at Atlantic City, in which he illustrated the scheme of the organization and its manner of training and employing the British disabled soldiers and sailors.

Captain Taylor volunteered to tour this country at his own expense for the object of calling on American machine-tool manufacturers, requesting them to donate machine tools for workshops being put up in Ireland, Scotland, England and Wales by the Lord Roberts Memorial Workshops organization. It is gratifying to know that American machine-tool builders have taken a keen interest in the mission of Captain Taylor and at the convention the membership unanimously approved of immediate action with the result that a committee was formed.

American workers had a big share in the wide machine-tool market in Great Britain during the time of the war. This was well brought out by Captain Taylor who said that American machine tools stand in great favor; in fact, his object in coming to this country for machine tools of American make and design is ample proof of his own experience that they are the most efficient and at the same time the lightest and the most easily handled by disabled men.

* * *

Convention of Marine Draftsmen To Be Held in Boston

The eighth annual convention of the American Society of Marine Draftsmen will be held at the Hotel Brunswick, Boston, Mass., on June 20 and 21. Arrangements for the convention are in the hands of the Boston branch of the Society and a most enjoyable time is assured the delegates and members of the various branches of the Society.

Organized at Philadelphia on Dec. 2-4, 1912, this Society has had a rapid and successful growth and branches are now located at all the prominent shipyards and navy yards throughout the country. It is the only strictly marine draftsmen's organization in the United States and has filled a most needed want for the members of this profession.

The object of the Society, as stated in its constitution, is to unite the marine draftsmen of the United States; to promote their general welfare professionally, intellectually and socially, and to cultivate the highest standard of professional ethics among them. The journal of the Society, which is published quarterly, is noted for its papers on naval architecture, marine engineering and allied subjects. The Society has now in course of preparation a marine draftsmen's handbook which will be of great value to marine draftsmen and others engaged in the great shipbuilding industry.

The present officers of the Society are as follows: President, Alfred H. Haag, chief naval architect, U. S. Shipping Board, Philadelphia, Penn.; vice president, W. A. Leavitt, Jr., New York Shipbuilding Corp., Camden, N. J.; secretary, B. G. Barnes, Lake Torpedo Boat Co., Bridgeport, Conn.; treasurer, J. Binford Sadler, industrial department, U. S. Navy Yard, Norfolk, Va.; executive committeemen, G. W. Nusbaum, U. S. Naval Gun Factory, Washington, D. C.; E. H. Monroe, bureau of construction and repair, Navy Department, Washington, D. C., and J. A. Kelley, consulting naval architect, New York City.

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E. A. Suverkrop Resigns from the Editorial Staff of the American Machinist

It is with genuine regret that we record the resignation of E. A. Suverkrop from our editorial staff, but his many friends will be glad to learn that he leaves to go into a line of work in which he has been deeply interested for many years, the production of gages of extreme accuracy.

It is probably safe to say that few editors have had the wide and varied experience from which to draw, both for writing articles and for assisting readers to solve their mechanical difficulties. Born in this country but educated on the other side of the water, serving an apprenticeship with a well-known Scottish firm of general engineers and founders and afterward sailing the seven seas in various engineering capacities, Mr. Suverkrop accumulated a remarkable fund of information which he is always willing to impart to anyone who may benefit by it.

Even before his connection with the *American Machinist*, which dates from Apr. 11, 1904, he made many friends by his articles, humorous and otherwise, under his own name as well as under the pen name of E. A. Dixie.

His work since his association with the paper speaks for itself and needs no comment. His many friends, both in and out of this organization, wish him the success which he so well deserves.

General Goethals Receives John Fritz Medal

On May 22, Maj.-Gen. George W. Goethals was presented with the John Fritz medal by the representatives of the four national societies of mechanical, electrical, civil and mining engineers; the medal being presented in honor of the work accomplished by General Goethals in building the Panama Canal. This medal was established in 1912 and is awarded not oftener than once a year for notable achievement along engineering lines. W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers, made the presentation speech and General Goethals after receiving the medal made a brief response. Other speakers of the evening were Henry L. Stimson ex-Secretary of War; Col. G. J. Fieberger, professor of engineering at West Point, and Ambrose Swasey, past president of the American Society of Mechanical Engineers.

* * *

Consulting and Advisory Service For Oil Men

The Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has recently inaugurated a new consulting and advisory service for oil men.

This company has secured the services of F. A. Bean, consulting engineer, to take charge of this work. Mr. Bean's engineering experience covers a period of 23 years.

Mr. Bean first became affiliated with the oil industry in 1902 in the Kentucky and Oklahoma fields. For the past year and a half he has been at the head of the maintenance and equipment department of the Sinclair Refining Co., and also had charge of the designing and construction of their sales branches and filling stations. He has also been closely associated with the automobile industry.

There is to be no charge connected with the service of this department. All advice, plans, etc., are to be given gratis.

* * *

Electrical Society Elects Officers

The anual meeting of the Society for Electrical Development was held at the Society offices in the Engineering Societies Building, New York City, Tuesday, May 13. J. Robert Crouse, vice president of the Society presided at the meeting. Members of the board of directors were elected as follows: Representing manufacturers, W. D. Steel, four years; representing jobbers, E. C. Graham, four years; representing contractors, James R. Strong, four years; Fred. B. Adam, two years; director at large, Charles W. Price, two years.

World's Industrial Forge

By E. C. Porter, News Editor

Westinghouse Courses for Technical Graduates

The success of the army system of training technical men for positions requiring a high degree of specialization has attracted much attention. However, the methods used are not altogether new, as many of them have been used for a number of years by the Westinghouse Electric and Manufacturing Co. in training college graduates for its commercial and engineering departments. Briefly, the principles involved are the careful selection of well qualified men for definite positions and the training by intensive methods for such predetermined positions.

Selecting the Men

Emphasis is laid on the selection of men with the proper characteristics for the line of work they desire. Indication of these qualities is found in the college work and other miscellaneous activities of the technical graduate. For some types of work certain characteristics must predominate, and for others these particular charactertistics are not so important. Personality, courage, tact and initiative are emphasized in the sales type of student. Mathematical ability, accuracy and analytical inclination indicate the engineering type. The basic qualities of character are considered rather than experience or skill. One point on which stress is laid is the necessity of an early determination of the kind of work desired, as a means of avoiding waste of time and in order to get the proper preparation for the ultimate position.

Specific intensive training is given for commercial, design, manufacturing and application engineering. The student is segregated for some particular branch as soon as he demonstrates his fitness and expresses a desire for this particular work. The radical difference in the experience afforded in the various shop sections, as well as the limited time available for each student, makes early segregation necessary. For instance, it is useless to have a graduate working on heating equipment or overhead line material when he is scheduled for sales in the marine machinery department.

Course Covers Twelve Months

The course covers a period of approximately twelve months divided into shop experience and intensive study. During the first period of the course short assignments in different manufacturing sections bearing a definite relation to the position in which the man will ultimately be placed are taken up. Weekly class conferences accompany this shop period to insure thoroughness in the shop's experience, to give a knowledge of the developments of the immediate work in which the men are engaged and to study the features of the company's product as a whole.

An Intensive Study Period

This shop training is followed by a short period of full-time intensive study adapting the student to his particular permanent work. This is conducted under the immediate supervision of the department heads. For instance, students training for work in the engineering departments spend the last three months of their course studying the salient features of Westinghouse design under the leadership of the chief engineer. Likewise the commercial students pass through a period of intensive study of business methods, advertising and the construction of Westinghouse apparatus from the selling point of view.

After completion of the intensive study period, the student is taken into the regular organization of the company in the department for which his entire training has been shaped to prepare him. The departmental requirements are known some time in advance and the number of men appointed to the course is carefully restricted to limits based on these requirements. The method of training more men than are needed has been found unsatisfactory. Every man now appointed to the course is selected and trained for some definite position. Quite a number of men are taken for training as managing operators for public-utility corporations. Men are chosen not so much because they express a desire for a particular phase of work, but because they show training and ability of a higher capacity than the average.

A Basis for Cultivation

The opportunities for work on problems of practical engineering application and commercial importance and of association with men of broad business and engineering experience give the student a basis for cultivation of whatever latent or active ability he may have. Continued contact with high standards in engineering ethics and business practice rarely fails to produce a favorable reaction. The preparation of these young men for positions of responsibility is a matter of vital importance to the company, dealing as it does with the man material for the future operation of the organization. The eminently successful system of "promotion from the ranks" to the higher positions makes it doubly important that the company and the young engineer each recognize the potentialities of the other and avail themselves of these opportunities.

The National Association of Manufacturers Meet

President of Association Delivers Address Followed by Reports of Officers and Election of Other Officers

The twenty-fourth annual meeting of the National Association of Manufacturers was held at the Hotel Waldorf-Astoria, New York City, May 19 to 21, 1919. The opening day was devoted to the appointment of committees and to the reception of reports from the various standing committees of the Association.

Stephen C. Mason, president of the Association, delivered his address on the second day. This was followed by reports of general officers and the following addresses: "Federal Revenue and Tax Legislation," by Hon. Daniel C. Roper, Commissioner of Internal Revenue; "Federal Promotion of Vocational Training," by Herbert E. Miles, director of division of training, United States Department of Labor and chairman of the National Association of Manufacturers' committee on industrial education; "The Banker and the Manufacturer," by Ferdinand C. Schwedtman, vice president, National City Bank, and chairman of the committee on banking of manufacturers; "The Metric System in Export Trade," by Frederick A. Walsey, commissioner, American Institute of Weights and Measures, New York City.

The evening of the second day was devoted to the export-trade session. On the third day the reading of papers proceeded as follows: "The Status of Informal War Contracts," by Hon. G. H. Dorr, assistant director of munitions, War Department; "Engineering and Standardization Branch, War Department—Its Present and Possible Relation to Manufacturers," by Charles V. Bacon, chief of engineering and standardization branch, general staff, the War Department; "Approaching Changes in American Patent Laws," by Edwin J. P. Pruidle, counselor at law, New York City.

At the conclusion of this session the regular elections of vice presidents and directors-at-large took place. The regular annual banquet was held on the evening of the final day in the grand ballroom of the Waldorf-Astoria Hotel.

* * *

New Shipbuilding Record

Two hundred and one vessels registering 375,605 gross tons, of which 75 ships with 316,177 gross tons were seagoing steel vessels, 30 with 52,097 tons were wooden ships for sea service, and 105 with 368,274 tons were non-seagoing vessels, was the new record for the American shipyards during April, 1919.

Business Items

The National Bank of Commerce of New York has opened an office in London, located at 17 Shorborne Lane, King William St. Kenneth H. Rockey is in charge.

At a recent meeting of the directors of the American Welding Society, J. H. Deppeler of the Metal and Thermit Corporation, Jersey City, N. J., was elected a director of the society.

The Fulflo Pump Co. announces the opening of a Chicago office, which will be in charge of R. E. Manly, of the Manly Sales Co., located at 6253 Ellis Ave., Chicago, Ill. A complete stock of the company's products will be maintained, including all standard pumps for machine tools, grinding machines, circulating baths, etc.

The American Bureau of Welding held a meeting on Apr. 11 at the Engineering Societies' Building, 33 West 39th St., N. Y., to elect its officers. The following were elected: C. A. Adams, director; H. M. Hobart, vice director; A. S. Kinsey, vice director; W. E. Symons, treasurer; H. C. Forbes, secretary. Regular meetings of the Bureau are to be held on the third Friday of each month.

H. W. Butler of Cravon House, Kingsway, London, England, is staying at the Manhattan Hotel, 42nd St., New York City, and will be glad to hear from manufacturers of small electrical tools, fractional horsepower motors, varnished fabric, paper, insulating materials, etc., with the view of development of trade in European markets. Mr. Butler is well known in English trade circles, having been chairman of the British Electrical Manufacturers Association for two years, from 1910-12, and also chairman of the organizing committee of the last Electrical Exhibition held in England in 1911.

The Solar Metal Products Co., Inc., Columbus, Ohio, announces the following changes in its organization: G. R. Le Sauvage was elected president on Jan. 2, 1919, and on his release from active duty as Senior Lieutenant in the U. S. Naval Reserve Force assumed the duties of general manager, succeeding H. R. Gogay, formerly the vice president, treasurer and general manager, who resigned on Mar. 30, 1919. E. C. Camp has been elected assistant treasurer, assistant to the president, and continues his work as sales manager in charge of sales and advertising. A. C. Rollins has been elected treasurer in charge of accounts and credits. E. C. Probst has been appointed purchasing agent and chief of order and service departments. A. Miller has been appointed works manager. H. C. Miller has been appointed superintendent of the paint-enameling department.

The stockholders of the Joseph Dixon Crucible Co. held their annual and regular meetings on Monday, Apr. 21. The following directors and officers were elected: Directors, George T. Smith, George E. Long, William G. Bumsted, Edward L. Young, J. H. Schermerhorn, Harry Dailey and Robt. E. Jennings; officers, George T. Smith, president; George E. Long, vice president; J. H. Schermerhorn, vice president; Harry Dailey, secretary; William Koester, treasurer; Albert Norris, assistant secretary and assistant treasurer. The American Graphite Co., incorporated under the laws of the State of New York, is a subsidiary of the Joseph Dixon Crucible Co., and its annual election was held on the same day as that of the Joseph Dixon Crucible Co., and resulted in the election of the following officers: George T. Smith, president; George E. Long, vice president; J. H. Schermerhorn, treasurer; Harry Dailey, secretary; William Koester, assistant secretary and assistant treasurer. The directorate is the same as that of the Joseph Dixon Crucible Co.

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Trade Currents

Cleveland Letter

While the market for machinery and machine tools in the Cleveland and northern Ohio district is still spotty, as the month advances it is easily seen that there is a slow, but steady improvement all around. The bulk of business still comes from the automobile industry in this section and those sections of the automobile trade served by certain firms in this locality. Forging and metal-working machinery demand is nearly normal, according to leading manufacturers and distributors of this class of equipment. Plumbing lines, presumably influenced by the prospects for larger building activities hereabouts, are taking larger quantities of smaller equipment. There is a lot more small material and equipment for general purposes being absorbed than was the case six weeks ago.

Large individual orders are not quite so frequent as would be expected under normal conditions, but a significant indication is the order now pending in this market from the Central Steel Co., Massillon, Ohio, which qauntity will probably aggregate $50,000. Lathes, boring machines and a miscellaneous assortment of smaller equipment will be included in the order, it is reported locally.

One influence upon stimulation of business is the assurance by the trade as a whole to consumers that prices will not be any lower. It seems that many consuming establishments have been waiting on such a contingency, and as it has not developed, are more liberal with their inquiries. Most of the inquiries being received here in the past week or so are generally for materials that can be furnished quickly by local manufacturers or distributors.

It is the opinion of leaders in the machinery industry here that as soon as definite disposition of Government-owned machinery is made, a speedy return to normal conditions all around will be seen.

Personals

L. M. MANLEY, for the last two years employed as chief of switchboard, wood and iron work section, planing division of the Western Electric Co., Chicago, Ill., has taken a position on the editorial staff of the *American Machinist*. Mr. Manley, prior to his connection with the Western Electric Co., was supervisor of engineering shops in the Western State Normal College, Kalamazoo, Mich., and has had wide mechanical and engineering experience.

CAPT. BEN SLOAN, who served in the Ordnance Department, U. S. A., for two years, has been discharged and is now connected with the New York sales office of the Pratt & Whitney Co.

J. P. ALEXANDER, who has represented a number of departments of the General Electric Co., Schenectady, N. Y., in central New Jersey, is now connected with the power and mining department of this company, Equitable Building, 120 Broadway, New York.

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric and Manufacturing Co., has been awarded the Edison medal by the American Institute of Electrical Engineers for "invention and development of electrical machinery."

MAJ. CHARLES E. CARPENTER, formerly general manager of the Allied Machinery Co., in Europe, and of the Quartermaster Department, A. E. F., has been awarded the ribbon of the Legion of Honor by the French Government.

M. H. JONES, who has been connected with the Westinghouse Electric and Manufacturing Co. for the last 15 years as assistant to manager of the Philadelphia district, has resigned his position with that company to become sales manager of the Standard Electric and Elevator Co., Baltimore, Md.

F. X. MEEHAN has been appointed advertising manager of the Walter A. Zelnicker Supply Co., St. Louis. He was formerly associated with Fairbanks, Morse & Co., A. T. & S. F. R.R. Co. Coast Lines, and the St. Louis smelting and refining works of the National Lead Co.

W. W. TARLETON has recently severed connections with the Southern Manganese Corporation, Anniston, Ala., to become purchasing agent and traffic manager for the Anniston Steel Co. Mr. Tarleton will be in charge of the sale of all equipment acquired by the steel company from the Illinois Car and Equipment Co.

HOMER L. FERGUSON, president and general manager of the Newport News Shipbuilding and Dry Dock Co., Newport News, Va., has been elected president of the Chamber of Commerce of the United States. This announcement was made recently at the offices of the

(*Continued on page* 1066*b*)

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Welding and Cutting Tips, Oxy-acetylene
Alexander Milburn Co., Baltimore, Md.
"American Machinist," May 8, 1919



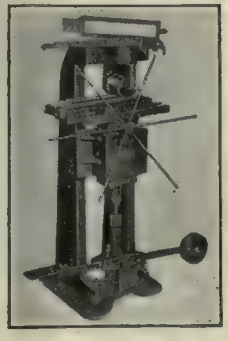
The advantages of these cutting and welding tips are that the same torch with a change of tip can be used for both cutting and welding. The tip at the left is the cutting tip while that at the right is the welding. Another feature is that the cutting tip can be burned back considerably without destroying the cutting qualities of the flame. To prove the foregoing statement, the tip in the center was purposely burned back in cutting an 8-in. piece of steel, after which the tip at the right was put in place and the piece again welded without cooling off. It is also claimed that it is impossible for these tips to backfire.

Jack, "Hi-Lo"
Harvard Machine Co., Harvard Sq., Cambridge, Mass.
"American Machinist," May 8, 1919



This jack has a range of adjustment from 2 to 4 in. and requires very little space in the tool case. By removing the top screw it is said to be useful in drilling parts requiring a support directly beneath the drill, as it allows the drill to go through. The top piece is secured in place but is free to adjust itself to uneven surfaces. All parts are made of steel and hardened.

Marking Machine
Noble & Westbrook Manufacturing Co., Hartford, Conn.
"American Machinist," May 8, 1919



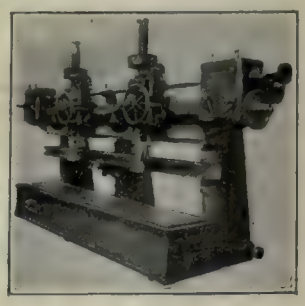
This machine is for impressing the graduations and figures on scale beams or other long work of similar character. It is claimed that the machine is simple, accurate, easy to operate and that it is a great saving to the manufacturer over other methods of graduating this class of work. The work to be marked is held on the table by a suitable fixture, the die being cylindrical. The die is carried in a yoke or holder, and is connected to a cut gear meshing with a rack. The marking is performed by pressure applied to the foot lever, and an adjustable cam regulates the depth of the impression, so as to make this uniform on the various pieces of work.

Steel, Chisel, "Seminole"
Ludlum Steel Co., Watervliet, N. Y.
"American Machinist," May 8, 1919



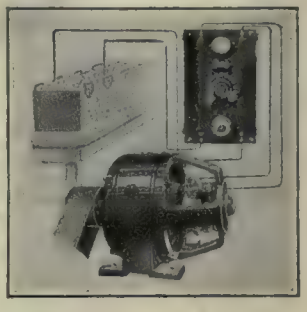
It is stated that this new alloy chisel steel can be made so hard that it will cut glass, yet may be bent by being hammered over the edge of an anvil. It is claimed that the steel is almost fool-proof in hardening and has a very wide temperature range, this being from 1650 to 1950 deg. F. The steel is quenched in oil and slightly drawn. The drawing does not seem to affect the hardness but assists in producing toughness. The illustration shows a spike made of this steel that has been driven through a piece of low-carbon steel and has curved slightly as it passed through the bar, yet the spike was not broken. It is also stated that in the case of chisels made of this steel the head will mushroom somewhat but will not chip off. It is said that the steel is very peculiar metallographically and that it seems to have a very fine structure that is quite difficult to define in the usual nomenclature of the metallographist.

Boring Machine, Locomotive Connecting Rod
Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn.
"American Machinist," May 8, 1919



Diameter of spindle, 4 in.; diameter of spindle nose, 5½ in.; length of automatic feed for spindle, 16 in.; minimum distance between spindle centers, 30 in.; maximum distance between spindle centers, 11 ft. 4 in.; maximum distance from top of table to end of spindle, 25½ in.; distance from center of spindle to upright, 17½ in.; work table, 24 in. x 13 ft. 6 in.; Morse taper in spindle, No. 7; distance between spindle centers with auxiliary table, 14 ft. 5 in.; distance from spindle to surface of auxiliary table, 50 in. maximum, 34 in. minimum.

Battery-Charging Outfit
Hobart Bros. Co., Troy, Ohio.
"American Machinist," May 8, 1919



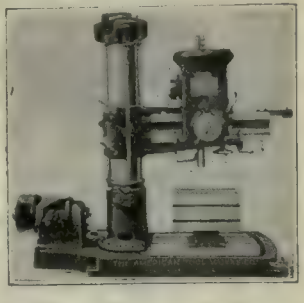
This outfit is for charging the storage batteries of industrial tractors, or the storage batteries of automobiles, and can also be used for regular electric-lighting work, if desired. The generator is wound for the desired voltage, direct current, and runs at a speed of 1800 r.p.m. The weight is 300 lb. It is intended to be operated from a lineshaft or engine and requires approximately 4 hp. at full load. The outfit includes generator, base tracks, field rheostat, charging panel and pulley with 6-in. diameter and 4-in. face, no switchboard being necessary.

Press, Trimming
Ferracute Machine Co., Bridgeton, N. J.
"American Machinist," May 8, 1919



Exerts a pressure of 200 tons and is provided with a side punch exerting a pressure of 50 tons. The side press has a stroke of 3 in.; the stroke of the ram of the main press being 6 in. Motor drive is furnished, the motor being mounted on a shelf and the drive being through a rawhide pinion. The flywheel weighs one ton and has a speed of 183 r.p.m., producing 20 strokes per min. of the press. The guards are made in sections composed of woven wire, the edges of which are cast into an iron frame. The diameter of the steel shaft at the journals is 7½ in. and at the crank 9 in. The adjustment of the main ram downward from top position is 5 in., and of the side-punch ram, 3 in. The total height of the machine is 13 ft., and the weight, 39,500 lb.

Drilling Machines, Radial 3- and 3½-Ft.
American Tool Works Co., Cincinnati, Ohio.
"American Machinist," May 8, 1919



Specifications for 3-ft. machine: Maximum distance from spindle to base, 53 in.; spindle speeds, 24, 30 to 700 r.p.m.; range of feeds, 0.004 to 0.026 per spindle revolution; taper in spindle, Morse No. 4; drills to center of circle outside of column, 72 in.; traverse of spindle, 12 in.; traverse of head on arm, 28 in.; traverse of arm on column, 28 in. Specifications for 3½-ft. machine: Maximum distance from spindle to base, 53 in.; spindle speeds, 24, 30 to 700 r.p.m.; range of feeds, 0.004 to 0.026 per spindle revolution; taper in spindle, Morse No. 4; drills to center of circle outside of column, 84 in.; traverse of spindle, 12 in.; traverse of head on arm, 34 in.; traverse of arm on column, 28 in.

Patented Aug. 20, 1918

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

The purchase and agency for the sale of machinery, tools, electrical material, chemicals, oils, etc., are desired by a firm in Spain. Quotations should be given f.o.b. New York. Payment, cash against documents at port of shipment. Correspondence should be in Spanish. References. No. 29,380.

The representative of an American firm who is now in Denmark desires to secure agencies for the sale in the Scandinavian and Balkan countries from manufacturers of agricultural implements and machinery, especially caterpillar tractors and steam plows, technical specialties, building supplies, machinery for oil wells, and medium-priced automobiles and accessories. References. No. 29,342.

The purchase of woodworking machinery, motor, and general engineering machinery, and tools, is desired by a firm in New Zealand. Quotations should be given f.o.b. port of shipment. Payment to be made against documents in New York. References. No. 29,364.

The purchase of tractors, plows and thrashers, to be used in northern Mexico, is desired by a man in that country. Correspondence may be in English. Reference. No. 29,390.

The purchase of small electrical material, such as sockets, rings, insulators, keys and switches, is desired by a firm in Spain. Terms, cash against shipping documents at destination. Correspondence should be in Spanish. References. No. 29,382.

An engineer in Belgium who intends to install a large agricultural plantation with big factory for canned meats and vegetables, and oil factory, wishes quotations for the latest agricultural machinery, machinery for manufacturing tin boxes and cans for a canning factory, and cylindrical crushes, hydraulic presses, and all necessary apparatus for the extracting of oil from corn, ricin, and sunflowers. No. 29,386.

A firm in Belgium desires to purchase and secure agencies for the sale of all electrical supplies, lamps, fittings for electrical lighting, wires, cables, switchboards, electrical accessories for motor cars, bells, batteries, fans, insulating material, dynamos, motors, heating devices (irons), and reflectors. Correspondence may be in English. References. No. 29,399.

Trade Catalogs

"Hindley" Worm Gearing. Albro-Clem Elevator Co., Philadelphia, Penn. Circular, describing the advantages of the "Hindley" gearing.

Imperial Welding Outfit No. 1. Imperial Brass Manufacturing Co., Chicago, Ill. A circular describing and illustrating Imperial welding outfits, and giving complete list prices.

Do-Di Finished Brass Castings. Doehler Die Castings Co., Brooklyn, N. Y. Booklet; pp. 19; 6 x 9 in. This is a description of its brass die-castings process which has been perfected within the past few years. All who are interested may receive a copy of this booklet.

Fifty Years of a Successful Industry, 1868-1918. Yale & Towne Manufacturing Co., Stamford, Conn. Booklet; Pp. 76; 5½ x 8 in.; illustrated. This is a souvenir issued in commemoration of 50 years' activity, illustrating to the general public the origin and development of the company.

Catalogs Wanted

A. E. Holaday, Naugatuck, Conn., would be pleased to receive catalogs of precision lathes, hand milling machines, sensitive drilling machines, electric grinding machines and small tools.

Personals

(*Continued from page* 1066)

Chamber in Washington as the result of a mail vote of the Organization's Board of Directors.

IRA J. PEAT is now associated with the Marine Equipment Co., Inc., Mobile, Ala., as mechanical engineer and factory superintendent.

D. L. JOLLY has returned to the Hart-Parr Co., Charles City, Iowa, after serving 15 months with the Naval Aviation at Pauillac, France.

H. S. MOLONY has been appointed manager of the machinery sales department of the Badger-Packard Machinery Co. of Milwaukee, Wis.

PAUL J. DRISCOLL, of the Tacony Steel Co., Philadelphia, Penn., has been made manager of the company's newly organized New York district sales office.

M. C. BOYD, formerly secretary and treasurer of the Heltzel Steel Form and Iron Co., is now associated with the Aetna Foundry and Machine Co., Warren, Ohio.

W. H. WILLIAMS, general sales manager of the Hart-Parr Co., for several years, has accepted the position of sales manager of the Eagle Tractor Co., Appleton, Wis.

W. W. CORKRAN, formerly with the Midvale Steel Co., Philadelphia, Penn., is now assistant sales manager of the New York district sales office of the Tacony Steel Co.

JOHN M. VIOLETTE has been discharged after 18 months' service with the Ordnance Department of the U. S. Government, at Kings Mills, Ohio. He has accepted the position of chemist at the Hart-Parr Co., Charles City, Iowa.

VICTOR E. REHR, formerly sales manager for the Trumbull Manufacturing Co., Warren, Ohio, has recently secured an interest in the Aetna Foundry and Machinery Co., Warren, Ohio, and is in charge as general manager.

H. HAMADA, president of the Tokoyo Gear Works, Tokoyo, Japan, is visiting this country for the purpose of investigating and purchasing machinery and machine tools to be installed in his works in Japan. Mr. Hamada's present address is Room 401, Bretton Hall, 86th St. and Broadway, New York.

THEODORE E. BUTLER, for the last 20 years manager of the Whitman & Barnes Manufacturing Co., London, England, office, recently visited the Akron, Ohio, twist-drill and reamer factory and the Chicago, Ill., wrench and drop-forge plant. Mr. Butler had not visited this country for five years prior to his recent trip. His office and salesrooms are located in the "American House," at 139 Queen Victoria St., London, E. C. While in Akron, Mr. Butler was tendered a dinner by the company, at which many business men of the country attended. He returned to London May 14.

Forthcoming Meetings

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

The American Society of Marine Draftsmen will hold its eight annual convention at the Hotel Brunswick, Boston, Mass., on June 20 and 21. B. G. Barnes, 1596 North Ave., Bridgeport, Conn., is the secretary.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs. Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Gas Engine Association will hold its twelfth annual meeting in Chicago, June 2-3. The headquarters of the association will be at Hotel Sherman. H. R. Brate, Lakemont, N. Y., is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

The Second Pan-American Commercial Conference will be held at the Pan-American Building in Washington, D. C., from June 3 to 6, 1919. John Barrett, Pan-American Union, Washington, D. C., is the director general.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

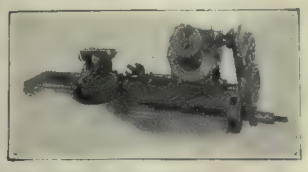
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Index Heads, Universal

Simmons Machine Co., Inc., Albany, N. Y.

"American Machinist," May 8, 1919

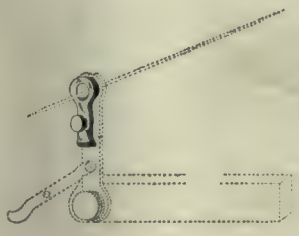


Designed to swing work up to 10 in in diameter. The swivel block is graduated and can be adjusted to any angle from 10 deg. below horizontal to 10 deg. beyond perpendicular, and by removing the extension arm the head can be swung 90 deg. The index crank is adjustable and all bushings are hardened. Equipment includes three index plates, gears, four ⅝-in. bolts, driving dog, wrenches, index chart showing every division obtainable up to 360 deg., and also a spiral chart. Taper in spindle, No. 10 B. & S.; hole through spindle, 1 1/16 in.; threads on spindle, 2 5/16 in. in diameter, threaded, 6-pitch right hand; swivel, from 10 deg. below horizontal to 10 deg. beyond perpendicular; diameter of wormwheels, 5 in.; gears, ¾ in. thick, 1¼ in. bore; weight, 150 lb.

Wiggler

T. Daniel Bush, 119 South Center St., South Allentown, Penn.

"American Machinist," May 8, 1919

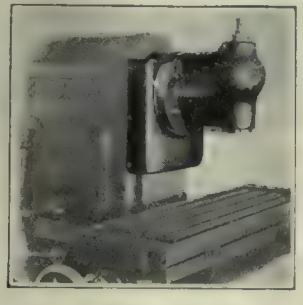


An attachment to be used in connection with the universal indicator described on page 419. This attachment allows the ball-headed needle to be reversed and is said to be very convenient for some classes of work.

Milling Attachment, Vertical Spindle

Cleveland Milling Machine Co., Cleveland, Ohio

"American Machinist," May 8, 1919

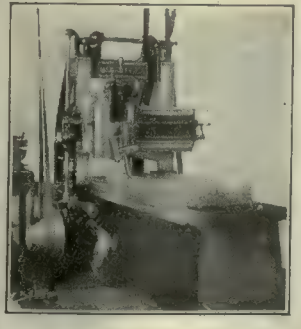


Specifications for a No. 1 machine: Distance from face of column to center of vertical spindle, 10¾ in.; distance from nose of spindle to table, 1¼ to 16¾ in.; cross range of machine, 8 in.; longitudinal range of machine, 22 in.; taper hole in spindle, No. 10 B. & S.; weight, 200 lb. Specifications for No. 2 machine: Distance from face of column to center of vertical spindle, 12½ in.; distance from nose of spindle to table, 1¾ to 16¾ in.; cross range of machine, 10 in.; longitudinal range of machine, 28 in.; taper hole in spindle, No. 11 B. & S.; net weight, 245 lb. Specifications for No. 3 machine: Distance from face of column to center of vertical spindle, 15 in.; distance from nose of spindle to table, 2 to 18½ in.; cross range of machine, 12 in.; longitudinal range of machine, 34 in.; taper in spindle, No. 12 B. & S.; weight, 350 lb.

Planing Machine, Combination Machine Tool

Multiplex Tool Co., Inc., 76 South 8th St., Brooklyn, N. Y.

"American Machinist," May 15, 1919

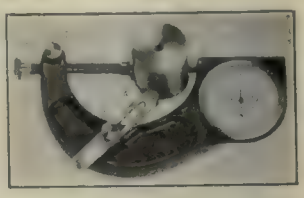


A machine tool that combines a planing machine, a lathe, a horizontal boring mill, a vertical boring mill, a milling machine, a drilling machine and a slotting machine. Length of table, 5 ft. 8 in.; length of bed, 8 ft. 2 in.; height over-all, 5 ft. 7 in.; width over-all, 5 ft.; planing capacity, 20 by 20 in. by 5 ft.; turning capacity, 14-in. swing, 44 in. between centers, arranged for thread cutting and taper turning, index head arranged in headstock; horizontal boring, 2-in. bar, 24-in. feed; rotary table, power or hand driven 20 in. in diameter and adjustable to swing 96 in.; spindle speeds, 16 to 350 r.p.m.; slotting, 3½-in. stroke which may be increased by making use of the vertical adjustment of the tool-head; drilling can be accomplished at any angle; shipping weight complete, 3500 lb.; floor space required for operation, 4 x 10 x 7 ft.

Calipers, Indicating

F. W. Horstmann, 210 Coit St., Irvington, N. J.

"American Machinist," May 8, 1919



An indicating caliper or dial comparator which is designed to take the place of the snap gage to some extent. It is claimed that work can be more quickly gaged, and that inexperienced operators may use it as readily and rapidly as the more experienced ones. Where it is desired to gage a number of round pieces the stop *A* is set to allow a standard plug gage of corresponding size to enter the proper distance between the measuring points to gage the maximum diameter; that is, to bring the gaging points diametrically opposite in relation to the center of the plug. The screw *B* is then turned until the pointer indicates 0 on the dial. Clamping screws *C* and *D* are now tightened and the tool used in the same manner as a snap gage except that the work will enter the gage readily if it is within 1/32 in. of correct size, and the pointer will show in thousandths of an inch the amount of the variation. Made in all sizes from 1 to 12 in. and weighs very little more than a micrometer of corresponding size.

"Tructractor"

Clark Tructractor Co., 80 East Jackson Blvd., Chicago, Ill.

"American Machinist," May 8, 1919



Load carried, 1½ tons; turning radius, 6 ft.; motor, four-cylinder, 3¾ x 4½; drive, internal gear; clutch, dry plate, multiple disk; transmission, selective, three speeds forward, one reverse; gasoline feed, gravity; steering gear, worm and sector type; weight, with standard body, 2050 lb.; wheel base, 72 in.; tread, 35½ in.; over-all length, 112 in.; over-all, width, 42 in.; height of platform above ground, 28 in.; speeds, 1 to 15 m.p.h.

Hobbing Machine, Worm Gear

Cone Automatic Machine Co., Inc., Windsor, Vt.

"American Machinist," May 8, 1919

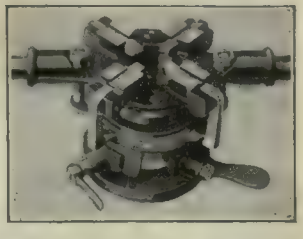


For hobbing worm gears on a production basis and intended for use on gears up to 18 in. in diameter, but can cut gears up to 24 in. The blank is attached to the upper end of the vertical spindle, while a master gear is mounted on the lower end of the spindle, this being driven from a master worm mounted on the horizontal shaft which is in turn driven from the cutter spindle. The cutter is fed into the blank, suitable stops being provided. It is stated that the machine is very simple in construction, that it is a good producer, and that there is little chance to go wrong in setting up the work.

Threader, Receding Pipe

Greenfield Tap and Die Corp., Greenfield, Mass.

"American Machinist," May 15, 1919



In operation the tool is screwed onto the pipe until a thread of the desired length has been cut, after which the threader may be pulled straight off. By releasing the lead screw, lifting the head and resetting the trigger the chasers are again pushed in to the proper point, and the device is ready to start another thread. One of the advantages is that none but the actual cutting teeth follow around the threads. The chasers are narrow and travel along the pipe parallel to the thread they are cutting and not parallel to the axis of the pipe. The device is made in both plain and ratchet styles, the illustration being of the former.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$30.75
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	26.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅛-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Near Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.50	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
⅛, 11/128, 5/64, 3/32, 7/64 No. 8, 9/128 and No. 10	25.50 to 33.00	⅛ by 12 in. long	14.00
No. 12		⅛ by 19 in. long	12.00
5/32, No. 14 and 9/64		¼ by 19 in. long	10.00
No. 18		¼ by 21 in. long	10.00
No. 20		Special Welding Wire, Coated	
Domestic 20c. for 1/16, 15c. for ⅛ to 7/64.		⅛	33.00
		5/32	30.00
		7/64	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	⅜ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	¼ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.50	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	5.25	5.25	7.00
Spelter	6.60	6.25	7.00
ST. LOUIS			
Lead	5.00	5.00	6.80
Spelter	6.25	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	23.00	22.50	31.50–33	24.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	24.00	34.00	22.00	31.00
Brass sheets	20.50	23.75–28	30.75	24.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	31.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	43.00	41.25	39.00	5.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

June 5, 1919 American Machinist Vol. 50, No. 23

1267

What a Tinsmith Can Do in a Machine Shop

By PETER F. O'SHEA

The value of oil chutes, spatter guards, grinding wheel shields and other similar devices is obvious, but their cost if made outside the plant may be considerable. The author tells of the achievements of the shop tinsmith of a New England plant in producing homemade time and labor savers which would be useful anywhere. It is quite possible that the average tinsmith cannot reach the heights attained by this particular individual in analyzing machine-tool operations and designing fittings to improve their efficiency, but he can at least handle the actual construction.

A TINSMITH can be of great benefit in a machine shop if his work is properly directed. Sheet metal is a peculiarly adaptable material and can be shaped and adjusted to serve a great many purposes. It can be quickly cut and formed and is so light that the products made of it can be attached almost anywhere. The many different articles required in a machine shop offer an opportunity for an efficient exploitation of the tinsmith's art. This article tells of the various things a tinsmith has made in the plants of the Greenfield Tap and Die Corporation, Greenfield, Mass., where many useful methods of applying sheet metal have been put into operation. First we will take up attachments to machines for separating cutting oil from the chips and products as all three drop away from the point of the cutting tool.



FIG. 1. CHUTE FOR SEPARATING SCREW-MACHINE PRODUCTS FROM OIL AND CHIPS

The simplest form of such a device is a small galvanized-iron chute bent into the form of an angle iron and attached under the point of the cutting tool. Part way down the chute an arrow-shaped slit is cut across the angle. As the oil and products fall down the chute the oil runs through the slit into the pan of the machine to be taken up by the oil pump. The products continue down the chute and drop into a box provided for the purpose.

A sharp point should be left just above the lower part of the slit and bent down so that the oil will be led to the proper point and run off in a steady stream instead of half of it jumping the slit and continuing down the chute, as a small part of the oil usually gets by this slit and it is necessary to cut a second slit a little farther down. This takes care of nearly all the remainder of the oil.

The oil that clings to the product itself drains off while the product is resting in the dry-product box or pan. If both product and oil were allowed to drop into the bed of the machine a great deal of oil would be carried away with the product and wasted. The chute described is one of the simplest forms to separate oil from the product when the product is so much bigger than the chips that it can be picked out of the chips very easily. If the product and the chips are of about the same size and it is desired not to have them mixed together in the bed of the machine or even in the product box, the chips can be separated from the oil and the product by the arrangement illustrated in Fig. 1. A short chute *A* attached at a flat slope beneath the cutting point catches chips, oil and products as before. Below it and slightly beyond is a second chute *B*. The product, chips and most of the oil slide down the first short chute, and the chips and oil drop off the end into the pan of the machine. The product, however, comes down the short chute so fast that it jumps the gap between the two chutes, lands in chute *B* and slides down into the product box. The chute *B* is provided with an oil slit *C*, so that whatever oil jumps the gap with the product drains into the pan of the machine.

The delivery chute may be attached directly to the machine or it may be run through a hole cut in the shield or apron at the front of the machine. This shield, or apron, may itself be detachable, so that when it is removed the chute goes with it and forms no hindrance to working at the machine. Fig. 2 shows the shield.

The product box, Fig. 3, into which the chute discharges has a perforated false bottom, so that what oil comes down with the product drains off during the



FIG. 2. GALVANIZED-STEEL SHIELD

day into the real bottom below. Devices of this sort save a great deal of time for the workman, not only because he no longer has to pick out his products from among the chips and oil but because he can clean the machine much quicker when he does not have to look out for products. Since the oil and the chips do not fall together in the same stream a box placed in the right way will catch the chips almost dry. The oil saved through not being carried away with the product amounts to considerable in the course of a year; enough to pay for the simple little chutes and the time of building them.

On a machine where the product is automatically discharged by an attachment on the turret head as it draws back it is not necessary to extend the chute under the cutting point or under the oil. It is attached instead under the position where the product will be discharged on the back stroke. As the oil does not flow down the chute at all it is only necessary for the chute to deflect the product to a product box. The only oil that goes down the chute is the small amount which is knocked off from the turret tools simultaneously with the discharge of the product. This small amount is separated in the usual fashion by having a pointed slit in the chute.

It is sometimes advantageous to install a chute to carry the clean products down almost to the bottom of the pan or pail. Near the bottom the chute takes an upward direction for a sufficient distance to slow up the rapid motion of the product, so that it drops softly only a couple of inches instead of having to fall a couple of feet on another piece of product which it may spoil; or the end of the chute may be directed against a wooden block from which the product bounds off with just sufficient force to roll out of the way before the next piece comes down. Otherwise a heavy piece such as a tap falling upon another may spoil the threads

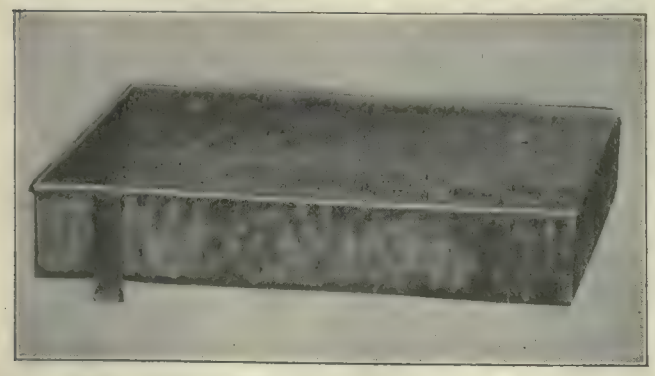


FIG. 3. PRODUCT BOX WITH FALSE BOTTOM

of both. On very small, light work another arrangement has to be used, since it is too light to slide down a chute which cannot help but be sticky with oil. In this case it is necessary that the oil, instead of being separated, shall go down the same chute with the product in order to wash it down. Therefore the top of the chute is inserted so that it avoids catching, or bends aside the big chips from the cutting-off tool, allowing them to fall into the bed of the machine. The light product drops on the chute and gets stuck there, but the next burst of oil washes it down. In Fig. 4 products may be seen on the chute, while in Fig. 5 the next burst of oil is washing them down.



FIG. 4. PRODUCTS STALLED ON STICKY CHUTE

Where the shape of the machine allows, the chips may be caught in a catch box. This should be a shallow box into which the chips settle to the bottom while most of the oil flows over the top and back to the pump. At the end of the day the operator takes out the chip boxes, pours off the remainder of the oil and dumps the chips into a chip-collection truck.

In many processes it is necessary for the operator to hold the piece of product against the cutting tool with his fingers while it is under process, then pull it out and lay it in a box. If, however, a small chute, Fig. 6, is placed with the upper end just beneath the cutting tool, the operator can simply let go of the product, which slides down the chute into a product box. The chute is merely a piece of sheet-iron pipe like an ordinary eave-spout, with a piece of the top cut away in the form of a scoop and the edges securely bound, and extends almost beneath the operation part of the machine. The operator simply has to hold the product in place while the tool is working on it, and then flip it off the centers with his fingers when it falls into the spout and slides down to the product box beneath. It is important that the mouth of the chute



FIG. 5. PRODUCTS WASHED DOWN BY STREAM OF OIL

should be a few inches below and to the rear of the cutting point of the tool so that only a slight motion will be necessary to send the product down.

The motions saved are individually small, but their total at the end of a day is important, for if a workman's hand moves a yard in delivering product to the product box 1700 times a day, that is about a mile of motion for the hand alone, to say nothing of the 1700 repetitions of muscular movement which involve considerable fatigue.

The chute may discharge into boxes, pails or trucks standing ready or into a reservoir or container from which the next machine is supplied directly.

A piece of sheet-metal equipment which saves the handling of hot metal is shown in Fig. 7. This is a chute leading down from under the point where the product is discharged after a process which results in each piece being hot at one spot. This small slanting tube discharges at the lower end into a pail of cooling oil through a neat hole in the cover near the edge.

The pail is half full of oil and is provided with a wire basket that closely fits the inside diameter. The basket

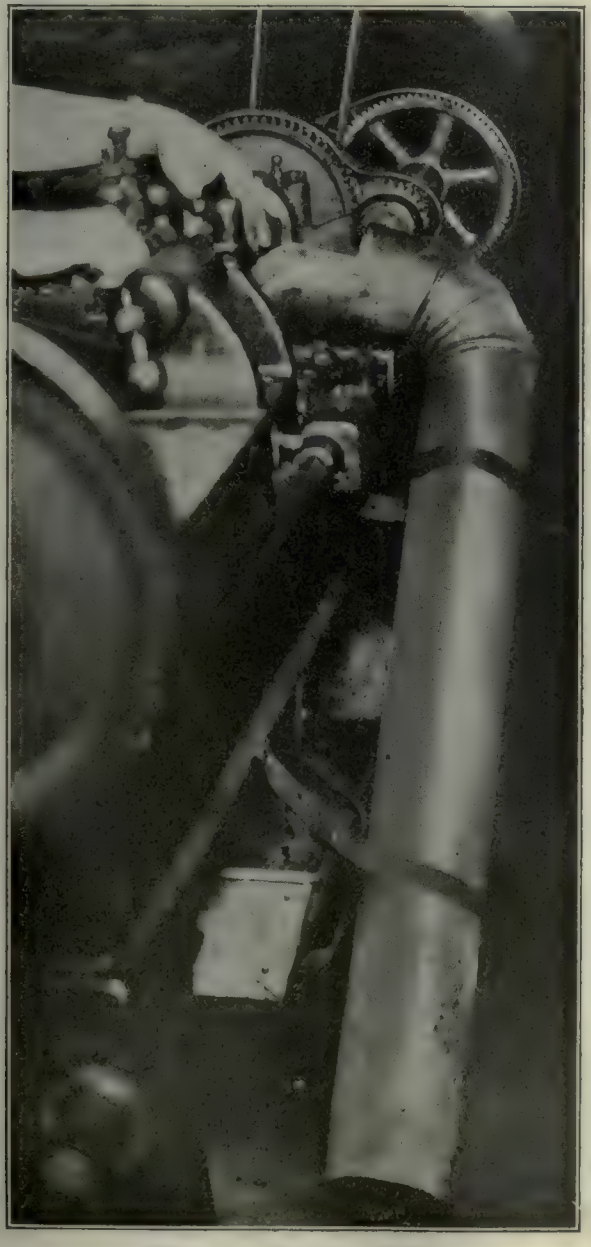


FIG. 6. A CLOSED CHUTE

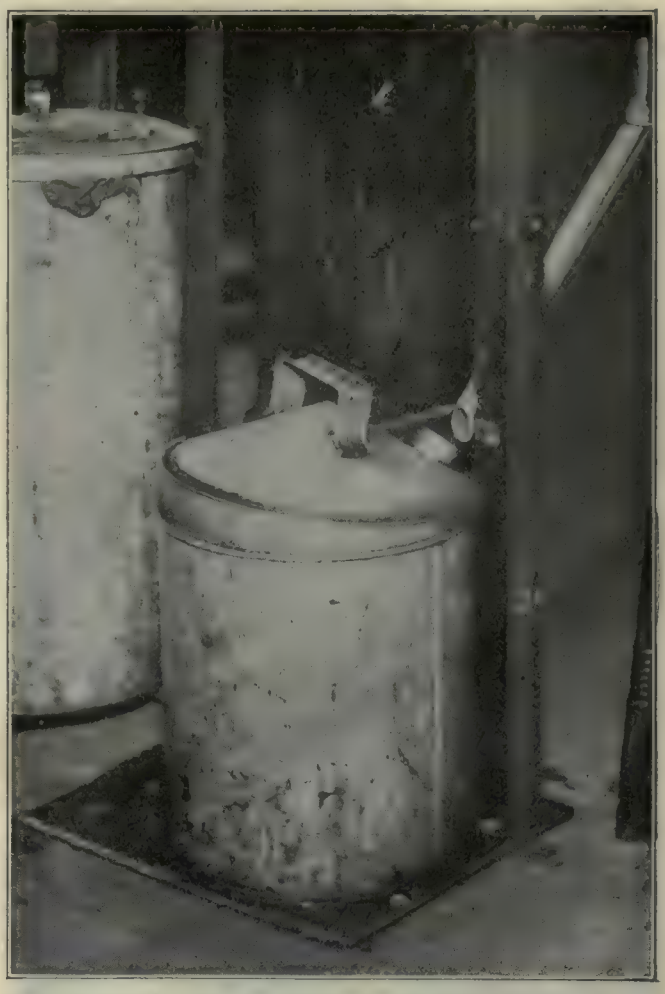


FIG. 7. CHUTE FOR DELIVERING HOT PIECES TO A COOLANT

has a stiff handle standing upright in the pail, but not high enough to interfere with the cover. When a job is completed the cover of the pail is lifted off and the basket lifted out of the oil and emptied.

Such chutes are inexpensive and can be curved in a variety of ways so as to discharge at the most convenient point either in readiness for the next process or into a box accessible for removal.

Sheet-Metal Guards and Casings

A large and necessary field of work in the modern shop is the making of protective devices of all sorts, such as gear casings, belt guards, shields and aprons.

The grinding machine shown in Fig. 8 is an endless belt carrying glued emery and carborundum. Shanks of products are ground smooth by being held against it for a moment. The belt travels so fast that the danger of breakage makes the workmen afraid of it and warrants the use of the protecting casing which leaves only a foot or two of the belt surface open for application of the work. In case it is necessary to get at the mechanism or the belt for repairs, access may be had through the side door, which is on vertical hinges offset at the proper distance from the edge of the casting, so that the door when thrown open will remain open while the work is being done.

Fig. 9 shows a sheet-metal hood over the gears of a semi-automatic machine. Formerly this machine had a cast-iron hood which weighed 100 lb. or more, which was difficult to lift for changing the gears.

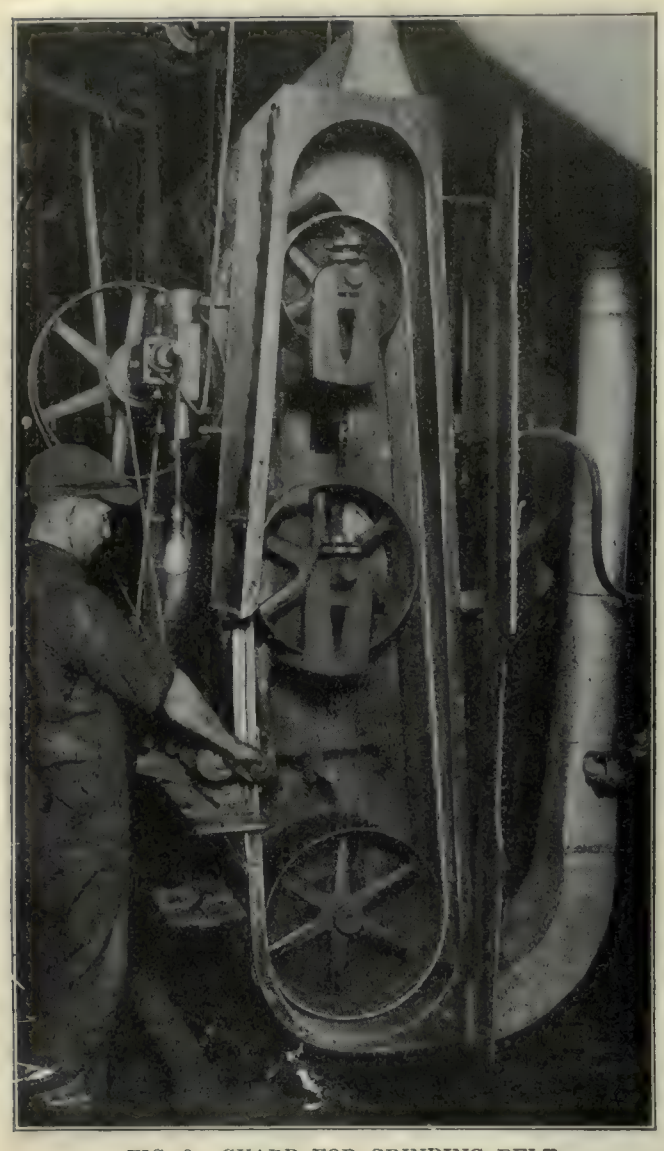


FIG. 8. GUARD FOR GRINDING BELT

The sheet iron of the hood is reinforced inside by straps of wrought iron and by angles; those in the middle, as shown in the figure, resting on the solid bearings along the center of the machine and supporting the weight of the hood. This leaves the edges of the sheet iron free of contact with the machine and prevents rattling.

A casing similar to that used on the polishing belt is put around polishing wheels and stones, as shown in Fig. 10. The side nearest the workman is hinged to the main casing and forms a door which gives easy access to the whole apparatus.

Tinsmith Can Design Casings for Grinding and Polishing Wheels

The tinsmith can also design casings to go around grinding wheels and polishing wheels so that they really fit the wheels. For instance, on one 3-in. wheel there used to be a large casing 1 ft. or more in diameter. The air suction in connection with the casing took away a great deal of the dust, but some sparks stuck to the wheel, went around again and came off at the top through the opening into the operator's face. It was very uncomfortable, besides being dangerous. A new case was designed, fitting closely around the wheel and coming well down in front. The restricted space increased the suction so much that almost all the sparks were taken away directly and those that did stick to the wheel and went around with it, on coming off, struck the low front of the casing instead of flying into the operator's face.

The effect of sparks on goggles or eyeglasses is shown by the micrograph in Fig. 11 taken from a lens after being used for 9½ hours. The reader has only to imagine what would happen to his eyes if they were in range of the rapid fire from the wheel. Equipping individual wheels and stones with cases that fit them closely is therefore important to health. Sheet-metal cases can be fitted much closer than cast iron or wrought iron and can be made of heavy enough material so that if the wheel bursts it may dent the casing, but the pieces instead of flying out will be churned around inside. When they do fly through the small front openings they will go directly downward and do the least possible harm.

Things to Be Considered

In designing these casings three things should be considered: The circumference of the circular part of the casing should be as nearly equal as possible to that of the wheel, taking into consideration ease of replacement of the wheel. The width of the casing across the face of the wheel should be as narrow as possible, after allowing enough clearance to prevent a piece of product which may slip from the operator's hand from binding between the wheel and the casing. The length of the

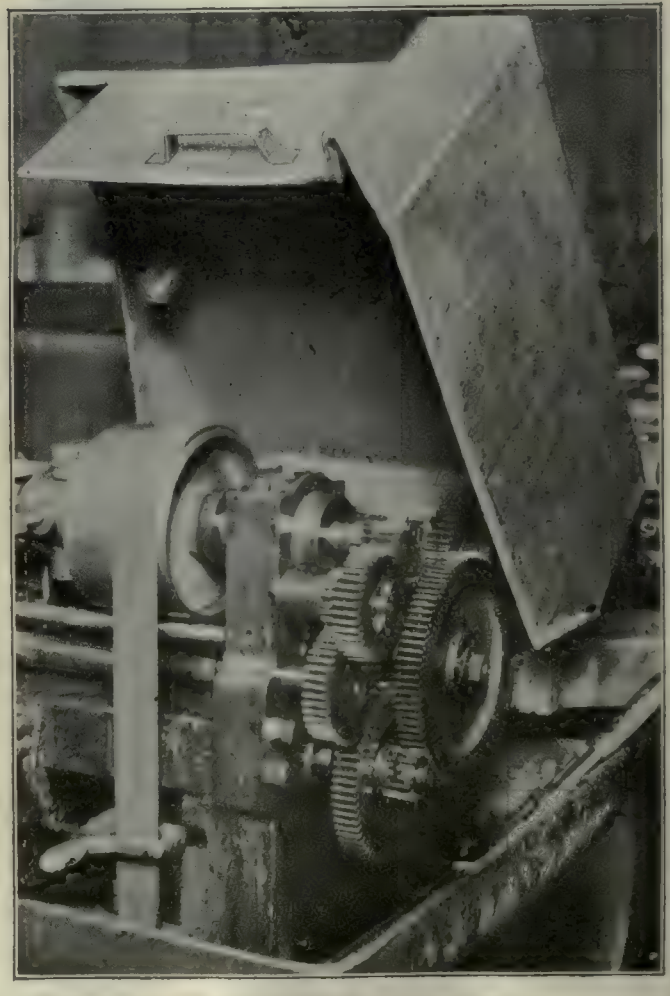


FIG. 9. REDUCTION GEAR SHIELD

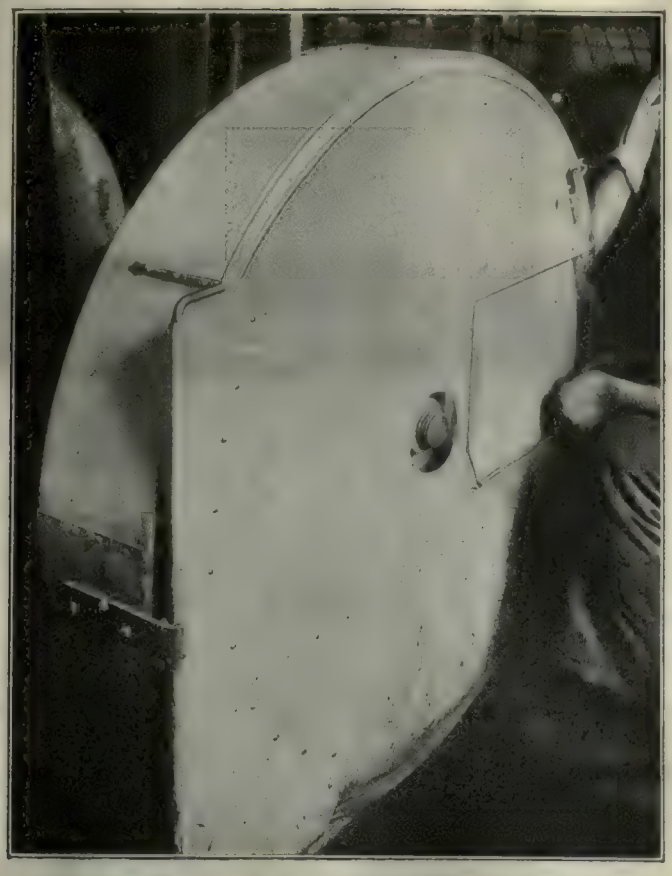


FIG. 10. SHIELD FOR VERTICAL POLISHING WHEEL

opening in the casing for the work should be kept as small as is consistent with the size of the product.

The form of the offtake of the exhaust pipe from the wheel depends upon the relative directions of the pipe and the rotation of the wheel. The offtake from the casing should be coincident with the line of flight of the sparks of emery thrown off.

If the wheel revolves upward and away from the operator the offtake should be vertically downward at the rear. If the wheel revolves downward from the operator the offtake should be horizontal at the rear, giving the sparks only a quarter revolution to cling to the wheel. When the direction of the offtake, as determined by the position of the exhaust main, necessitates a departure from the horizontal or vertical direction the pipe should be kept in the proper tangent.

Each branch exhaust should enter the main not at a right angle but at an acute angle in the direction of the draft, forming a Y. The pipe should have no sharp bends to check the speed of the flow and allow the dust to settle.

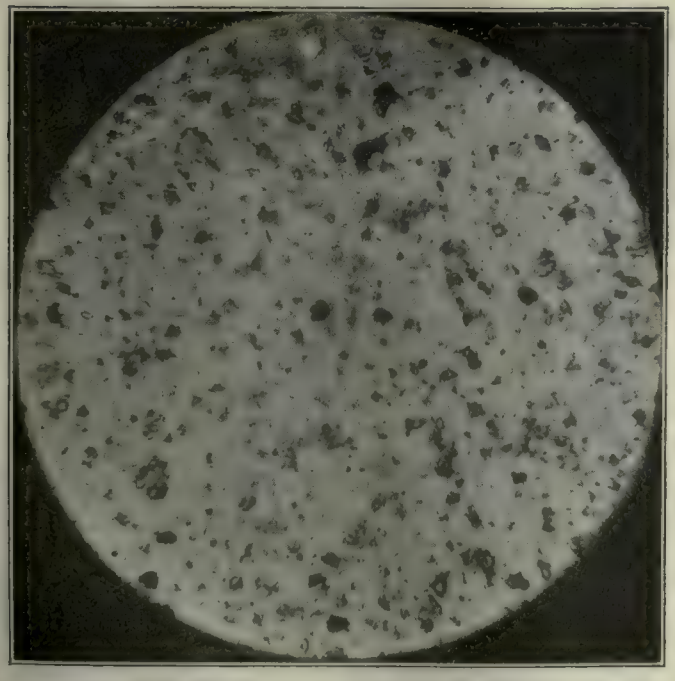


FIG. 11. MICROGRAPH OF LENS AFTER USE BY GRINDING-MACHINE OPERATOR

Preventing Oil From Spattering and Chips From Flying

For the comfort and safety of the operators, especially now that women are employed in the shop, it is necessary to prevent oil from spattering and chips from flying. For this purpose the shop tinsmith can be useful in fitting sheet-metal walls or cases around the machines.

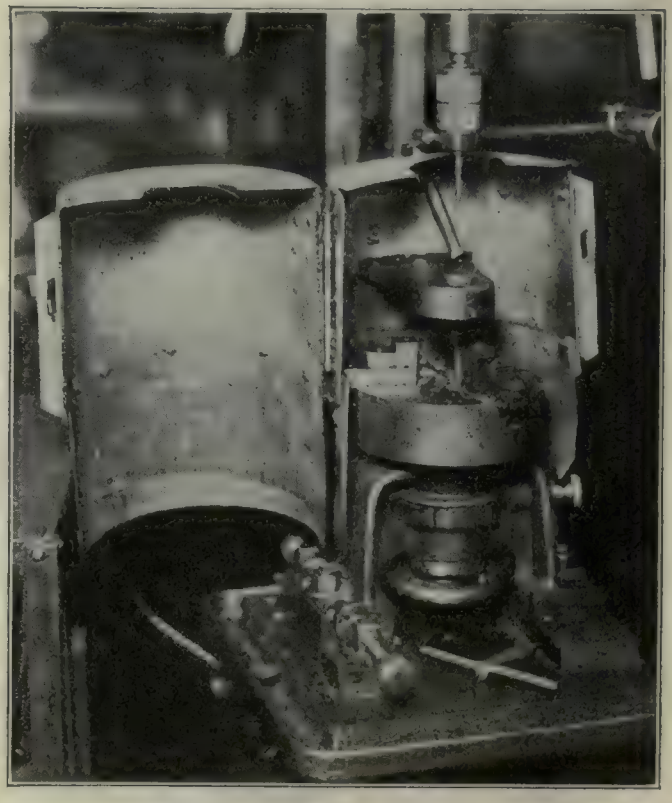


FIG. 12. OIL GUARD FOR DRILL

An example of such a casing is shown in Fig. 12 where a cylindrical casing completely incloses a drill, chuck and products while the drill is at work. This hollow cylinder is split vertically into halves hinged together so that the outer half may be opened wide when the operator is setting up the work. The casing is snapped shut as the drill is started and the oil turned on. The oil is led into the trough of the table of the machine and back to the oil well.

A simple guard designed to keep the oil of a pulley from flying on a desk immediately behind the pulley is illustrated in Fig. 13. This is merely a sheet of metal bent into the proper curve to loop partly over the wheel and prevent the oil from flying out either horizontally or vertically. Passersby are prevented from bumping into the pulley or the guard by a pipe fence.

Machines that do not need an entire casing around them can be protected where necessary by shields or aprons which may be attached to the machines permanently or may be detachable and adjustable. For the front of the machine the detachable style of apron is usually better. It is generally a flat piece of sheet-metal with the corners turned over and bound so as not to be sharp. Near its lower edge it has two strap-iron fingers riveted on. The sheet-metal fits against the inside of the lip of the bed or table of the machine and the fingers slide down on the outside. This apron



FIG. 13. OIL SHIELD FOR PULLEY

can be slid along the edge of the table to enable the workman to get at the product, and then slid back again, or it may be slipped off entirely to clean the machine.

Neatness is one of the first requirements of efficient arrangement. This is illustrated in the galvanized-iron trough which runs along the front of the four-spindle drilling machine in Fig. 14, and is divided into three compartments. A sheet-iron partition across the trough a short way from the right end is soldered in and made water-tight. The compartment thus formed is used as a well for the cutting fluid which flows off the bed of the machine and drops through a hole bored in the cast-iron trough. Each time a jig is opened and the product taken out, the jig is dipped in this well of cutting fluid and thoroughly washed before having the next piece of work inserted, thus keeping the jig free from chips, which might cause an error in the location of the work and spoil it.

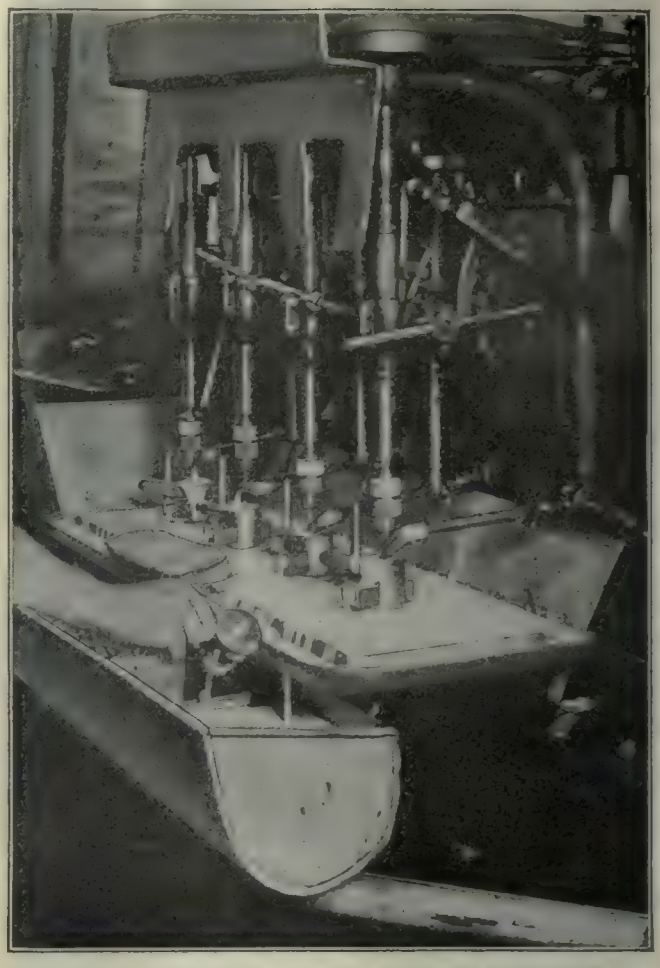


FIG. 14. TROUGHS AND GUARDS FOR MULTIPLE DRILLING MACHINE

In the trough next to the well is a small box with perforated bottom into which the product is emptied from the jig. The cutting fluid drains off and the work can be emptied at any time or inspected. In the farther end of the trough is another sheet-metal pan for holding the blank products. With this arrangement the operator has all his work directly before him and can operate the four spindles to their full capacity.

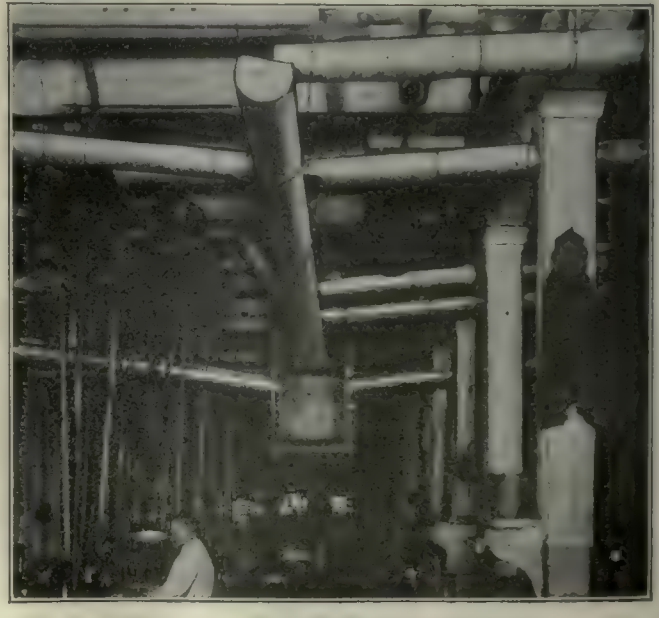


FIG. 15. OIL-COLLECTION SYSTEM

In the photograph of this machine will be noticed two of the adjustable aprons spoken of, one in the rear and one at the farther end. They are neat in appearance, rigid and effective.

At the top of this same figure may be seen an additional safeguard which was put on when women came to work in the factory of the Greenfield Tap and Die Corporation and were taught to operate machines of this sort. A sheet-metal guard is bent as shown to protect a woman's hair from being caught either in the belts or in the revolving spindles of the drills as she bent over to look at the work. Preventing the first strand of hair getting blown into a revolving part and twisted around until it secures a dangerous grip on the girl obviates most of such accidents.

Fig. 15 illustrates a system for collecting cutting oil and cutting fluid from the machines on the floor, which was put in to replace a system made up of steam pipes. The trough is shaped like an eave spout, is 6 in. in diameter and is supported by U-shaped hangers screwed to the beam above. One trough is run underneath each line of machines, and from each machine a hose comes down through a hole in the floor and discharges into the trough. All the branch troughs discharge into a central trough along the middle of the room, which in turn discharges into a tank suspended on a framework near the ceiling. The oil and cutting fluid are taken from this by a detachable pipe into a separator in the cellar. With the old system chips would block up either the branches or the main at least once a week. The riser then had to be taken apart by pipe fitters, cleaned out and put together again. The job cost $30 every month, as it took all day.

With the open troughs the cleaner can put a ladder against the trough, climb up with a brush or semicircular piece of sheet iron shaped to fit the inside of the pipe and brush whatever chips there are in the trough along it into the main trough and there clean them all out into a basket or pail. One man can clean out a trough in five or six minutes and the whole system needs only one man for a few hours instead of a gang for an overtime Sunday.

The best pitch for the side trough is at least one in ten, while that for the central trough should be a little more. This pitch will carry the chips along. There should be enough side troughs so that the pipes leading down from the machines can be nearly vertical to prevent dogging.

A good illustration of an exhaust system in a polishing room is shown in Fig. 16. It will be noticed that the main starts small at the near end, that is at the first machine, and grows larger as it goes on taking in branches from the other machines. The polishing wheels are 16 in. in diameter and to carry the necessary draft a 4-in. branch goes into the main from each machine. The proper size of the main at any point can therefore be figured from the number of branches which have come into it. The rule is that the diameter varies as to the square root of the number of duplicate feeders. For example, a main at the point where four feeders have come into it should have twice as large a diameter as where there is only one.

The near end of the exhaust system has a cap cleanout end instead of being permanently closed. This cap is made of a band of sheet metal several inches wide and is of a circumference to give a snug fit over the pipe



FIG. 16. FACTORY EXHAUST PIPING SYSTEM

itself; it also has a disk soldered over the end to close it. If the pipe becomes plugged or dirty the cap can be quickly twisted off by hand and a long rod run into the straightway of the pipe. Since the cap is on the extreme end of the pipe the suction tends to hold it on and there is no danger of it accidentally dropping off even if it were loose.

How to Make a Cleanout

Other cleanouts may be put in either when the line is first designed or afterward when experience has shown where they are required. To make such a cleanout, cut a circular hole in the top side of the pipe as big as is necessary to insert an arm or a cleaning rod. Then make a covering band of sheet metal out of a strip just long enough that when the two ends are bent upward at right angles they will not quite come together around the pipe. When the two upright lugs are drawn together by bolts the band will tighten around

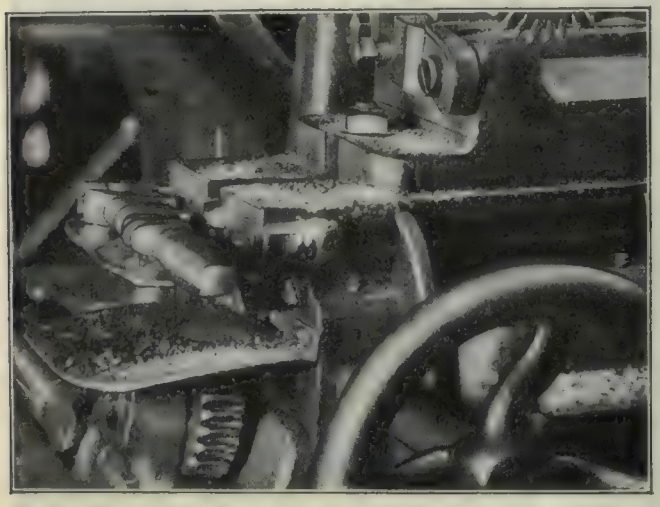


FIG. 17. SHELF TO PROTECT GEARING FROM CHIPS

the pipe so snugly that it becomes practically a part of it. If the lugs are made right the bolts can be loosened when it is necessary to get at the cleanout, and the band may be slid along the pipe out of the way while the work is being done.

The large dust-exhaust main leads into an exhaust fan at the center of the room which discharges the dust into the raceway running under the factory. The section shown is only one part of the system for the room, which is one of four in the factory which discharge at different points into the raceway. One of these systems, in order to reach the raceway, comes up over the roof of another building. The whole system was built by the factory's tinsmith at less cost than having the work done outside, the big riser and elbows having been built for $500 including material and time.

Miscellaneous Small Accessories

A tinsmith is most at home when he is making things that nobody ever made before. In a factory his opportunities for turning out handy aids to production are almost unlimited. For instance, from the milling machine in Fig. 17 chips used to fall into the mesh of a worm and wheel. Gears were broken and had to be replaced or the machine was stopped until the gears were cleaned out, thus delaying production. It was found that a small sheet-iron shelf bolted to the machine above the gears protected them from most of the chips.

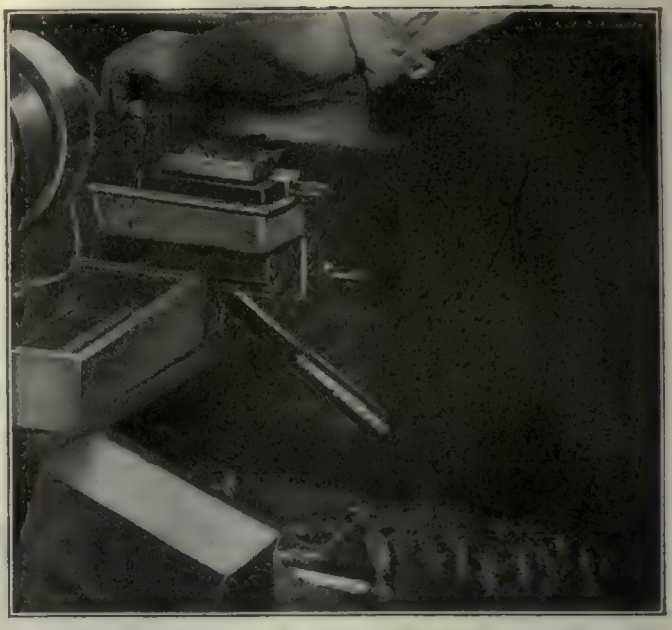


FIG. 18. SCOOP FOR PICKING UP SMALL PIECES

Similar small shelves can be bolted to machines at the handiest point on each to hold a gage or wrench. These are not only of theoretical value but are of real service to the operator. He soon gets accustomed to reaching to that one point for the proper tool and so instinctively uses it. It is highly advisable in instructing a workman in the use of gages to supply such a place for the gage at the nearest possible point to the work, so that the necessity of reaching for the gage will not deter him from using it as often as he should. He will soon get into the habit of using it on every piece if he loses no time thereby. This is a practical example of applied psychology which has been successful in the shop.

Scoops or Pans for Small Work

Small scoops or pans made to fit the table of a machine are found handy in dealing with small work. Usually the operator has to reach for a handful of small pieces and if his is the third or fourth process he is apt to get chips into his fingers or to be cut by a bur. If, however, he is supplied with a small pan turned up at

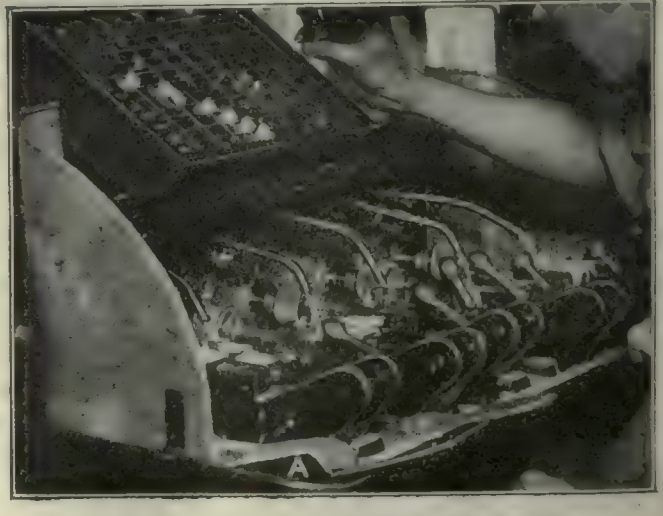


FIG. 19. SCOOP OR SHOVEL FOR CHIPS

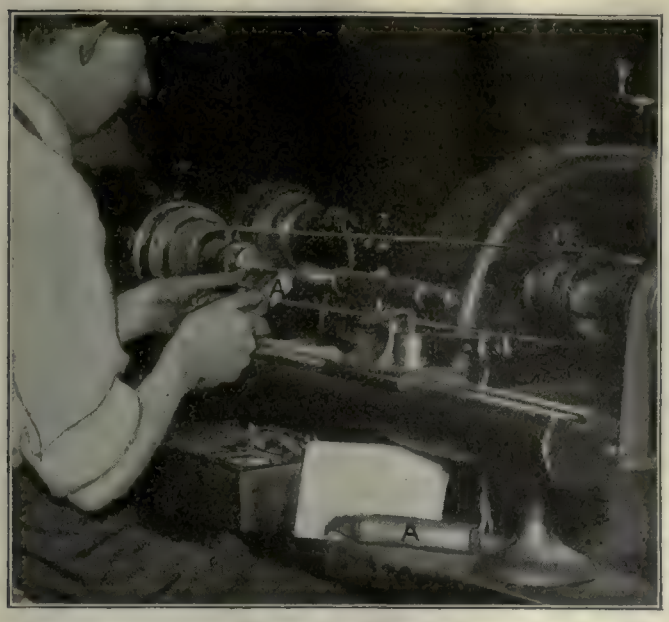


FIG. 20. SUPPORTING TOOL TO SAVE FINGERS

the edges as shown in Fig. 18, he can scoop up a sufficient supply out of the big supply box for several minutes' work and place them on his machine. From the small pan he can handle them so carefully as to avoid injury. The scoop or pan should be of such size that it will fit on the table or rest of the machine without projecting over the edges enough to get knocked off. Small shovels or scoops can also be used to pick up chips from the bed of the machine. These shovels can be of such a size that they will fit between the projecting parts of the machine like the one shown at *A*, Fig. 19.

How Tinsmith Can Make Small Tools For Holding Work

Small tools for holding work or to act as jigs may be made to order by tinsmiths for cases like the following: It was noticed that in holding a small cylindrical piece the operator had such difficulty in keeping his fingers from being injured that his work was slow as well as awkward. The factory tinsmith, observing the work, decided that the piece might continue to be supported at one end by the spindle center, as it was already, but that the other end could be supported by a small metal hook held up against it instead of by human fingers. He therefore cut a notch in a thin iron strap, split a short piece of broom handle in two for a handle, inserted the notched strip and bound the two halves of the broomstick together with a curved sheet of tin tacked round them. When this notch was held against the revolving piece of work as at *A* in Fig. 20, it supported it perfectly and not only saved the operator's fingers but released one hand so that he could reach for the next piece while the one in the machine was being done. He was able to work so much faster that the little holding instrument was improved to a permanent form.

In the same way many devices can be tried out in sheet metal, which is cheap and can be twisted into any shape. If the device works out well in this experimental form it can be made in steel or iron for greater permanance. Using sheet metal is also much quicker than waiting for a pattern and a casting or doing complicated machine work that one hesitates to do on merely experimental devices and might be greatly extended.

The tinsmith is also useful in making repairs. An instance of this is illustrated in Fig. 21, which shows the air-blast pipe on a heat-treatment oven. The blast enters through the 3-in. pipe, but a small hole was left near the base through which to light the oil and start the fire. The blast, however, was at such a height that it formed a back current of air at the bottom of the furnace, and after the fire was going blew back some of the oil spray out of the small hole. This caused a great deal of smoke and seriously reduced the oven temperature. The trouble was cured by running a small bypass into the small hole. This assisted the draft in the proper direction, blowing the oil back where it belonged and obviating the smoke.

All the tinsmith's work in this factory is done by one tinsmith, an apprentice and a helper. Of course everything he does is on order from the maintenance department, but sometimes such orders are not specific. One may come in on a formal blank but in quite informal language, such as: "Trouble with machine No. 1702. See if you can fix it." The tinsmith then sits down by the machine and lives with it. He questions the operator as to its workings, watches it and analyzes its movements. He finds out how the man works, what are his movements and the movements of the machine; how far they move, when and what movements are interlocking, what depend upon each other, where



FIG. 21. AUXILIARY DRAFT PIPE

spattering occurs, where the product strikes when it falls and how hard it strikes, where the chips come off, and the direction of the oil as it falls. Then he cuts and tries until he has his device adjusted to cure the given trouble.

Of course an order always comes from the maintenance department as a source, but as the tinsmith in wandering around sometimes sees a possible opportunity to solve a trouble there is nothing to prevent him from suggesting his solution first and getting an order for it afterward.

It is hoped that this article will be of benefit in drawing the attention of factory managers and maintenance superintendents, and even the engineering departments, to the uses that can be made of sheet metal.

"Jim"—Efficiency Engineer

By E. E. Watson

Apropos of recent discussions appearing in the columns of the *American Machinist* upon the subject of "efficiency" and "efficiency engineers," I want to tell you about Jim.

"Jim" was not his real name but it will serve for publication purposes, while the man himself will be immediately recognized from the description by the thousands who have come in contact with him.

Not so many years ago Jim and Jack started to work for the same automobile concern; Jim, owing to his superior education, as a clerk in the cost department while Jack went into the shop.

Jim advanced quite rapidly; in fact it was only a couple of years before he got a dollar or two more per week, while Jack was still chasing sky-hooks and looking after left-handed monkey wrenches at the same old figure.

About this time there dawned a new era in machine-shop management and all the boys bought dictionaries to study up on the new pass-word "efficiency." They could then make intelligent comparison between the rules as laid down by Webster, and the four or five specimens of the real thing that the old man had recently hired to tell him how to run the place.

Jack at first found the change quite welcome, as under the new conditions he was no longer required to go after the gookum oil every time a machinist wanted to polish the muchlen bar, but he soon found that this advantage was more than offset by his having to punch job tickets, and to put his number, age, general description and next of kin on sundry cards, signing same on dotted line, every time he wanted to get file handles, waste, oil, etc.

Contemporaneously with the new era there arrived in town one A. Hokus Pokus, the man who really founded the efficiency business, educated most of its experts, and was now in search of promising material for further efforts along the same line. To enable him more quickly to attain the desired end he forthwith opened up a school where ambitious young men could, in exchange for a considerable sum in coin of the realm, have instilled into their systems all the great underlying (accent the two last syllables) principles of scientific management.

Jim was very much interested in the literature which he received in reference to this school, and later met Mr. Pokus personally. This gentleman slapped Jim on the back and told him that only four or five years ago he, Pokus, had been nothing but an ordinary clerk in a factory office; but right there he stopped telling the truth and before Jim had gotten away he had signed on the dotted line and parted with the price of his next spring's suit.

In due time Jim graduated, and with the aid of a much beribboned and sealed diploma succeeded in landing a job as efficiency engineer in the forge shop of the Blankety Blank Corporation.

Way back in his childhood days Jim had "repaired" his mother's sewing machine—once—but from the time his mother caught him, up to the moment of his entrance upon his new duties, he had kept severely away from machinery of all kinds—the memories were too harrowing. Now one of the tenets of A. Hokus Pokus' teachings happened to be "always obtain competent counsel" and as the aforementioned company employed a real master-mechanic this fact automatically provided the competent counsel which Jim so much needed. In other words, the M-M. held down Jim's job for him—for awhile.

The Blankety Blank Corporation was suffering from a shortage of help. Good steam-hammer men were scarce and crippled equipment correspondingly plenti-



ful. Broken piston rods became quite too common and Jim was assigned to the job of applying the remedy.

Straight to the office of the master-mechanic went Jim, to take counsel. That official carefully explained to him the theory and construction of steam hammers, that lack of alignment coupled with the inflexibility of the average piston rod was probably the cause of the breakage, and artfully suggested that Jim, with the help of his glittering diploma and one of the draftsmen, could probably design a piston rod with a knuckle joint in it that would enable the ram to glide gracefully around any curve that the guide ways might assume—just like an express train on a railroad track.

Jim saw the point—was he not getting the benefit of competent counsel?—and by virtue of his authority as efficiency engineer prevailed upon the drawing office to put this scheme on paper.

In due time a wonderfully ornate blueprint bearing Jim's name in six places as the designer of the now famous flexible piston rod was laid before the superintendent.

The superintendent is a man of few words but on that occasion those few were carefully chosen. Jim is now a clerk in the cost department of the Old Times company.



HEAT TREATMENT of ALLOY STEEL

By
K. A. Juthe
CHIEF ENGINEER—WHEELOCK, LOVEJOY & CO.

Heat-treatment has always been clouded with more or less mystery to the average man who is not directly connected with it. In this article the author, who has had wide experience, gives many practical points and suggestions which will be of value to those who desire to become more familiar with this work.

THE heat-treatment of steel can be classified into two distinct groups: First, that which includes the hardening and tempering of crucible steel, annealing, case-hardening and the relieving of strains from hardening or forging operations, and second, that which includes the alloys—steels which carry certain percentages of manganese, chromium, nickel, vanadium or other elements. The automobile industry is largely responsible for the last group, and the tremendous amount of research work which has been going on for the past few years on gun and ammunition requirements has added to the interest and knowledge of the subject.

The first group is so well understood by the majority of practical mechanics that I will consider only the second group as having the greatest interest at the present time. It is well to bear in mind, however, that the same principle underlies all steels, no matter what the percentage of carbon may be, and even the so-called tool steels are all made with one or more alloys.

The purpose of heat-treatments for the alloy group is to increase strength and toughness of material and at the same time to increase machining ability by leaving steel ductile. To properly heat-treat steel we must know the composition of steel and at what degrees of heat changes occur.

The Properties of Iron

From text books we know that iron possesses the allotropic property of existing in three different conditions and still remain the same chemically. If we heat pure iron to 1390 F. it suddenly loses its magnetism and instead of being soft and ductile it becomes hard and brittle. If we continue to heat it until it reaches 1635 F. it again suddenly changes its properties and instead of being brittle becomes again ductile, but still hard and nonmagnetic.

These stages of iron are called respectively:

ALPHA iron, soft and ductile and stable on lower critical point;

BETA iron, hard and brittle, stable between critical points, and

GAMMA iron, hard and ductile and stable above high critical point.

Now if carbon is added to the iron the critical point is lowered in direct proportion to the percentage of carbon until the point of calescense is reached. In carbon steels this is about 1350 deg. Fahrenheit.

The composition of steel is given by Prof. Albert Sauveur, as follows:

FIRST, FERRITE, which is pure iron, low in tensile strength but very soft and ductile;

SECOND, CEMENTITE, which is a carbide of iron, present in steel of over 0.9 per cent. carbon, very hard and brittle, and

THIRD, PEARLITE, which is simply a mechanical mixture of pure iron with cementite.

Pearlite is present in steel in increasing percentages up to 0.9 per cent. carbon, with a corresponding decrease in ferrite. At 0.9 per cent. carbon the steel is all pearlite. When the carbon is over 0.9 per cent. the pearlite decreases in percentage with a corresponding increase of percentage of cementite.

The Conditions of Steel

Every condition of heat on steels, from the low critical point to that above high critical or overheated steel, has been recorded by numerous authorities on the subject. I will briefly touch on these not because of any actual value to the operator, but simply to show that a difference of a few degrees in heating gives a different structure of steel easily recognizable in a microphotograph.

OSMONDITE appears at about 750 deg. when cementite begins to dissolve in Alpha iron;

SORBITE appears at 1100 deg. F., and is nearly all pearlite, but with a certain percentage of cementite undissolved;

PEARLITE is thoroughly saturated Alpha iron with cementite;

TROOSTITE is the higher carbon steels in tempered conditions;

MARTENSITE is properly hardened steel, and

AUSTENTITE is present in high-carbon overheated steel.

Supposing a demand is made on a steel mill for a certain quality of steel—From the laboratory diagrams and reports of a certain combination of elements can be selected, the proper percentage of each figured out

and steel can be made for so much a ton. Beautifully simple, but let us see how it works out.

The first consideration is that the manufacture of a great number of alloy steels and their heat-treatment are still in their infancy in this country. Steel manufacturers of this country have been forced into a regular whirlpool of specification requirements and demands of all kinds during the past few years to such an extent that our laboratories, colleges, chemists, etc., were taxed beyond capacity to furnish data. As an example, take the requirement for gun steel.

Difficult Specifications

Suddenly requirements came for several million guns to be made at once. Specifications from a foreign government were such that no mill in this country could or would furnish material. If we had been able to manufacture the steel no one would have had the proper facilities for heat-treating nor the knowledge to heat-treat such steel to the requirements demanded. Take for example the following:

Elastic Limit	Tensile Strength	In 2-In. Elongation	In 2-In. Contraction
90-100,000 lb. per sq.	125,000+	18+	40%

Not only did the specifications give us the physical properties wanted but they also gave us the analysis from which we were to develop these properties. Here are the specifications:

Carbon	Tungsten	Silicon	Sulphur	Phosphorus
0.60	1.0	0.20	Not over 0.02	Not over 0.02 Only trace of other elements

On top of these specifications the manufacturers of the complete guns had a specification of their own which reads:

"All heat-treated steel *must* possess the quality of easy machining."

This steel referred to practically pure Norway iron base, with its alloy tungsten added, which it would have been next to impossible to get at any reasonable price in such quantity as wanted. It would also have to be made either in a crucible or in electrical refining furnaces, and the whole proposition was hard to figure on.

Finding a Substitute Steel

The next proposition was to substitute a steel at a reasonable price which under heat-treatment would meet the physical and mechanical requirements. It was my good fortune to have this particular requirement put up to me for solution, and I will outline the proceedings step by step that solved this problem in the hope that it may assist others.

By looking up our regular charts and records we found a steel formula to give us the following:

Elastic	Tensile	Elong.	Cont.
75,000	110,000	20	45%

Carbon	Manganese	Silicon	Sulphur	Phosphorous
0.50	1.10	0.15	0.06	0.08

How to increase the elastic limit and keep the elongation or ductility high at the same time was the problem. If it had been only to increase strength without regard to elongation or machining qualities it would have been a simple matter, as increasing the carbon content would have been sufficient.

Some foreign element, or alloy, had to be added to ordinary steel to meet the physical requirement and still after heat-treatment show a grain of all pearlite. In other words, we required a thoroughly saturated steel to which had been added the necessary degree of toughness to meet requirements and which also showed the needed ductility for excellent machining. By adding the manganese contents, and also adding a small percentage of chromium and nickel we could easily reach physical requirements, but we could not under our ordinary heat-treating methods keep it uniform and secure the ease of machining which was necessary.

Making the Tests

A series of tests were then made. Hardening heats from 1350 to 1650 deg. F. varying by 25 deg. were taken, all being heated exactly the same length of time and quenched in oil at the same temperature of oil. Microphotographic plates were taken so as to find the saturation point. The rest of the bars were then put into tempering furnaces, given a certain length of time at a certain temperature, when a few were pulled out from each hardening heat and buried in lime. Tempering was started at 900 deg. F. and went by variation of 10 deg. until we reached 1350 deg. F. when the remainder were pulled out and buried in lime.

It will be noticed that hardening was started at the critical point of steel, 1350 deg. F., and also that the tempering was stopped at the same critical point. This was for the reason that no changes would take place in this grade of steel below the critical point in hardening, and if tempered above this temperature, the unstable condition would be reached.

Another batch of test pieces was immediately started. This we made from steel 5 points lower in carbon and 10 points higher in manganese, the other elements remaining the same. These were hardened and tempered as before, every piece of course being properly marked. We kept this up until we had determined the proper condition of steel to meet all the requirements wanted. The fact was thus established that any modification of analysis in any of the elements, except that of sulphur and phosphorus, makes a change necessary in the hardening heat, in the length of time of the heat, in the temperature of the cooling compound (generally oil), in the heat of the tempering and in the time the steel was left at high heat, as well as the time allowed for cooling.

For heat-treatment of parts on which all the machining has been done and which simply require grinding to finish a great deal of work on the steel can be saved as the condition of saturation does not make so much difference. But where fine machining is to be done afterward, segregation must be avoided, as well as hard spots, soft spots, ghost lines, cold checks caused by cooling too quickly after tempering and strains caused by careless heating in tempering or by careless burying after tempering.

We can now take up the elements which determine the transformations in both hardening and tempering. The question naturally arises as to the need of first hardening such steel and then tempering until it becomes ductile.

The reason is that after the steel solidifies after pouring, it cools very rapidly from its liquid state, thereby causing segregations (the ferrite and cementite do not have time to get together), stress, etc. In reheating we bring it beyond the upper critical point to Gamma iron, that state wherein the condition is stable. Quenched from this temperature the molecules remain in the right crystalline form, so that a slow tempering process can finish the work and deliver a perfect sorbitic or pearlitic saturation, as we may desire.

The effects of some of the components and alloys of steel are of great interest and should be noted.

Carbon is, as far as the steel referred to here is concerned, the controlling factor in determining the critical point. In other words the hardening temperature is determined by carbon content.

Manganese of 1 per cent. (100 points) or more controls the time of soaking at high critical point.

High silicon will shorten the time of soaking somewhat, but low silicon will not increase it.

Chromium, if present to the amount of over 5 points, will add 1 deg. F. to hardening heat as predetermined from carbon for each point of chromium. For instance, if the predetermined heat is 1500 deg. F. and steel to be hardened contains 1 per cent. (or 100 points) chromium, add 100 deg. F., making the critical point 1600 deg. Fahrenheit.

Nickel to the extent of over 10 points will add approximately 1 min. to the soaking time for each point present up to 50 points. If over 50 points both hardening and tempering heats will change.

For tempering, however, a different process is carried out for the determination of the factors involved.

Carbon we practically eliminate, as no martensite condition exists at a heat of 700 deg. F. and over.

Manganese has done its real work, keeping a sort of fibrous grip on the molecules in suspension.

Silicon, in conjunction with sulphur and phosphorus, acts as a lubricant and facilitates the relocation of the saturated mass from one of rigidity to one of ease. Too much lubricant is just as bad here as in high-speed engines. It will prevent the proper binding of molecules together and weakens the structure, but all three are a great help to machining operations. Sulphur should not exceed 0.07 and phosphorus 1 per cent.

Chrome and nickel control both temperature and time in direct proportion to their percentage. When chromium is present at 1 per cent. or more and nickel at 3 per cent. or more, singly or combined, they present a problem not as yet solved by heat-treatment experts. They are most difficult to treat with any certainty of uniformity as far as ease of machine operations is concerned.

Functions of Different Elements

We can sum up the different elements in ordinary alloy steels to have the following functions: Carbon for hardness and rigidity; manganese for toughness; silicon a sort of adjuster; sulphur and phosphorus as lubricants; chromium as a refiner of grain and to add hardness to help carbon; nickel as a protecting support of structure and as an aid to stability, and vanadium in small doses acts as a scavenger, in high percentage it is a great resister of friction.

In heat-treating alloy steel there are certain factors to bear in mind. These factors may vary slightly as to the duration of heat limits, but they are always present, and the following points must be considered:

First, one must know the critical points.

Second, one must not fall below high critical point when soaking steel.

Third, steel of the same analysis must have the same length of time for soaking to give uniform results.

Fourth, quenching must be done within certain limits of temperature, depending on the quality of the work performed, or uniform results cannot be obtained.

Fifth, tempering heats vary on a 10-deg. F. basis; very close heat limits must be established for the quality of work desired.

Sixth, a low limit must be set as to the time necessary for soaking at high heat. This heat must not fall below the heat wanted while being soaked, for if it does, the timing must begin when this temperature is again reached. Too long soaking may cause a reaction, giving a dry steel with a great drop in elastic strength.

Seventh, when taken out of the furnace the work should be buried in lime and thoroughly covered with no chance for air pockets. Air-cooled steel will contain hard spots on the surface and soft spots in the interior. If no information is at hand as to the critical points of steel they can very easily be ascertained by pyrometer or magnet methods.

The Calescent Point

The calescent point can be determined by use of the pyrometer by closely watching its needle. The thermocouple, or fire end should be inserted in the steel. Drill a hole in the piece to take in the fire end of thermocouple. As the heat advances the needle will follow until it reaches a point where it suddenly stops, wavers and then suddenly drops several degrees, although the heat is constantly advancing; then the needle will again suddenly commence its upward swing. Where the needle stops its upward swing and rests is the calescense, or low critical, point.

Now reverse the operation. Heat beyond the critical point and shut off the fuel and watch for the same phenomena. The needle will fall with heat, suddenly stop, then advance several degrees, when it again starts to drop for good. This upper change is called the recalescense point.

When testing with the magnet use an ordinary horseshoe magnet. Touch the steel with magnet during heating and at that temperature at which the steel fails to attract the magnet, or in other words loses its magnetism, that is the point of calescense, or critical, point.

Even Heating Necessary

Strains in steel are very often caused by having no heat circulation about the work, particularly when heating in furnace, by work being placed on the furnace floor. Circulation of heat is necessary, and the best method is to lay long pieces or strips on raised perforated platforms.

The furnace should be "balanced;" in other words, the heat must be evenly distributed; in fact several firing ends should be in the furnace at all times, connected by switch to the same pyrometer.

The cooling agent should be kept within very close temperature limits.

How Johnson's System Speeded Production

By John R. Godfrey

Johnson's faith in his new system, which has cost him days and nights of hard labor to say nothing of wads of cold cash, received a solar-plexus blow the other day. He had personally put through an order for a particular friend, for a special blowpipe, the chief feature being that the nozzle was to be bent a few degrees more than the regular pattern, this bending taking about seven minutes after the job was really in hand.

Knowing that time was apt to be lost sight of in

the way of orders, checks and other parts of the system he played safe by putting the shipping date three weeks ahead. Then he personally started the order through the mill, filling out the first blank and shooting it straight to the fountain where all good little orders get a proper start in life.

Then he promptly forgot it as he should knowing full well that on the 29th of February the aforesaid blowpipe would be in the hands of his friend.

Imagine his surprise a few days later to get a red-hot, sarcastic letter from this self-same friend reminding him of his new system, and then asking when he might perhaps be permitted to gaze upon the aforementioned and much-desired blowpipe. He had been notified of its shipment but couldn't trace it.

Johnson was hot. He grabbed the 'phone and called the foreman of his blowpipe department, a man who had been with him for years and on whom he could bank every time to get work out.

"Jack, what about that special blowpipe for my friend X? Order went through three weeks ago. Put it through myself. When did it leave your department?"

"Never had such an order, Mr. Johnson. No such order has come through this department."

"It hasn't? Well where in helenblazes do you suppose it is? How long would it take for you to get it ready for shipment after you got such an order, Jack?"

"Not fifteen minutes, sir. I'd just take a standard blowpipe from the lot going through and bend it to the angle he wants. You get me the order and you can send for the pipe in fifteen minutes."

A Little Sherlock Holmesing

By this time Johnson was getting cagey and he thought he'd try a few practical experiments on his new system. So he called the shipping department.

"When did you ship that special blowpipe to X?"

"February 28th, Mr. Johnson," replied the clerk, looking up a shipment schedule.

"And did you notify them the pipe had been shipped on that day?"

"Yes, sir—always do so."

"Well, where in thunder did you get the blowpipe to ship? Jack says he hasn't made it yet. What's the use of records that record what you *ought to have done* but not what you did? The order for that pipe hasn't reached the shop and you notified the customer it's been shipped just because the schedule said it was to be ready that day. Darned if I know which is the bigger jackass, you or the system."

Then he started on a still hunt. He found the order finally, dusty and somewhat begrimed. It had gone from the shipping clerk back to the engineering department for engineering investigation. Someone had discovered that the old man—that's Johnson—had written "copper" tube when he meant brass. Hence it had to go back again to one of the departments and start all over again.

The only trouble was it didn't start. It got sidetracked and was in the basket of one of the many clerks who formed a part of the system. It had also gathered unto itself various kinds of orders and notations. It would seem as though every systematizer was a stockholder in a paper mill and a carbon-paper establishment. Reams and reams of forms, carbon copies, etc., etc., seemed to be the first thought.

By the time Johnson had found the order he was not in the best of temper, even though he is a mild-mannered man in most cases. He was just getting ready to go to the stockroom and take a blowpipe by force if necessary, and take it over to Jack's department to fix it as X wanted it. But before he could put this determination into action the office boy came in with the desired pipe.

"Where the deuce did you get that, Johnnie?"

"I heard you talking and guessed you wanted one pretty bad. So I went downstairs to the stockroom, walked in, picked this up and walked out again. Jack thought you'd sent it and fixed it for me himself—told me to send him the order later to keep his records straight. And here it is, sir. You aren't mad, are you?"

"No son, I ain't mad. I'm darned glad some one in the office has a little pep. The system evidently doesn't hinder you, or anyone, from grabbing what he likes out of the stockroom, but it sure does block an order from going through in the regular way.

"I've heard of systems that told you what you should have done the week before, and I guess I've got it. Son, you stick around the office and keep your eyes peeled as you've done today and you won't be sorry."

Using the Compound Rest for Accurate Tool Setting

By Joel Sundell

A compound rest equipped with micrometer dial may be used for making extremely minute adjustments by merely swiveling it to any ratio desired, for instance:

If it is set at 45 deg., one 0.001-in. division on the dial will advance the tool 0.0005 in. or remove 0.001 in. on diameter of work. If set at 30 deg., the tool advance will be 0.00033 in. and if set at 50 deg., 0.00005 in. The following is the formula:

A = Advance of tool.
B = Amount removed on diameter of work.
C = Number degrees of set over of compound rest.
D = 90 deg.
E = 0.001 division on dial.

$$A = E \div \frac{C}{D}$$

$$B = 2A$$

$$C = D \div \frac{E}{A}$$

How Would You Prevent Oil From Discoloring Finished Surfaces?

By J. H. Gravell

In answer to the above query, printed on page 802 of *American Machinist*, I would suggest the following method which I have used with success:

Wipe off the old oil, softening it with kerosene if it has become hardened; apply Deoxidine with a brush, allowing it to remain on the surface about two minutes, and then wipe the surface with a clean dry cloth. Let the surface thoroughly air dry for about two hours and then apply a light machine oil. Deoxidine is made by the American Chemical Paint Co., Philadelphia.



XIII. Gas Cutting Torches

The heating part of a gas cutting torch differs but little from that used for welding, except that, as a rule, the jets are multiple. The principal difference lies in an added jet of oxygen which does the "cutting." The various makes of gas cutting torches are here shown in detail in order to make clear their interior construction.

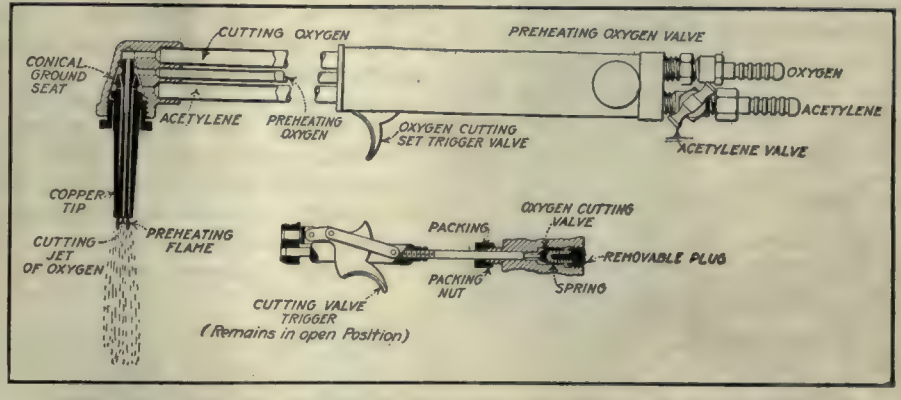


FIG. 129. DETAILS OF THE DAVIS-BOURNONVILLE CUTTING TORCH

THE gas cutting torch is commonly used for cutting through various thicknesses of steel or wrought iron, which are the only metals which can be satisfactorily or economically cut by this process. Cast iron cannot be cut with a gas torch. As an adjunct to a welding outfit, the cutting torch is used for beveling and for cutting out patches and holes. The process is based on the fact that a jet of oxygen directed upon a previously heated spot of iron or steel, causes it to ignite with the result that the metal, acting as its own fuel, burns away rapidly in the form of iron oxide. This oxide runs, or is blown, out of the cut or kerf produced, in a stream, provided the torch is fed along properly. The same sources of gas supply may be used as for welding, though in some cases other regulators must be employed.

As previously stated, steel and wrought iron are the only metals which can be satisfactorily cut by this process. The reason is that these two metals combine readily with oxygen, with the liberation of heat. The slag is produced at a temperature below that of the melting point of the metal, with the result that it is easily separated from it. Other metals do not produce so much heat when combining with oxygen, and the oxide formed is not reduced to a molten condition at temperatures below that of the melting point of the metal, with the result that it cannot be easily separated.

The combination of the oxygen with the iron is not that of complete combustion. An examination of the slag produced shows the presence of metallic iron, which leads to the belief that the oxidation follows the grain surfaces of the metal and more or less mechanically disintegrates the mass at the line of cutting.

There are two kinds of cutting torches used, known as the central and follow-jet types. The central type has a number of heating flames surrounding a central hole from which only oxygen issues. The follow-jet type consists of one heating jet and one following-oxygen jet.

*For the author's forthcoming book, "Welding and Cutting."
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Since the temperature to which it is necessary to heat the iron or steel, in order to have the oxygen act, is comparatively low (about 900 deg. F.) a number of gases may be used for heating. Oxy-acetylene is very commonly used on account of its convenience, for ordinary work. For heavy work oxy-hydrogen is used on account of its longer flame and because no products of combustion that hinder cutting are produced. The temperature required is well within its heating range, and steel up to 36 in. thick has been cut. The thicker the metal the greater the pressure of oxygen used, as will be seen from the various tables. In the cutting torches, the holes for the various jets are usually drilled in the same tip, though in some cases separate tips, set

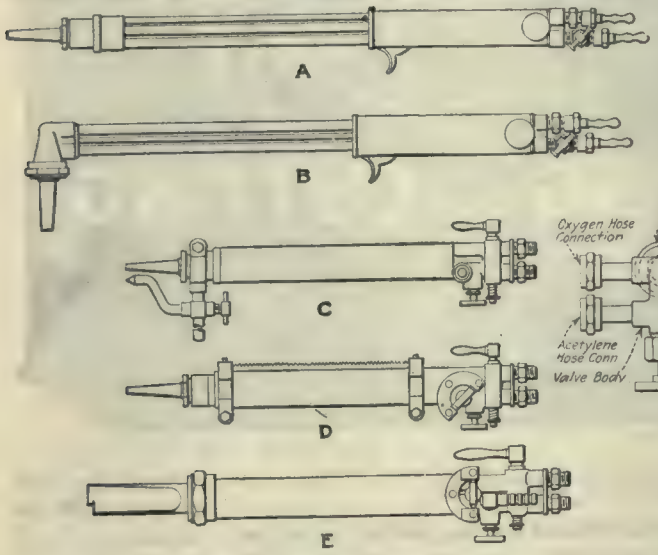


FIG. 130. VARIOUS MODELS OF THE DAVIS-BOURNONVILLE CUTTING TORCHES

close together, are used. The ordinary cut or kerf made by the cutting torch is from $\frac{1}{16}$ to $\frac{1}{8}$ in. wide, according to the size of the oxygen jet used.

Since the same construction of the heating part of a cutting torch is used as in the welding torch, it naturally follows that both the positive-pressure and low-pressure, or injector types of heating units are used in conjunction with the single oxygen cutting jet.

The Davis-Bournonville Cutting Torches

The details of a Davis-Bournonville, No. 3000, cutting torch are shown in Fig. 129. This is typical of the



FIG. 132. THE OXWELD CUTTING TORCH, MODEL B

general principle on which all of this firm's cutting torches are made. In use, the positive-pressure heating unit is first started and applied to the work to be cut. As soon as the metal reaches a red heat, the trigger is pressed and the oxygen jet commences its work. This particular model of torch is supplied with five interchangeable tips, and the cutting jet of oxygen may be turned on or off by a simple pressure of the trigger, as just mentioned. This trigger is so made that it is not necessary to keep the finger on it all the time

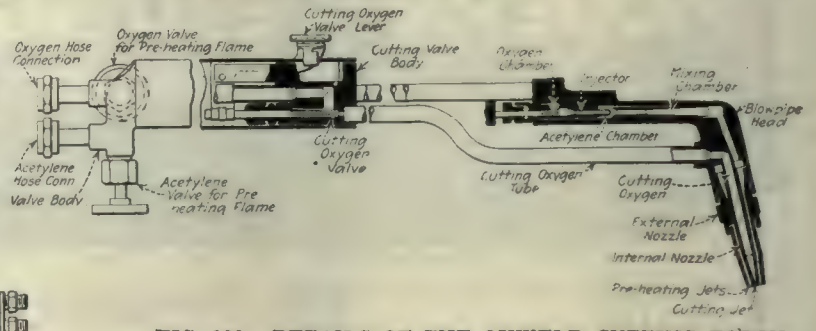


FIG. 133. DETAILS OF THE OXWELD CUTTING TORCH, MODEL B

it is in use. There are only two hose connections for the gases, one for oxygen and one for acetylene. The pressures of the respective gases vary with the thickness of the metal being cut, which may be from $\frac{1}{8}$ up to 12 in. or more. The torch is 20 in. over all, and is especially adapted to freehand cutting, and in wrecking or scrapping metal.

A number of different styles of cutting torches are shown in Fig. 130. *A* is a straight-head cutting torch (No. 2018) which may be fitted with curved tips for cutting boiler tubes, rivet heads, etc. Three bent and two straight tips are regularly furnished. In general, it closely resembles No. 3000.

The torch *B*, known as No. 1316, is very much like

STYLE No.	STYLE of TIP	ILLUSTRATION	SIZES	REMARKS	STYLE No.	STYLE of TIP	ILLUSTRATION	SIZES	REMARKS
7	OXY-ACETYLENE BOILER TUBE TIP	45°	1 2 3 4		674	OXYGRAPH CUTTING TIP		1 2 3 4 5	5 HEATING HOLES
10	OXY-ACETYLENE WRECKING TIP	30°	1 2 3 4		1511	REG. OXY-HYDRIC CUTTING TIP		1 2 3 4	
12	REGULAR STYLE "C" CUTTING TIP		1 2 3 4 5 6 7 8 9 10	TWO HEATING HOLES	1567	LARGE OXY-HYDRIC CUTTING TIP		1 2 3 4 5	
15	OXY-HYDRIC HAND CUTT. TIP		2 3 4 5	WILL CUT FROM 6"-16"	1568	LARGE OXY-HYDRIC BENT CUTTING TIP	30°	1 2 3 4 5	
16	OXY-HYDRIC MACH. CUTT. TIP		2 3 4 5 6	WILL CUT FROM 6"-24"	1678	OXY-HYDRIC CUTTING TIP		1 2 3 4 5	"ALCO"
25	STYLE "C" OXY-AC. CUTTING TIP		2-1 2-2 2-3 3-1 3-2 3-3 3-4 3-5 3-6 3-7 3-8 3-9 3-10	4 HEATING HOLES	1967	CITY GAS TIP CHICAGO STYLE		1	INJECTION TYPE
26	STYLE B.C. CUTTING TIP		1 2 3	FOR BILLET CUTTING ONLY	2017	PANAMA CUTTING TIP		2	7" LONG 2 HEATING HOLES
29	MULTI. FLAME B.C. CUTTING TIP		2		2113	STYLE "A" TIP		1 2 3	FOR CUTTING ATTACHMENT
35	STYLE "C" CUTTING TIP		4-1 4-2 4-3 4-4 4-5 4-6 4-7 4-8 4-9 4-10	FOR CARBO-HYDRIC CITY-NATURAL GAS	2133	OXY-HYDRIC HAND CUTTING TIP		2 3 4 5	"ALCO"
206	OXY-ACET. PL. CUTTING TIPS		2 3 4		2272	PANAMA CUTTING TIP		3 4	7" LONG 4 HEATING HOLES
207	OXY-HYDRIC PL. CUTTING TIP		2 3 4		2690	OXY-HYDRIC CUTTING TIP		1 2 3 4 5 6 7 8 9	G. E. CO.
208	OXY-HYDRIC BENT WRECKING TIP	30°	2 3 4						

FIG. 131. DIFFERENT TIPS FOR USE WITH THE DAVIS-BOURNONVILLE CUTTING TORCHES

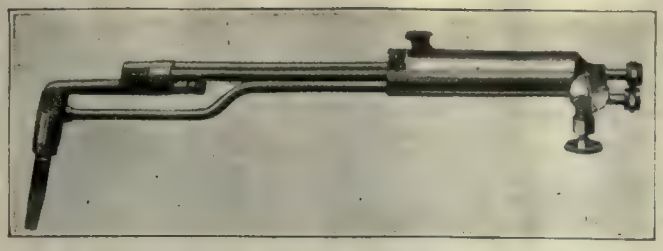


FIG. 134. THE OXWELD CUTTING TORCH WITH A RIVET HEAD-CUTTING NOZZLE

the first torch described, except it is intended for use with oxy-hydrogen. Torch *C* (No. 471) is a circle cutting torch fitted with a 15-in. radius rod adjustable for various sizes of circles. It uses either oxy-acetylene or oxy-hydrogen for heating, and takes all standard size tips. It is the standard torch for nicking billets for breaking. It may be had fitted with special adjustable

TABLE XVI. GAS PRESSURES USED WITH THE DAVIS-BOURNONVILLE STYLE C CUTTING TORCHES, USING STYLE 12 TIPS

Tip No.	Thickness of Metal Inches	Acetylene Pressure Lbs.	Oxygen Pressure Lbs.
1	1/8	3	10
1	3/16	3	15
1	1/4	3	20
1	5/16	3	20
2	1/4	3	10
2	1/2	3	20
2	3/4	3	30
2	1	3	35
3	1	4	30
3	1 1/2	4	40
3	2	4	50
3	3	4	60
4	3	5	60
4	4	5	70
4	5	5	85
4	6	5	100
5	6	6	90
5	7	6	100
5	8	6	125
5	10	8	150

holder, rack and pinion, for machine cutting. Torch *D*, No. 640, is a machine cutting torch for use with the different cutting machines made by the Davis company. It is fitted with an electric switch and shut-off valve which automatically starts the cutting-machine feed when the oxygen cutting jet is turned on, without the necessity of readjusting pressures or the heating flame. It uses all standard-size cutting tips and special Oxygraph and Radiagraph tips. A larger and heavier

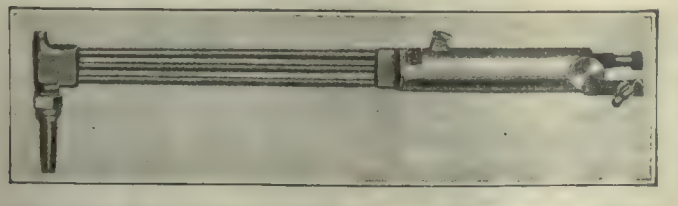


FIG. 135. THE OXWELD CUTTING TORCH FOR SHIP WORK

torch of similar design and construction for oxy-hydrogen machine work is shown at *E*. This is known as No. 1314. Larger sizes, or special torches used for cutting, are water-cooled. Tips of various styles, for different purposes, which may be used with the torches mentioned, are shown in Fig. 131.

The approximate oxygen and acetylene pressures used in the Davis style C cutting torches, using style No. 12 tips, are given in Table XVI. As in welding, these pressures are only general guides for the make of torch mentioned, and the skilled operator usually adjusts his flame regardless of the tables given, since a neutral heating flame is essential at all times for satisfactory results.

An Oxweld low-pressure or injector type of cutting

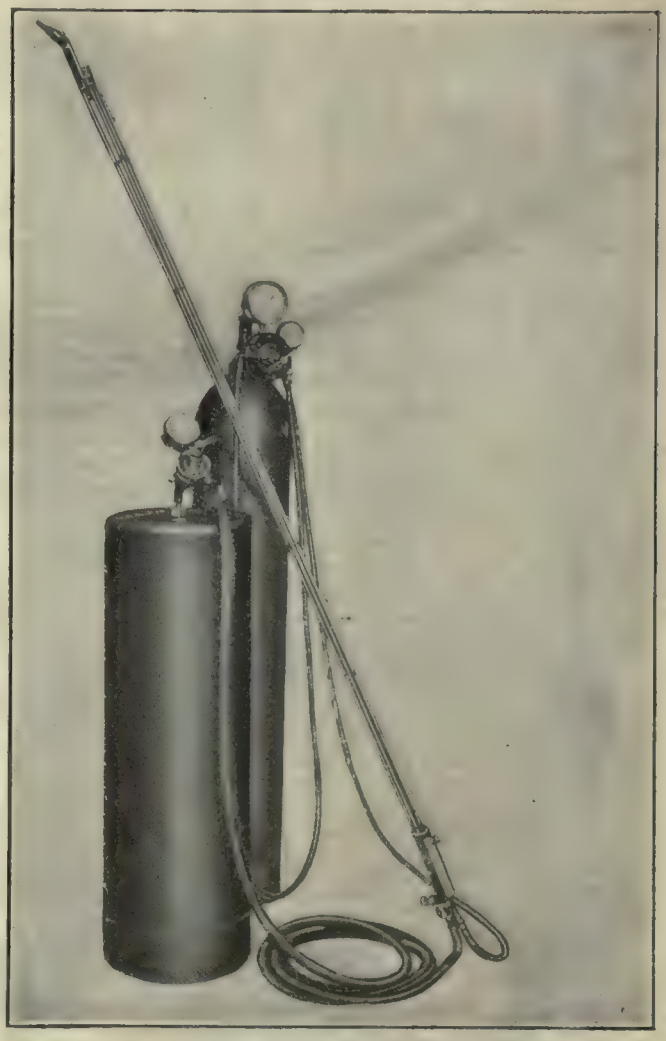


FIG. 136. THE OXWELD STAYBOLT CUTTING-TORCH

torch is shown in Fig. 132. This is their model B. Details are shown in Fig. 133. In this torch, the cutting jet is entirely surrounded by the preheating flame, as the oxy-acetylene is delivered through six openings arranged in a circle around the orifice for the oxygen jet. This arrangement makes it possible for the preheating flame to always precede the cutting jet, no matter in what position the torch is held, or in whatever direction the cut is made, be it horizontal, transverse, circular, elliptical, toward or away from the operator. In so working, the operator does not have to shift his position or turn the torch. This is especially valuable in wrecking steel structures, removing risers

TABLE XVII. OXWELD CUTTING DATA

Thickness of Metal In.	Size of Internal Nozzle	Oxygen Pressure Lb./Sq. In.	Per Hour: Speed: Machine Lin. Ft.	Per Hour: Speed: Hand Lin. Ft.	Per Hour: Gas Consumption: Oxygen Cu. Ft.	Per Hour: Gas Consumption: Acetylene Cu. Ft.	Per Linear Foot: Gas Consumption: Oxygen Cu. Ft.	Per Linear Foot: Gas Consumption: Acetylene Cu.Ft.
⅛	No. 1	10	120	90	28	7.8	0.31	0.09
¼		15	93	74	37	11.3	0.50	0.15
⅜		20	81	62	48	14.2	0.67	0.23
½		25	73	55	58	16.3	1.05	0.30
¾		30	63	46	80	19.7	1.74	0.43
1		35	57	40	100	22.0	2.50	0.55
1¼	No. 2	35	53	36	120	23.6	3.33	0.66
1½		40	50	33	141	25.3	4.27	0.77
2		45	46	29	184	27.7	6.34	0.96
3		55	41	24	268	31.9	11.2	1.33
4	No. 3	65	36	20	352	35.6	17.6	1.78
5		75	32	17	436	38.8	25.7	2.28
6		85	29	15	522	41.5	34.8	2.76
8	No. 4	95	23	11	698	46.2	63 4	4.2
10		115	18	8	880	50.3	110.0	6.3
12		135	15	6	1080	53.9	180.0	9.0
14		155	12		1290	57.3		
16		175	10		1520	60.4		
	Rivet Nozzle	40			240	25.0		

from steel castings, or cutting steel scrap, especially where places difficult of access are encountered. The preheating flame is produced in practically the same way as in the welding torch previously shown.

There is a separate valve for controlling the oxygen to the preheater, which enables the operator to secure close adjustment and avoid waste of gas. The oxygen-jet valve is of the plunger type, which is so constructed that its movement produces no tendency to deflect the cutting jet from the line of the cut. The location of the valve lever is on top of the handle and its motion is in the direction of the vertical center plane of the torch. The valve is held open for continuous cutting, when desired, by a simple but effective button-like latch, which may be instantly engaged or released by a slight movement of the thumb. The external nozzle is furnished with a copper tip. The internal nozzle is held in place by tightening the external nozzle. To remove the former it is only necessary to unscrew the external nozzle. This torch is regularly furnished with four interchangeable tips, for cutting up to 1 in.; from 1 to 3 in.; from 3 to 6 in.; and from 6 in. up.

A model-B torch fitted with a specia' rivet-head cutting nozzle is shown in Fig. 134. Another form, known as model C-6, is shown in Fig. 135. This was made to meet the demand for a light, rugged and adaptable cutting torch for work on double bottoms and below decks of ships. In general, it closely resembles the other models. It weighs 2¾ lb. and is 20 in. overall.

For cutting inner and outer shells of locomotive fireboxes, where length and slenderness is necessary, the staybolt cutting torch shown in Fig. 136 has been

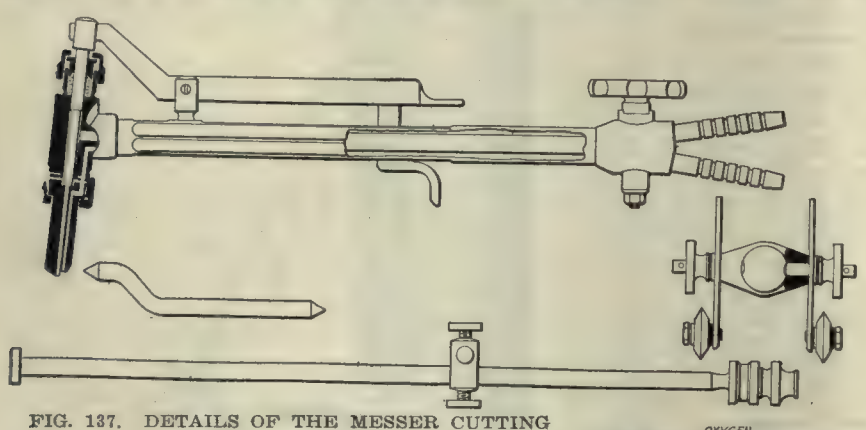


FIG. 137. DETAILS OF THE MESSER CUTTING TOOL

TABLE XVIII. CUTTING STEEL RISERS WITH THE GENERAL WELDING AND EQUIPMENT CO. TORCHES

TEST NO.	SHAPE OF CUT	NUMBER OF CUTS MADE	TOTAL SQUARE INCHES CUT	TOTAL OXYGEN CONSUMPTION, CU. FT.	SQUARE INCHES CUT PER CU. FT. OXYGEN	SQUARE INCHES CUT PER MINUTE	TIME, MINUTES
1	Different shapes, 1 in. to 5 in. thick	40	615	248	2.84	—	—
2a	Wheel rim 1⅜ in.	10	94.5	8	11.8	22.5	4.17
2b	to 2½ in. thick	10	100.6	10.4	9.67	18.3	5.5
3	6½ in. x 8 in.	1	52	14	3.7	27.1	1.92
4	5 in. x 10 in.	1	50	18	2.78	20	1.5
5	5½ in. x 15½ in.	1	85.25	34	2.5	22.8	3.75
6	5½ in. x 15½ in.	1	85.25	28	3.04	26.2	3.25
7	5½ in. x 16½ in.	1	90.75	32	2.84	27.9	3.25
8	11 in. x 11 in.	2	242	112	2.16	—	—
9	6 in. diameter	4	113	46	2.48	11.3	10.00
10	15 " "	1	177	162	1.1	12.6	14.00
11	16 " "	1	200	200	1.0	14.3	14.00
12	18 " "	1	254	250	1.0	15.9	16.00
13	20 " "	1	314	300	1.05	17.3	18.00

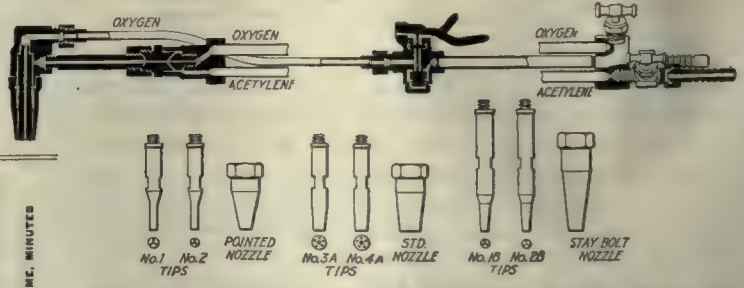


FIG. 138. DETAILS OF THE CUTTING TORCH MADE BY THE GENERAL WELDING AND EQUIPMENT CO.

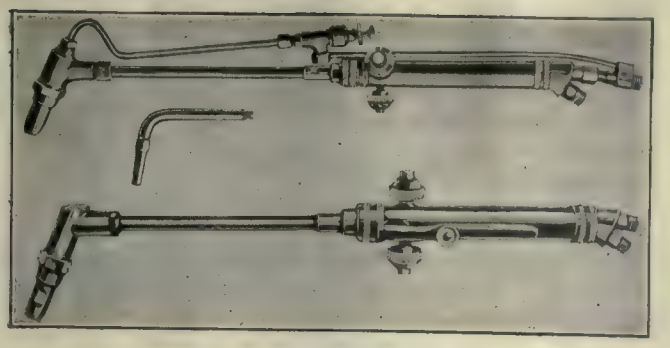


FIG. 139. THE IMPERIAL CUTTING TORCHES

made. This is, however, merely a special form of the model B. The long "stem" is made up of three gas tubes as shown. This torch is regularly furnished in 42, 54, 69 and 84 in. lengths to suit the needs of the user. The 84-in. torch weighs 6¼ lb. The head is set at an angle of 20 deg., which experience has shown is the more generally useful. All the regular nozzles can be used with this torch.

In addition to the torches mentioned, the Oxweld Acetylene Co. makes straight-tipped machine cutting torches, which may be used on any of the cutting ma-

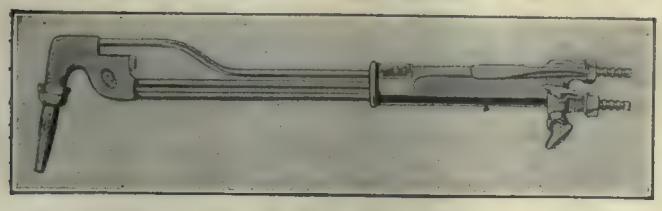


FIG. 140. CARBO-HYDROGEN MODEL C CUTTING TORCH

chines on the market. Like all other cutting torches, small guide wheels may be used for steadying the torch when cutting to straight, irregular or circular lines by hand.

In Table XVII are given the oxygen pressures and amount of gas consumption for various thicknesses of

TABLE XIX. PRESSURES FOR OXY-HYDROGEN CUTTING WITH IMPERIAL TORCHES

Cutting Tip	Thickness of Wrought Iron or Steel to be Cut, In.	Pressures	
		Oxygen, Lb.	Hydrogen, Lb.
1H	¼ to 2	30 to 40	5 to 10
2H	2 to 4	50 to 70	10 to 15
3H	4 to 6	80 to 100	15 to 20
4H	6 to 9	100 to 125	20 to 25
5H	9 to 12	125 to 150	25 to 30

These figures represent minimum and maximum pressures. For intermediate thicknesses, use pressures in proportion.

metal. The acetylene pressure is the same as for welding, 1 lb. With the data given in this table, and knowing the cost of acetylene and oxygen, the approximate cost of gas for any given job may be calculated with a fair amount of accuracy and serve as a basis for price estimates. It must be kept in mind that old rusty metal, like boiler plate, will take much more gas than will clean metal.



FIG. 141. CARBO-HYDROGEN MODEL B CUTTING TORCH

In order to give the reader an idea of the construction of some of the other well-known cutting torches, a few will be shown. Fig. 137 shows details of a cutting torch made by the Messer Manufacturing Co., Philadelphia. This type of torch will use either medium or low-pressure acetylene, as it works on the injector principle which is independent of the acetylene pressure. The oxygen jet is operated by means of the lever shown on top. The wheel guides are adjustable so that the tip may be kept the proper distance from the work.

The construction of the cutting torch made by the General Welding and Equipment Co., Boston, Mass., is shown in Fig. 138. The valve lever for the cutting

TABLE XX. PRESSURES WHEN USING THREE-WAY GAS SYSTEM

Cutting Tip, No.	Thickness of Steel or Wrought Iron to be Cut, In.	Pressures		
		Oxygen, Lb.	Acetylene, Lb.	Hydrogen, Lb.
1T	¼ to 2	30 to 40	5	5 to 10
2T	2 to 4	50 to 70	5	10 to 15
3T	4 to 6	80 to 100	10	15 to 20
4T	6 to 9	100 to 125	10	20 to 25
5T	9 to 12 and over	125 to 150	15	25 to 30

jet has a lock that is easily manipulated with the thumb. This torch will use either medium- or low-pressure acetylene, and like the other torches, will use either acetylene or hydrogen with the oxygen. The parts are easily changed when necessary. The head is fastened to the mixing chamber by means of a ground-joint swivel and loose-nut coupling. The swivel is brazed into the head so as to make a tight joint even under heat. The mixing chamber can be easily taken out and cleaned. The lever key is accessible from all sides and the seat can be replaced in a few minutes.

As has been previously mentioned, the consumption of the various gases for different work can be only approximately estimated beforehand, as so many elements

TABLE XXI. GAS CONSUMPTION AND PRESSURES WHEN USING OXY-CARBO-HYDROGEN CUTTING-TORCHES. THE CARBO-HYDROGEN PRESSURE IS ABOUT 5 LB. IN EACH CASE

Thickness of Steel in Inches	Size of Cutting Tip	Lineal Feet Cut per Hour by Hand	Pressure of Cutting Oxygen in Pounds	Cu. Ft. of Oxygen Used per Lineal Ft. of Cut	Cu. Ft. of Carbo-Hydrogen Used per Lineal Ft. of Cut
¼"	1-A	110	15	1	1
½"	2	90	25	1⅔	1
¾"	2	75	32	2⅓	1½
1"	2	60	35	3	1½
1½"	3	45	45	4⅔	2½
2"	3	38	50	7	3½
3"	3	28	60	14	6
4"	3-A	18	75	26	9
5"	4	13	85	32	12
6"	4	11	100	40	13
7"	5	8	120	50	13
8"	5-A	7	140	64	14
9"	5-A	6	160	78	16

Above pressures can be increased at times on various grades of steel advantage.

enter into the work. Even in cutting the same piece, if the cut is of any length, the gas consumption and time will often vary to a marked extent from different causes. Parts may be clean and others rusty. The operator's skill will vary as he is fresh or tired, and many other reasons may enter into the calculations. However, tabulations of specific results may often be of considerable value. Those already given have been for average conditions, and are believed to be as near correct as it is possible to get them. The company making the torch last mentioned has made some calculations regarding the time taken to cut clean metal, which will be of interest. On ½-in. steel, the time for cutting 1 ft. with a regular machine cutting tip, was

0.67 min. and by hand, 0.90 min.; for 1-in. steel, 1.25 and 1.50 min. respectively; for 2 in., 1.40 and 1.60 min.; for 4 in., 1.50 and 2.00 min.; for 6 in., 3.00 and 4.00 min. and for 8 in., 3.25 and 4.50 minutes.

An 8-in. steel shaft was cut through in 3 min., using 14 cu.ft. of oxygen; an 18-in. shaft was cut in 16 min. with 250 cu.ft. of oxygen; a 20-in. shaft in

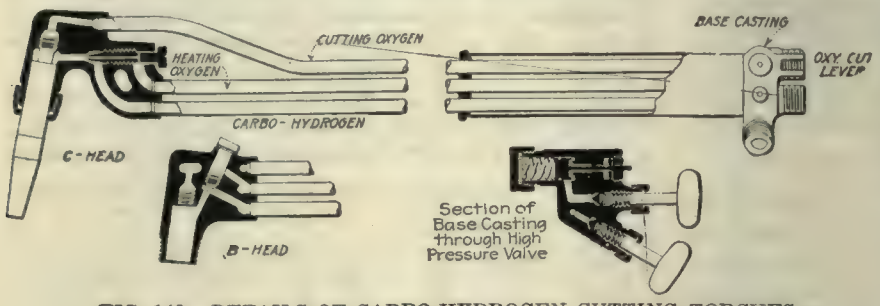


FIG. 142. DETAILS OF CARBO-HYDROGEN CUTTING TORCHES

18 min. and 300 cu.ft. of oxygen. For the last two, oxy-hydrogen was used.

The cutting of steel risers and shafts, under what is claimed to be average conditions, is tabulated as shown in Table XVIII. The tests are classified as follows:

Test No. 1 comprises ordinary work as it came along. Risers were not clean and especially the smaller risers had sand and holes in the core. The oxygen consumption contains all the waste changing from one piece to another.

Test No. 2a was made on clean metal with oxy-acetylene and with a special pointed tip.

Test No. 2b was the same as No. 2a but cut with oxy-hydrogen, a regular tip being used.

Test No. 3 was made on a very clean riser. The operator could rest his hand very comfortably. The cut looked as if it was done by machine.

Tests Nos. 4-7. Cuts were made on risers of a 20-ft. flywheel.

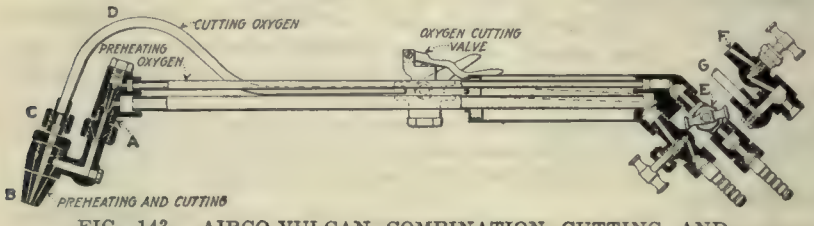


FIG. 143. AIRCO-VULCAN COMBINATION CUTTING AND WELDING TORCH

Cleaning was only superficially done and operator was in a fair, but not ideal position. One riser showed a large blow-hole. The cuts were clean through.

Test No. 8. Two cuts were made on the same flywheel. Risers were well cleaned, but the cranes could not be spared to bring the face of the risers into a horizontal line. They had to be cut diagonally and the operator had to bend so far over that with the first riser he lost his balance and fell and had to interrupt the operation, therefore, no time was taken. The maximum thickness of the cut was 13 in. The cuts were clean through.

Tests No. 9-13. Cuts were made on risers of circular shape. The number of sq.in. cut per cu.ft. of oxygen is in the average lower than with rectangular shapes, as it is too cumbersome to regulate the oxygen pressure according to the varying thickness. It does not pay to start with lower pressure at the beginning and increase it the more the cutter is nearing the center or full thickness of the metal. Moreover, the cuts were made with a two-line cutting torch so that the preheating flames would have suffered with regulating the oxygen pressure in such wide limits. With the heavier cuts of 15 in., 16 in., 18 in. and 20 in. thickness, the principal consideration was to cut through rather than to get stuck, and not look too close to the oxygen consumption.

The Imperial Brass Manufacturing Co., Chicago, makes the cutting torches shown in Fig. 139. These are of the positive-pressure type. *A* is a combination cutting and welding torch, the oxygen pipe and tip being detachable, so that the curve tip may be put on when the torch is wanted for welding. *B* is a cutting torch only. Either may be used for oxy-acetylene or for oxy-hydrogen. When using oxy-hydrogen, the respective pressures are given in Table XIX.

The torches may also be used for the company's three-way gas system, which uses a combination of acetylene, hydrogen and oxygen, as explained under welding torches. The acetylene and hydrogen are mixed through a Y-valve and enter the torch through the same hose. Pressures when the gases are used in this way are shown in Table XX.

The Carbo-Hydrogen Co., Pittsburgh, Penn., makes two models of the injector-type hand cutting torches, shown in Figs. 140 and 141, and in detail in Fig. 142. They also make straight-nozzle machine torches. Mechanical guides, or wheels, may be had for attaching to the regular hand models, or to the straight-nozzle torches. Tips are furnished in a number of interchangeable sizes and shapes. They are made from a solid brass bar, with an outer shell of copper solidly attached with rivets. The preheating holes are arranged closely around the cutting orifice so that the flame cones do not have a tendency to melt edges of the cut. It is claimed that the tips remain cool and do not have to be dipped in water to keep them cool when used for long periods. The regular sizes of the tips are arranged for cutting from the thinnest metals up to 18 in. in thickness, or more with special tips. The head and base castings of the torches are of Tobin bronze and the tubes are of seamless drawn steel, surrounded by an aluminum or a fiber handle. A special swivel-point valve stem, instead of the usual solid needle point, is used for controlling the combustion gas. All parts are easily removed for cleaning, and the injector may be taken out with a pair of pliers. These torches are designed for use with oxy-carbo-hydrogen gas. Carbo-hydrogen is a fixed gas, permanent under all weather conditions. Since it does not solidify there is said to be no residue left in the tanks or cylinders at any time. It is clean, easy to use, and safe, since it is combustible but not explosive within itself. It is a product of the destructive distillation of suitable hydro-carbons, and has a general analysis of 85 per cent. hydrogen and 15 per cent. light hydrocarbons. It is claimed that this gas has no tendency to harden the surface of the metal being cut. It is not a sensitive gas, and backfiring is rare. It is marketed in steel cylinders under 1800 lb. pressure and of about the usual capacity. The pressure is reduced to from 5 to 10 lb. for working purposes, 5 lb. being the pressure usually employed.

In Table XXI are shown the approximate number of feet cut per hour, the pressure of the oxygen and the amounts of the gases used per lineal foot of cut. The carbo-hydrogen pressure is 5 lb. in each case.

Several companies make combination welding and cutting torches. These usually consist of a cutting attachment for the welding torch. As a commercial proposition, such combinations are not to be recommended, but where an operator occasionally has to shift quickly from welding to cutting, they may sometimes be used to advantage. Along with their regular lines of welding- and cutting-torches, the Air Reduction Sales Co., N. Y., put out the combination torch shown in detail in Fig. 143. This is known as the Airco-Vulcan cutting and welding torch, and it well illustrates the general principles of this kind of a torch. The main

body is that of the regular Airco-Vulcan welding torch. The regular welding tip is removed from *A* to receive the connection of the special tip *B*. This tip is connected at *C* to the high-pressure oxygen tube *D*. A combination valve is screwed into the torch body at *E* in place of the single oxygen valve used for welding. This valve has a passage at *F* for the preheating oxygen and one at *G* for the cutting oxygen that goes out through *D*. The preheating flame surrounds the cutting jet as in other regular cutting torches, so that an operator may cut circles or angles without altering the direction of the torch body to any extent.

Meeting the Reconstruction Period With a Depleted Staff

BY JAMES LESLIE LANE

WITH hostilities at an end, and himself free to take up the production and marketing of his goods once more, the average manufacturer finds himself in more or less of a quandary. The field looks good, for in many lines the supply during the past two years has been entirely inadequate to meet the demand, and probably the need for speedy and efficient output has never before been as insistent as it is today. Machinery and apparatus of every description have been worked to the point where they are practically worthless and must be replaced at once if the business of the country is not to be impaired.

Despite this he may well wonder how, in the face of the sharp competition he is sure to meet abroad, he is to make headway during the reconstruction period. His tools and equipment are out of date and, for the most part, so badly worn by the tremendous striving for war output as to be practically useless.

The war has for four years put a stop to immigration, and this source of new labor is apt to be more or less uncertain for some time to come, depending a great deal on what stand the different European nations take toward permitting their citizens to seek employment here. The army has taken a goodly number of their mechanics, their clerks, and men from their technical staffs: the younger blood on which they would have depended to carry the brunt of the work. They now find themselves with an organization far below the 1914 standard, since not all will come back and those that do will have lost from two to three years of industrial training. Clearly then, though the war is over, we are not to go back at once to pre-war conditions. Much more than autocracy has been overturned, and business methods of the future demand careful attention as well as the readjustment of European boundary lines.

The matter of sales is not as pressing as that of production, and the first question is how to attain this with the men and tools at hand. The manufacturer should not be content to leave this entirely to his foremen and designers, trusting to them to secure as good and efficient help as possible under the circumstances, unless he is willing to run the risk of being outdistanced by his competitors. Even in normal times it has been clearly recognized that for these two branches to function properly there should be a broad-minded and tactful executive to act as intermediary between them, and it is doubly so today. Both foreman and designer are human and sometimes hesitate before advancing new ideas or making suggestions, each for fear of antagonizing the other. They realize that a certain amount of jealousy and distrust always exists between the designing office and the shop, and there is a tendency to keep their ideas to themselves rather than risk stirring up trouble. This reticence, if the employer is tactful and fair, can in nearly every case be overcome and the business will profit by many new methods and short cuts that would not otherwise become available.

Unfortunately this condition of mutual distrust between office and shop is likely to be more acute than ever at the present time. The average foreman has been used to doing big things during the past two years. Work has been turned out with makeshift machinery and methods hitherto unknown because of the urgent demand for production. The war conditions have developed new practices and the shop man is apt to feel that the office is out of date, and is more than ever inclined to resent any suggestions from that source. On the other hand, the soldier returned to civil life is quick to realize that much new knowledge has passed him by. He hesitates to make suggestions for fear of being ridiculed and is more than ever inclined to play safe and stick to the antiquated methods with which he is familiar. Clearly then, if headway is to be made, it is up to the owner or manager to act as an intermediary in reconciling the opposed elements and bringing forward new ideas.

Even in normal times the manufacturer has probably experienced more or less trouble by reason of costly and ill-considered design. Parts could have been so made that patterns would have been less expensive, intricate machine work avoided, and the work accomplished with tools and machinery at hand. Again specifications would call for special material when standard stock might be utilized to advantage. "If all this trouble arose when times were normal," the owner is likely to ask, "what will happen under the new and changed conditions?"

No hand was ever played less well for knowing what was in it, and it is best at the outset to look matters squarely in the face, to realize that for the present at least the standard of efficiency will not be as high as it has been. If the productive capacity of the shop is not to be lowered, help must be extended where necessary and the deficiency made up.

Instead of leaving the designing office to its own devices the owner will, if far sighted, adopt some plan whereby the designer may profit by the practical knowledge of the shop before plans have left the drawing board.

As soon as a general layout has been prepared in pencil, a half-dozen photostat copies should be made and distributed among the shop departments with a printed form attached explaining that the design is

merely a tentative one, to be looked over for criticism or suggestion before finishing. Each department head who may be called upon later to make some part of the product should receive a copy with instructions to return it with his approval or suggestions noted thereon.

The wording of the form should receive careful attention, for it may determine the success or failure of the venture. Each department head should feel that the request for suggestions is genuine and that the slip is not attached as a matter of formality or shop routine. It should be so tactfully expressed that he will not feel that he is criticizing the designer's finished product but rather making helpful and time-saving suggestions while the design is in its formative stage. If he is put at his ease in this respect and does not feel that he is stepping on any one's toes, the chances are ten to one that he will cut loose as he would not have done had the draftsman asked him personally for his opinion on the matter. The man at the board should be made to understand clearly that the object of this is to help him in his work rather than to criticize his methods.

When the photostats are returned to him he is free to give his whole time and attention to the subject, safe in the knowledge that no one is going to pounce upon him later. In the end this way of handling things will not only avoid costly practices and mistakes but it will lead both shop and technical man to a better appreciation of each other's abilities.

Where possible the method should be extended to the pattern shop and foundry as well. If they are under one management this is, of course, a simple matter but where they are not, suitable arrangements can generally be made with some company receiving the bulk of this work. As each is saved annoyance and delay later, the small amount of time spent in looking over the other's work is negligible when the gain is considered. In most cases the arrangement can be made reciprocal and will not involve any additional cost for either. In cases where this plan is not feasible the trifling cost of engaging a master patternmaker or molder to look over the projected designs at home will prove a good investment when the final cost is considered.

In this way the draftsman will in a short time gather a lot of information that he would not otherwise get if left to go into the shop on his own account where he would feel that he was "butting in."

It is a good plan to have a complete set of data made up, showing the capabilities of every tool in the shop. Let it give in a concise way the capacity of each machine, the size hole it will drill or punch, the over-all dimensions of the work it will take, its speed and the number of square feet of floor space it occupies; also whether it is new or old and how close it will work; whether it is fit for close operations or only adapted to coarse work; the approximate cost of operating it per hour; everything in short that will enable the designer not only to design a part correctly from a mechanical standpoint, but to plan it so that it can be made entirely in the shop with the tools at hand and at a minimum of expense. Thus armed with a clear knowledge of costs and machine capacities the owner will soon find the designer proportioning the parts so that should the occasion require the work can be split up among various tools instead of being handled on only one machine while others stand idle. He will in short find him working with shop conditions in mind, with something more than just the mere detailing and drawing end in view. He will be looking ahead and saving dollars.

Nor should this stop here. The staff should be provided with technical literature on welding, cutting, machinery, etc., and be encouraged to read it. They should be encouraged to keep abreast of the times and gather ideas from outside sources. Above all, they should be encouraged to talk over new ideas with the owner. Some of these ideas may be of little value at first, but however trivial they may appear they should be recognized. Instead of a curt rejection, in case of an impractical idea, the designer should be told exactly why it cannot be adopted, and the next time instead of drawing back into his shell he will come along with something better. A little frank talk and encouragement will do wonders.

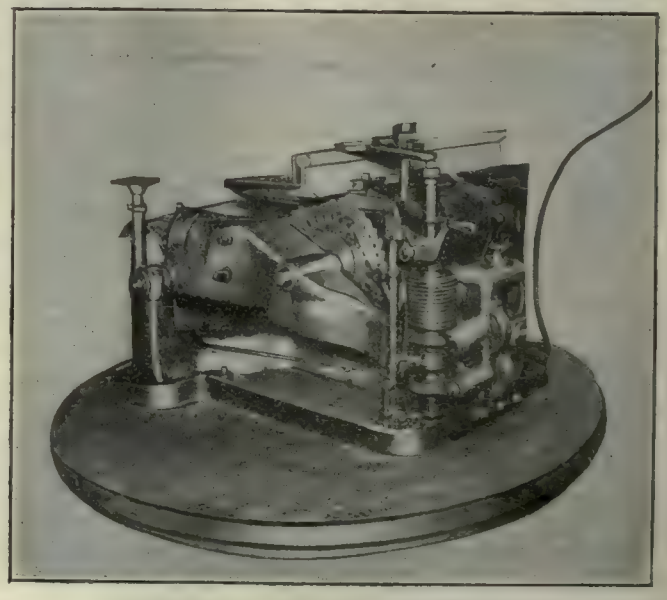
Thus far we have only considered the effect of such a policy on the draftsman. How will it affect the shop man? The management is interested not alone in good design but in the speedy execution of it afterward, and it is a well-known psychological fact that to make a man do his best work you must first make him interested. We are all human and especially interested in seeing the working out of something that incorporates a few of our own ideas, and the very fact that a foreman or machinist has been consulted in advance will secure his coöperation much more effectively than simply handing him a set of the completed drawings and leaving him, without any previous thought on the subject, to devise his own ways and means of doing the work, especially when these plans do not conform to his idea of good practice and are badly suited to the tools he has at hand.

A Cutting-Off Machine Mounted on a Turntable

By J. J. McIntyre

A firm in Newark, N. J., having to do considerable work on railroad rails, cutting angles, etc., and being somewhat cramped for room, mounted a Lea-Simplex cutting-off saw on a turntable as shown in the cut. The table can be clamped at any point in the circle.

In making frogs and switches for railroads the rails have to be cut at an angle, hence the advantage of arranging the position of the saw to accommodate the long rails in a machine shop which has very little available floor space.



LEA-SIMPLEX SAW ON A TURNTABLE

US ARMY ORDNANCE NEWS

Manufacturing the 9.2-In. Howitzer Shell—III

By S. A. HAND
Associate Editor *American Machinist*

This article, the last of the series, covers washing, fitting and riveting the base plug, varnishing, baking and the final inspection both by the shop and Government inspectors. It will be noted that the shells do not undergo any heat-treatment, hydraulic or volumetric test and that no adapters, fuse timers, fuse cups, boosters or booster cases are supplied at this plant.

IN FITTING the base plug the shell is held vertically in a floor vise of special construction, as shown in Fig. 28. Details of the vise are shown in Fig. 29. The nose of the shell rests at *A*, which is provided with a copper lining to protect that part from injury. The upper part of the vise is semicircular in shape and is provided with a clamp pivoted at *B* and fastened or released by the swinging screw *C* pivoted at *D*, and the lever-operated nut *E*. Both the stationary jaw and the clamp are lined with leather, which gives a better grip on the shell and prevents the surface from being marred.

The vise is mounted on a concrete foundation and on the front of the base is a semicircular platform of wooden blocks set on end to prevent injury to the shell as it is dropped when released. In Fig. 28 the rope grommet referred to in the previous article may be seen on the shell in the foreground.



FIG. 28. FLOOR VISE

The screw threads of both the shell and the base plug are air-blasted to remove the dirt and oil, and the base plug is turned upside down and the flange tried in the shell counterbore to test the fit. Part of the first thread, which is more or less out of shape due to the machining operations and handling, is cut off with hammer and chisel. Part of the first thread in the shell is also removed, but with a hand scraper shaped like a small hoe. The fitter then paints the shoulder of the shell counterbore with a light coat of liberty (prussian) blue, enters the plug and screws it halfway down. At this point the shop inspector tests the thread fit by grasping the plug with both hands and shaking it. If the fit is passed the plug is screwed home with the wrench *F*, which is provided with two pins *G* fitting into the holes *H*. After screwing the plug home by hand the wrench is struck several blows with a sledge, to firmly seat the plug. The shop inspector then taps the plug all around with a hammer, keeping the fingers of his free hand on the joint. By this means he can tell whether the plug flange is in contact with and rests solidly on the shoulder of the shell counterbore. If it is all right the inspector puts a chisel mark across the joint to mark the home position of the plug when it is finally screwed into place. The plug is now unscrewed half way and the under side of the flange inspected. If it has been properly seated this part will be fully marked with blue from contact with the paint on the shoulder of the shell counterbore.

This fit is very essential, as the shell is not provided with any form of gas check and the close contact between these surfaces is solely relied upon to prevent possibility of flame from the propelling charge reaching the the explosive charge when fired from the gun.

The plug is now removed and with the shell is passed along to be weighed; the two together should weigh not less than 250 lb. nor more than 253 lb. However, if the weight should not be less than 247½ lb. the discrepancy may be made up by fitting an overweight plug, some of which are always kept in stock. As the shells with their plugs are never over weight no provision has been made for correcting an error in that direction. It would seem that weighing before fitting the plug would allow a plug of the proper weight to be selected and fitted in the first place and save the back-tracking and extra work necessary, but the reason given for not doing this is that the proportion of underweight shells is so small that it would not pay to disturb the routine.

ARMY ORDNANCE NEWS

After stamping the plug with the serial number of the shell to which it belongs the two are passed over to the washing department, where the threads of both are thoroughly scrubbed with a hot solution of Oakite to remove all dirt and grease. In addition to cleansing the thread on the shell its whole interior must be cleaned. This is necessary, as the explosive charge has

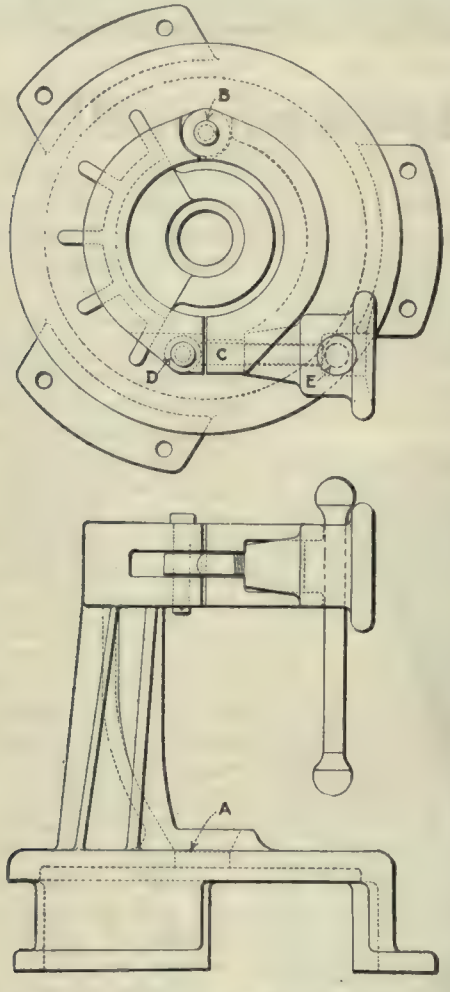


FIG. 29. DETAILS OF FLOOR VISE

a great affinity for oil and grease and would be rendered less stable by their presence.

The shell is rolled onto a cradle mounted on trunnions, which, after receiving the shell, is tipped up into a nearly vertical position as shown in Fig. 30. This brings the open base of the shell into a tank of hot Oakite solution, which is blown into the interior by a steam jet directly beneath the opening. A cap *A* loosely fitted and held in place by gravity covers the nose hole and deflects downward any hot solution escaping at that point, thus washing the exterior. After cleansing, the cradle is dropped back to a horizontal position and the shell is rolled onto an adjoining and similar cradle where the former operation is repeated except that water is used instead of cleansing solution.

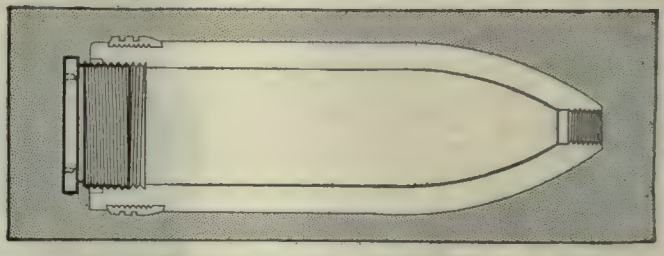
As all operations on the interior of the shell are finally inspected by gages before the base plug is put in to stay, it is necessary that it should be cooled after the hot washing and rinsing. For this purpose it is



FIG. 30. CRADLE FOR WASHING SHELLS

put under a cold-water spray coming from a series of pipes parallel with the shell length and arranged around half the diameter.

After cooling and gaging, the shell is put in a floor vise similar to the one used for fitting the base plug. The base plug is now screwed home, which position is indicated by the chisel mark on its flange coming fair with that on the shell base.



TRANSFORMATION FOR OPERATION 514—FIT BASE PLUG

Machine—Special floor vise. Number of operators—One. Cutting tools—Chisel and scraper. Production—Thirty per man in eight hours.

To prevent the possibility of moisture reaching the explosive charge this joint must be sealed. This is a riveting or calking operation and is done before removing the shell from the floor vise.

An air hammer provided with a ball-ended tool is used for this purpose in connection with a shouldered

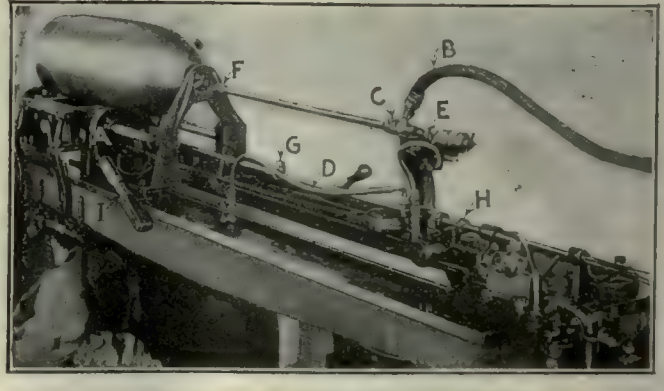


FIG. 31. VARNISHING MACHINE

ARMY ORDNANCE NEWS

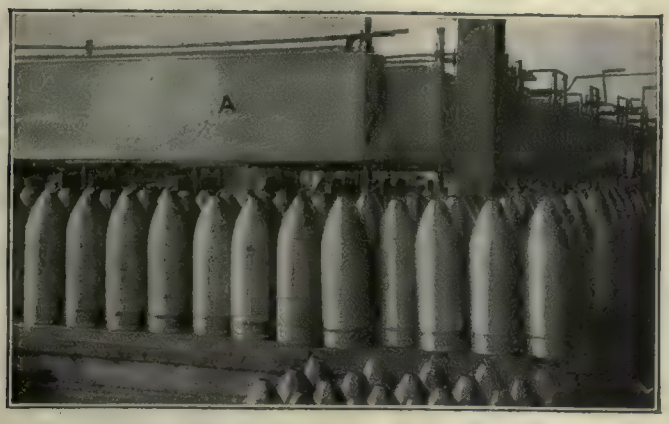


FIG. 32. ELECTRIC OVENS FOR BAKING THE VARNISH

ring that is put over the shell base and used as a guide for the calking tool. The hole in this guide ring is enough larger in diameter than the joint to allow the center of the calking tool to come directly over the joint when pressed against the interior wall of the ring. By

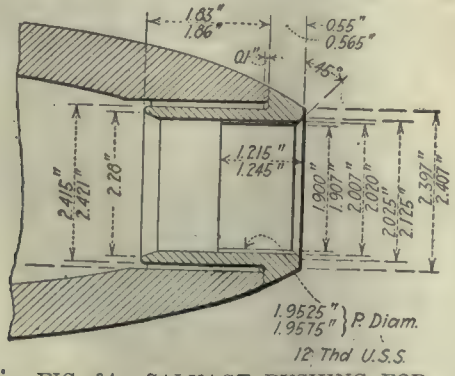


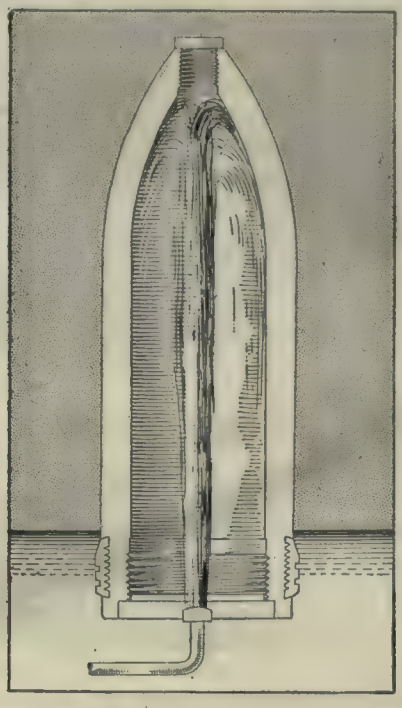
FIG. 34. SALVAGE BUSHING FOR SHELL NOSE

keeping the tool in this position and moving it around the interior of the ring the joint is thoroughly calked.

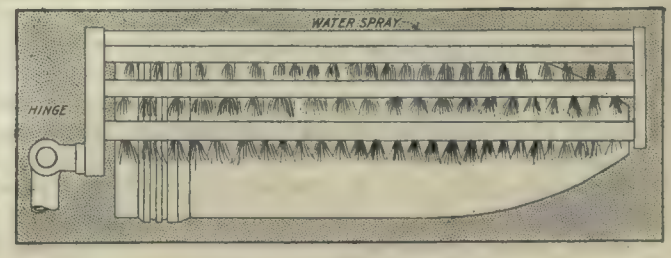
This operation is now subjected to Government inspection, and when passed the shell is stamped for size and class and also with the manufacturers name or initials. After final inspection by the shop it is varnished on the inside in a machine, Fig. 31, built especially for that purpose. The shell rests on four rollers, one of which may be seen at *A*, and is slowly revolved thereon by friction, power being supplied from a motor.

Varnish is conducted from an elevated tank through the flexible tube *B* to the ejector *C*, which is supplied with compressed air by the flexible tubes *D* and *E*. By the action of the ejector the varnish is emitted in the form of a spray through suitable perforations in the nozzle *F*.

In operation the nozzle *F* is passed into the rear of the shell through the hole in the nose, and the carriage, on which the spraying apparatus is mounted, striking the tappet *G*, opens the air and varnish valves, setting the spray in operation. When the spray is withdrawn



FIRST OPERATION



SECOND OPERATION

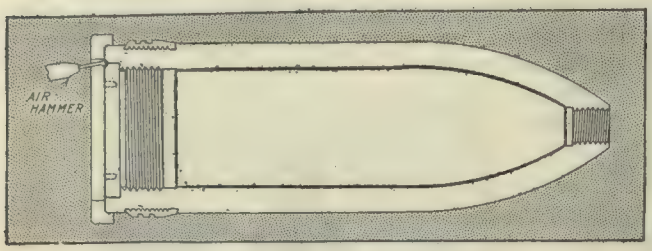
TRANSFORMATION FOR OPERATION 516—WASH

Machine—Special. Number of operators—One on machine and two on bench. Work-holding device—Cradle. Production—Four hundred and seventy-five per man in eight hours.



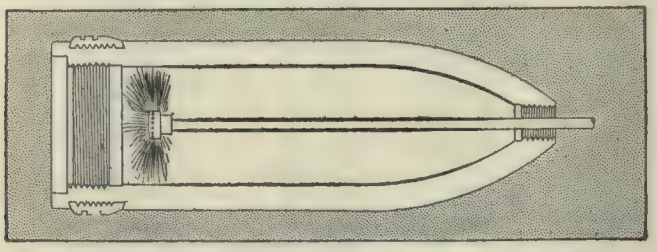
FIG. 33. THE BOND ROOM (GOVERNMENT INSPECTION)

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TRANSFORMATION FOR OPERATION 518—RIVET BASE PLUG

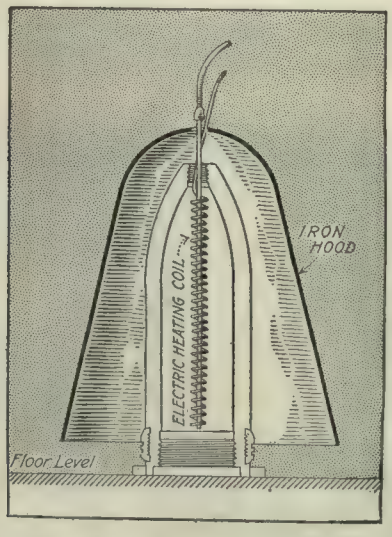
Machine—Air hammer. Number of operators—One. Work-holding device—Floor vise. Tool—Ball-pin riveting tool and air hammer. Special fixture—Ring fitting over base of shell to guide calking tool. Production—Four hundred and seventy-five per man in eight hours.



TRANSFORMATION FOR OPERATION 520—VARNISH INSIDE

Machine—De Vilbiss varnishing machine. Number of operators—One. Work-holding device—Rollers. Production—Four hundred and seventy-five per machine in eight hours.

the carriage strikes the tappet *H* just before the nozzle leaves the shell and closes both the air and varnish valves. It will thus be seen that the shell while slowly revolving is thoroughly coated with varnish on the inside and that the automatic closing of the valves prevents the wasting of varnish and the bespattering of objects. Upon removal of the spray a long-handled brush is inserted in the still revolving shell and moved back and forth once or twice to thoroughly spread and even the coat of varnish. Depressing the level *I* raises the shell from the rollers, and it is then rolled down a slight incline to the electric ovens shown in Fig. 32, of



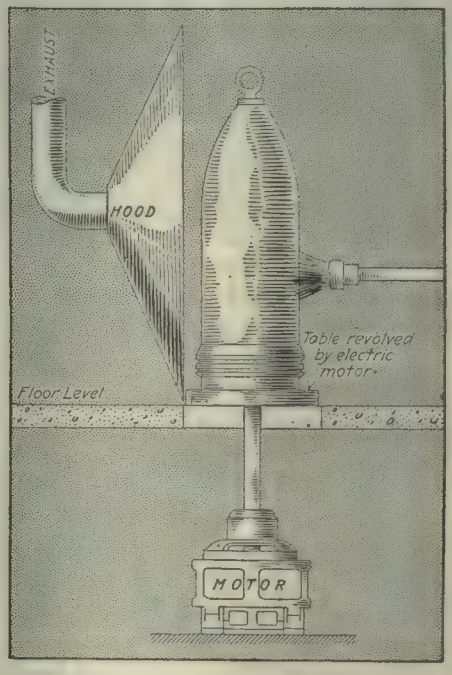
TRANSFORMATION FOR OPERATION 521—BAKE

Machine—Special electric bake oven. Electric-heating coil inside shell; one oven accommodates nine shells; 27 ovens in battery; bake for three hours. Production—Five hundred in eight hours.

which there are 27, each one taking care of nine shells that are stood on end in shallow locating cups.

Electric-heating coils inside the metal hoods *A*, and therefore invisible in the illustration, are lowered into the shells and the current turned on. The hoods cover the shells while being baked and prevent dissemination of the heat. Three hours are required to thoroughly dry the varnish.

After varnishing, the shells are ready for the final



TRANSFORMATION FOR OPERATION 524—VARNISH OUTSIDE

De Vilbiss hand spray—Revolving table at floor levels. Shellac varnish mixed with blue or lampblack. Production—One machine easily takes care of output.

Government inspection, which is done in a separate room known as the bond room. This inspection includes examination of the interior by an electric lamp to see that it has been thoroughly covered with varnish and that too much varnish has not been applied, check weighing, gaging all operations on the outside and a hammer

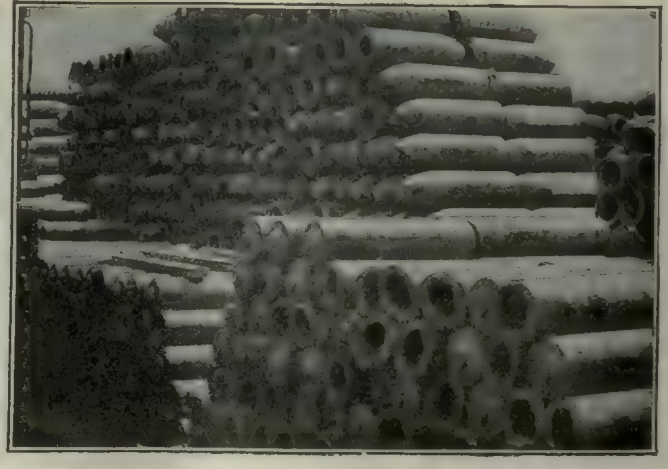


FIG. 35. A SMALL PERCENTAGE OF SHELL FORGINGS IN STOCK

ARMY ORDNANCE NEWS

test of both the base plug and the copper band to detect any looseness.

Several girls are engaged on this inspection, and when at work they stand in long pits so that as the shells are rolled along the floor they are at convenient height for inspection. After passing inspection a cast-iron plug with an eye in it is screwed into the nose. This acts as a stopper to keep out dirt and the eye can be used for hoisting.

The final operation is varnishing the shell on the outside and stenciling it for size and class. In varnishing, the shell is stood on end on a revolving table at the floor level, power being furnished by a motor below the floor. Lampblack or a blue pigment mixed with shellac is sprayed on the revolving shell by an air-operated spray moved by hand. Behind the revolving table is a large cone to catch any varnish that may miss the shell or be splashed from it. The cone

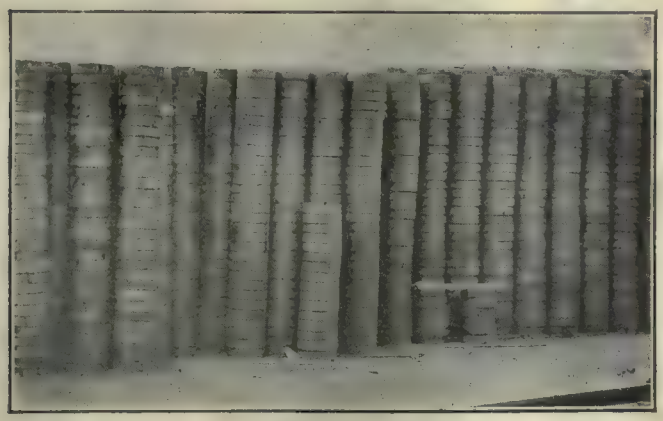


FIG. 37. ONE OF MANY PILES OF COPPER BANDS

is connected to an exhaust system which carries off the varnish fumes. The varnish dries almost immediately and the shell is then stenciled in yellow with its distinguishing marks.

This final operation has brought the shells close to a door outside of which a freight car stands ready to receive them. Its floor and that of the bond room (Fig. 33) are on the same level so that loading is a comparatively easy matter.

Two salvaging operations are allowed on shells that fail of inspection. First, if a copper band is loose or any work upon it has been improperly done the shell may be rebanded, in which case all operations that are done after the original banding must necessarily be repeated; second, if the nose of a shell is bored or tapped too large or if the hole in the nose should be in bad condition either before or after tapping it may be rebored and a bushing screwed in as in Fig. 34. In this case all operations on finishing the nose must be repeated and the end of the bushing finished to the proper profile.



FIG. 36. BASE-PLUG FORGINGS

To show the abundance of material kept ahead, three views in the yard are appended. Fig. 35 shows a small percentage of the shell forgings on hand; Fig. 36 shows some piles of base-plug forgings, and Fig. 37 shows one of the many piles of copper bands in the rough.

PERSONALS

Col. William P. Barba, who was appointed Major in August, 1917, and who has been on duty in the office of the Chief of Ordnance, has been discharged. Before entering the service, Colonel Barba had been with the Midvale Steel Co. for 37 years. His permanent address is 3107 Coulter St., Germantown, Philadelphia, Penn.

* * *

Lieut.-Col. Charles E. Warren of the Liberty National Bank, 60 East 42nd St., New York, who was transferred from the Q. M. C. as Major, in May, 1917, has returned to civil life. He is a graduate of the University of California.

* * *

Lieut.-Col. Eugene T. Savage, who was appointed Major in January, 1918, was discharged on his return from France recently. While with the A. E. F. he acted as Division Ordnance Officer. He attended Yale University and before entering the service was with T. R. Savage Co., Bangor, Me., where he lives. Colonel Savage will resume his former business.

* * *

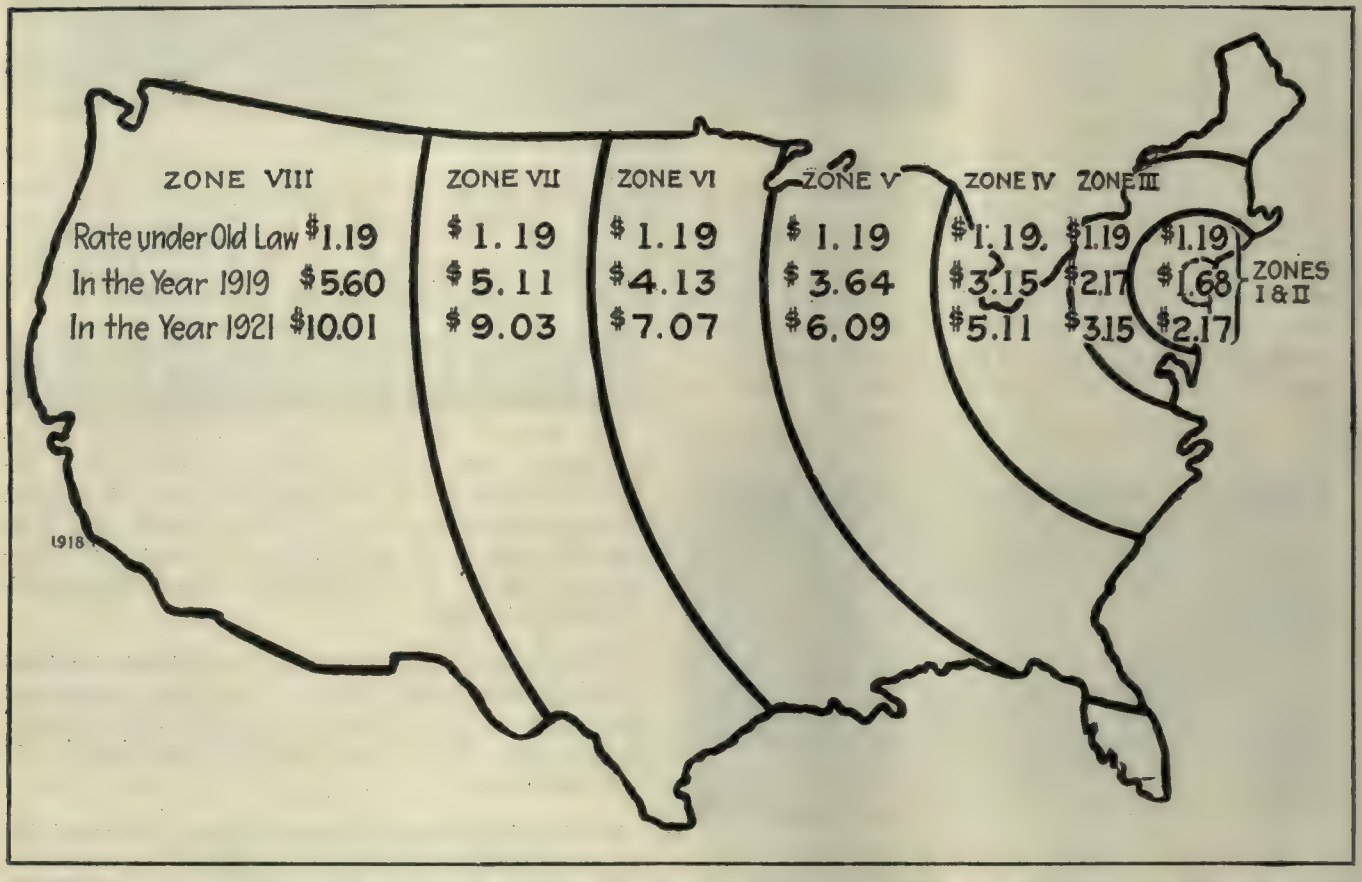
Lieut.-Col. L. H. Van Dusen, who was appointed Captain in June, 1917, has been discharged. He has been in charge of the Civilian Personnel Section. He is a graduate of Princeton University and University of Pennsylvania Law School. Previous to entering the service Colonel Van Dusen was a lawyer with the civil service commission, Philadelphia, Penn. His permanent address is 1012 Stephen Girard Bldg., Philadelphia.

* * *

Maj. George E. Carpenter, of Montpelier, Vt., has returned to civil life. Major Carpenter came into the Ordnance Department from the National Guard in November, 1917, and has served as Divisional Ordnance Officer with the 81st Division, A. E. F. He was formerly treasurer of Norwich University.

Where Do You Live?

This map shows the zones created by the Postal Zone Law and the postage to be paid on your copy of the *American Machinist*.



NOTE—For the year 1918 we paid the penalty postage. For the year 1919 we are billing our subscribers who live west of the Mississippi $1 extra to cover a part of the Zone Postage. There will be another increase in 1920 and still another in 1921. (See Map.) If the Zone Law is not repealed, we shall be compelled to readjust our subscription price so that the Subscriber will pay according to the Zone in which he lives.

Prior to this Zone Law all citizens had equal rights.
Why should not these rights be restored?

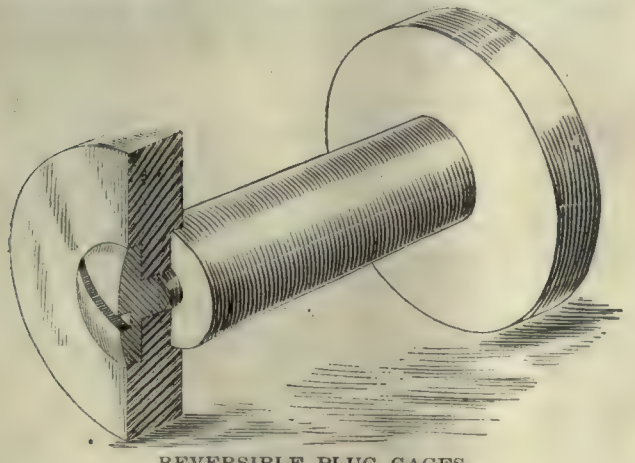
Ask your Congressman!



Renewable Plug Gages

By I. B. Rich

In order to decrease the cost of upkeep of plug gages, particularly those of such diameters as 1½ in. and over, the H. H. Franklin Co., Syracuse, N. Y., is making plug gages with removable heads as shown in the illustration. As the front end of the gage always



REVERSIBLE PLUG GAGES

wears first, it is an easy matter to reverse the gaging heads, these being designed especially for this purpose.

Each side of the gaging head is countersunk to fit the end of the handle, and the head of the screw which holds the handle in place is made of the same size so that they are easily reversible. Then when the front or entering end of the gage wears a trifle small, the head is simply reversed and the gage made usable for another period.

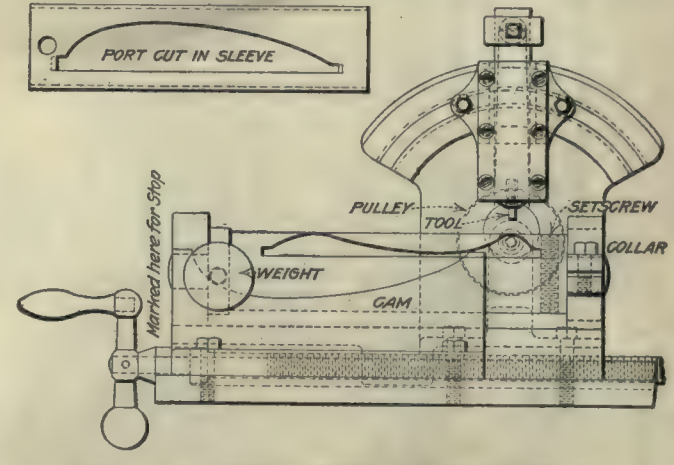
A Machine for Slotting Recoil Cylinders

By Charles Runzi

The accompanying cut shows a machine for cutting the peculiar-shaped slot in the recoil-cylinder sleeve shown in the upper left-hand corner. This port opening was held to a very close margin and as each sleeve was completed, the inspector would try his gage which had to fit the aperture. Two tools were used on this job; one, $\frac{3}{16}$ in. round by 1¼ in. long, and the other, a flat tool $\frac{1}{8}$ x $\frac{1}{4}$ by 1¼ in. long. The round tool was used to cut the curved part of the port and the flat one to cut the straight part.

The following is the method of operation: The tube or sleeve is put in a jig so as to drill an oil hole a certain distance from the end as shown in the cut, the same jig being used to drill another hole in the sleeve from which the tool commenced its cut. To place a sleeve on the arbor, the collar must be removed. When the sleeve is in place with the oil hole over the headless screw in the arbor, this screw is partly backed out. As this screw is somewhat larger than the oil hole and has a slight taper, it will lock the sleeve in position. The collar is then replaced and clamped in position by the capscrew as shown, and the carriage is moved to the left.

The cut is started at the hole which was put there for that purpose. The weight fastened to the arbor



RECOIL-CYLINDER SLEEVE AND MACHINE FOR SLOTTING IT

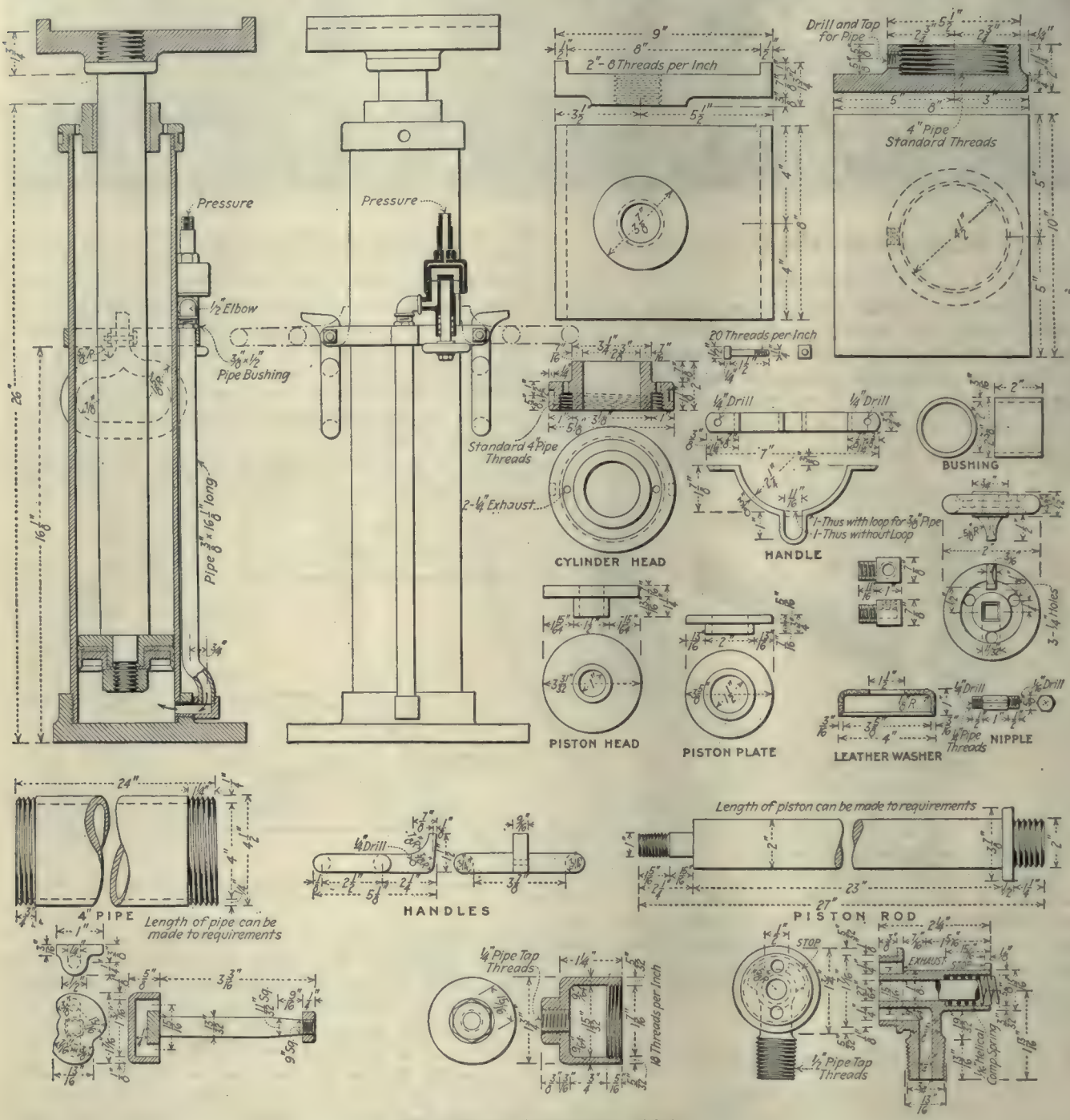
will cause the latter to follow the curve of the cam which determines the outline of the curved side of the slot. When the weight reaches its highest position, it is locked by tightening the capscrew. The round tool is replaced by the flat one and the straight part of the port is cut on the return movement of the table. The head which carries the ram may be thrown over at an angle to undercut the face of the port at the points indicated. As soon as a few of the sleeves were done, the machine was marked as shown in the drawing and the operator could then go ahead and turn out the parts almost as fast as he could turn the handle.

Pneumatic Jack for Locomotive Work

By J. Long

The pneumatic jack shown in detail in the drawing has been found to render valuable service in locomotive repairs. Its principal use is for putting in place the heavy pedestal caps which, owing to their weight and the difficulty of getting them into the position they occupy,

ordinarily require the services of two or three men to place them. These jacks are used in the pit, and to place a pedestal cap it is only necessary to put the cap on the top shoe of the jack, turn on the air and guide the cap to place. The cylinders are made of 4-in. extra-



DETAILS OF PNEUMATIC JACK

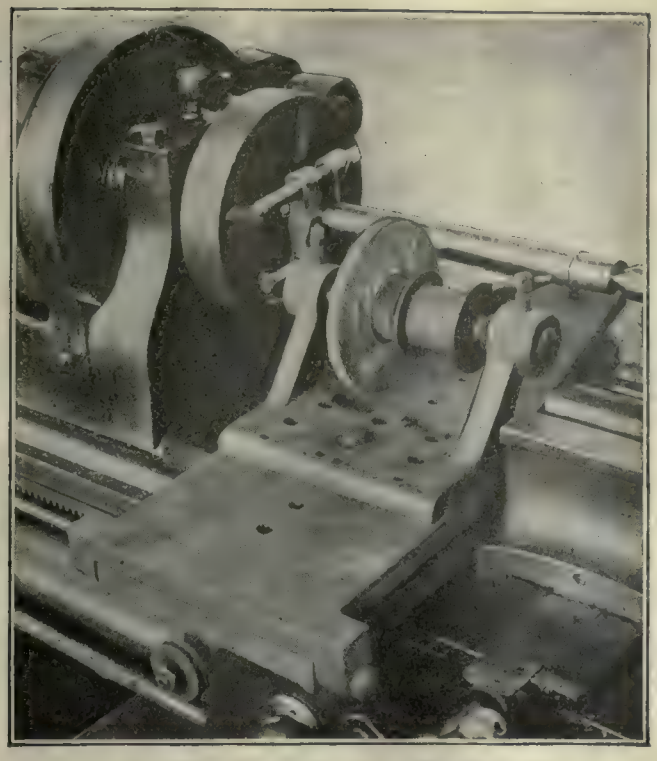
heavy wrought-iron pipe bored, and the piston is of axle steel and is fitted with a leather cup washer. The details are very clearly shown in the drawing.

A Patriarch Among Grinding Machines

BY JOHN DREW

The grinding attachment shown in the cut is not primarily a thing of beauty, and it may not remain a joy forever, but its claim to distinction is its long and useful existence. It is indeed the grandfather of grinding machinery, having been in service even before the universal grinding machine became a commercial factor. No one seems to know how old it is nor by whom it was built, but in the shop where it has its present domicile it is known to have been in use 35 years ago, and was to all appearances as old then as it is now.

It is not now in service but is posed for its portrait upon a comparatively youthful and vigorous lathe of the vintage of about 1880. The attachment bolts onto the wings of the lathe carriage, is provided with its own crossfeed and vertical adjustment, and the wheel bracket may be set in any desired position on the rise and fall plate. There is no provision, however, for grinding tapers except by the more or less good old method of shoving over the tailstock.



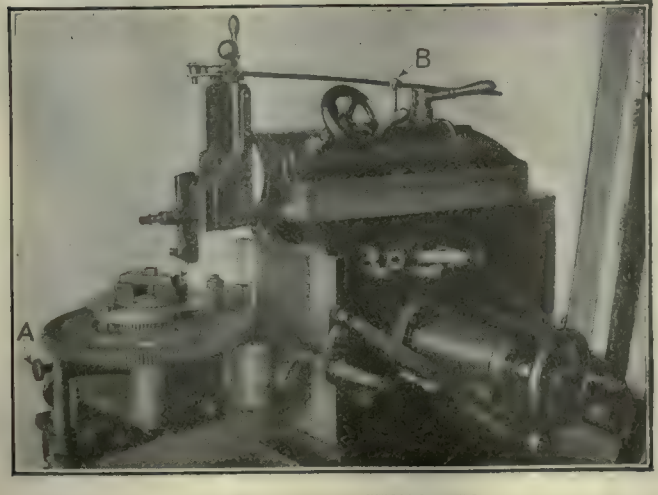
AN ANTIQUE GRINDING ATTACHMENT

The wheel arbor ran on conical points in wooden bearings contained in iron poppets that were adjustable endwise in their brackets. The wheel shown on the spindle is a present-day product, but otherwise the device presents exactly the same appearance as 50 years ago. Should occasion arise, it could be put into service again upon short notice and within its limits would no doubt set a good pace for even the most modern of grinding machines.

Shaping Machine Rigged to Cut Special Cams

By A. Des Angelis

The illustration shows how a shaping machine was arranged to cut a quantity of two-, three- and four-step face cams. The rotary fixture was made to fasten on the knee of the machine and the feed is through the medium of bevel and spur gearing by the regular pawl and ratchet feed movement, which has been transferred from its normal position on the crossfeed screw to the feed shaft of the fixture. A new and longer connecting-rod was required.



NOVEL CAM-CUTTING RIG

The knob *A* operates a clutch, which disengages the power feed and allows the rotary table to be turned quickly by hand to any desired position. The starting positions for the various cams are indicated by lines upon the rotary table, and a stationary finger which enables the operator to accomplish the indexing quickly and accurately.

A pawl and ratchet feed is also supplied to the vertical slide in the head of the machine and is operated by a rod which slides freely through a ring in the stationary stud *B*, the movement of the rod being stopped at the required point at either end of the stroke by collars fastened to the rod by setscrews.

The forgings come to this operation bored and faced so that only the rise and the lower dwell are left to be machined. The "operatress" clamps a forging in place, turns the table to the line which indicates the starting point of that particular cam, drops in the clutch, starts the vertical feed by engaging the pawl and goes to the next machine.

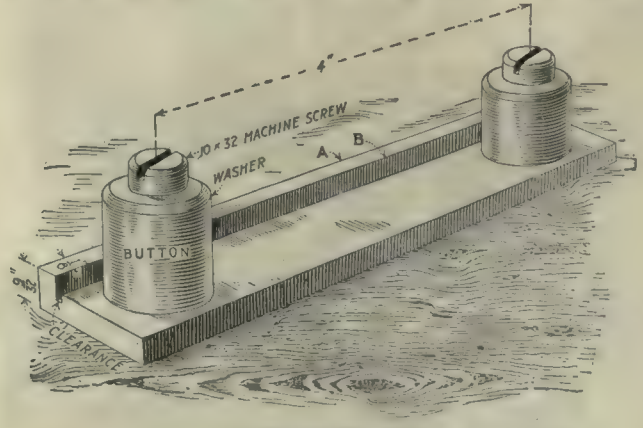
When the bottom of the rise is reached the downfeed is disengaged and the lower dwell is finished by the rotative movement alone. As the tool reaches the vertical face of the next step it is necessary to stop the machine, raise the tool and reset the table for the next cut.

An Easily Made Sine Bar

By J. B. Gray

The article by John Teckeer on page 260 of the *American Machinist* deals with a subject and a tool upon which, it seems to me, much more might well be said. In studying Mr. Teckeer's sketch and text, however, it seems to me that in making such a sine bar one would experience considerable difficulty in attaining the high degree of accuracy required in a tool of this sort.

The sketch shows how I made my sine bar. It is very accurate, the center line of the buttons being parallel with the working surface *A* within 0.0001 in. Moreover, the bar is easily made during working hours,



SIMPLE SINE BAR

as most of the work can be carried along simultaneously with the company work. I would suggest that no attempt be made to make the buttons, for it will probably be more convenient and satisfactory to buy them.

The bar is made of machinery steel and should be

roughed out approximately to size and shape before pack-hardening. The tap holes can be drilled in a minute or two and tapped during lunch hour, and at the same time the clearance groove for the grinding wheel can be cut with a hacksaw. The surface *B* for aligning the buttons and the working surface *A* must be ground at one setting. For this purpose a saucer wheel is used, reversing its position for each surface. For this operation the sine bar should be clamped on a low paralled block. In the bar described, both buttons are free to move. They are set for distance with a pair of either outside or inside micrometers and kept against the aligning surface when tightening.

Figuring Diameter of Three-Surface Tangent Plug

By Cleveland C. Soper

In connection with the design of a flush-pin gage for a gun part the problem of obtaining the diameter of a plug tangent to three surfaces arose. A solution for

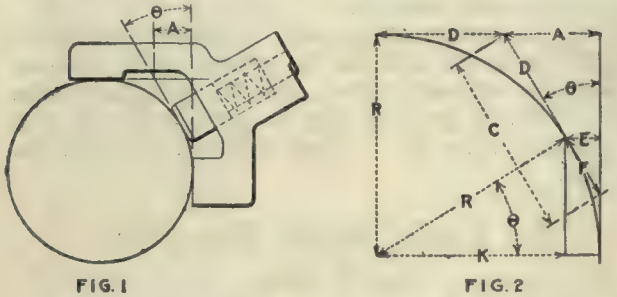


FIG. 1 FIG. 2

FIGS. 1 AND 2. SMALL FLUSH-PIN GAGE

Fig. 1—Gage with three surfaces tangent to plug. Fig. 2—Double-scale diagram

a general case is submitted with the hope that it may be of assistance in similar cases.

Fig. 1 is a sketch of the plug and gage for testing the relation and angularity of the small pin with regard

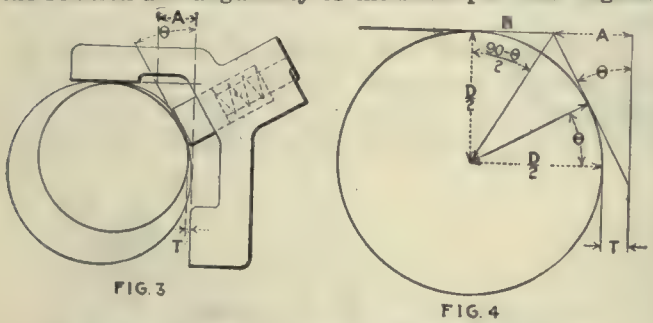


FIG. 3 FIG. 4

FIGS. 3 AND 4. LARGE FLUSH-PIN GAGE

Fig. 1—Gage with two surfaces tangent and size block. Fig. 2—Double-scale diagram

to the perpendicular surfaces of the frame. It is desired to find the diameter of a plug which will properly locate the flush pin to permit grinding the flush end. The angle θ is given and also the intercept *A*. This solution applies only when the surfaces are long enough to be tangent to the plug. Another solution is given for the case where they are not.

In the diagram, Fig. 2,

$$C = \frac{A}{\sin \theta}$$

$$D = R - A$$

$$F = C - D = \frac{A}{\sin \theta} - (R - A)$$

$$E = F \sin \theta = A - (R \sin \theta) + (A \sin \theta)$$

$$K = R - E = R \cos \theta$$

$$R \cos \theta = R - A + R \sin \theta - A \sin \theta$$

$$\therefore R = \frac{A\,(1 + \sin \theta)}{1 + \sin \theta - \cos \theta}$$

The required diameter of the plug is of course equal to

$$2R = \frac{2A\,(1 + \sin \theta)}{1 + \sin \theta - \cos \theta}$$

Fig. 3 illustrates the case where the plug is not tangent to all three surfaces and a size block has to be inserted. The smaller circle represents a standard plug of convenient size which is tangent to two of the surfaces and to the size block *T*.

In the diagram, Fig. 4,

D = Diameter of the standard plug

$$T = A + B - \frac{D}{2}$$

$$B = \frac{D}{2} \tan \left(\frac{90 - \theta}{2} \right)$$

$$T = A + \frac{D}{2}\left[\frac{\sin (90 - \theta)}{1 + \cos (90 - \theta)} \right]$$

$$= A + \frac{D}{2}\left[\frac{\cos \theta}{1 + \sin \theta} - 1 \right]$$

A Spanner With Renewable Pins

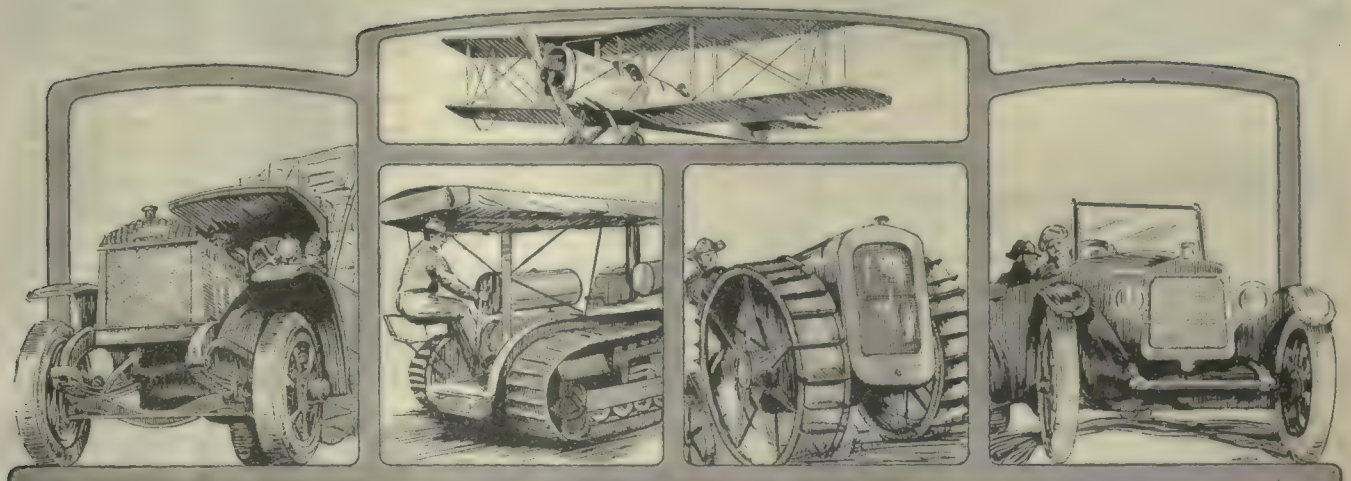
By R. G. Kenyon

Our assembly department was putting together parts requiring the peculiar-shaped little nuts shown in the sketch to the number of 5000 or more per day. The



IMPROVED SPANNER SCREW DRIVER

screwdrivers or spanners in use were first made solid and every time one of the projections broke off there was a job for a toolmaker to repair it. We soon devised the tool shown in the sketch in which the projections are of drill rod which is cut in suitable lengths and tempered all over. Now when a point breaks off, we loosen the binding screw, push out the drill rod and grind the broken end smooth.



AUTOMOTIVE CONSTRUCTION

Modern Methods of Making Motor Cylinders

BY FRED H. COLVIN
Principal Associate Editor, *American Machinist*

It often happens that shops with a comparatively small output devise and use methods which would do credit to a much larger plant. The question of production costs is not always as carefully considered with relation to the output as in this case. The cylinder department of the Locomobile Co. has reduced handling to a minimum.

IN STUDYING the methods used by the Locomobile Co., Bridgeport, Conn., in the production of the Riker truck, it must be borne in mind that, as with the building of the Locomobile passenger automobile, it is not a case of quantity production but of a somewhat limited output. In spite, however, of this being almost a custom-built product in most cases, the question of cost has been carefully considered and both machines and fixtures are employed to insure duplicate production and to bring the cost within a reasonable figure.

In order to show what is accomplished in this direction, the operation sheet for the cylinders is given, as well as the production per hour. Remembering that the cylinders are cast in pairs, it can easily be remembered that the number of castings handled per hour is one-half that of the cylinder production shown in the operation sheet. The cylinder job is concentrated in one small building to reduce handling. The first operation is performed on a No. 6 Becker vertical milling machine as shown in Fig. 1. The cylinder casting rests in a special fixture having four jaws, *A*, *B*, *C* and *D*, and two stop screws, one of which is shown at *E*. The jaws are controlled by right- and left-hand screws operated by a

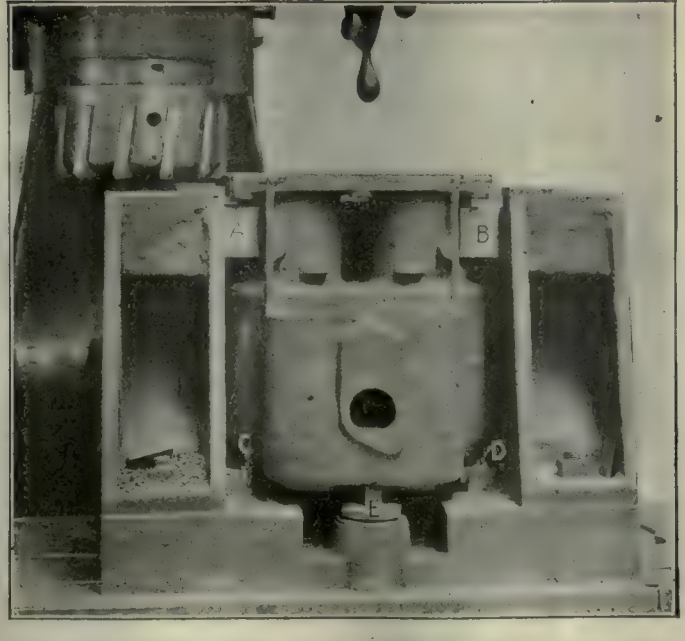


FIG. 1. MILLING THE CYLINDER BASE

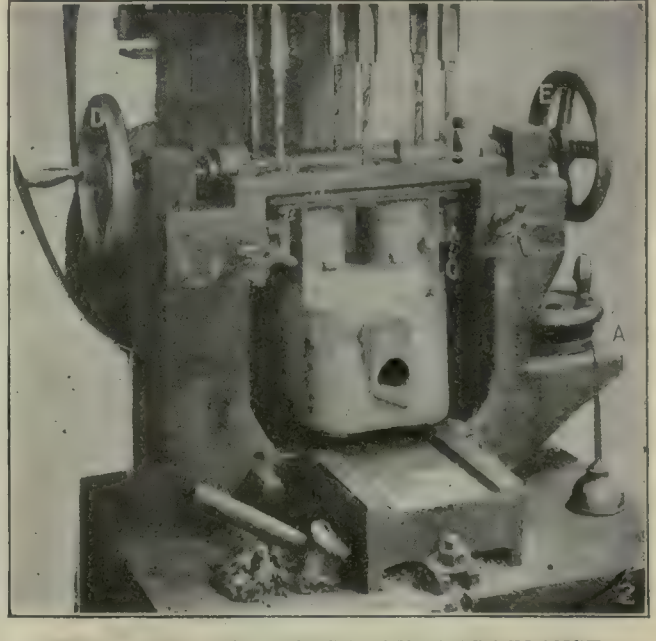


FIG. 2. DRILLING HOLES IN THE BASE FLANGE

AUTOMOTIVE CONSTRUCTION

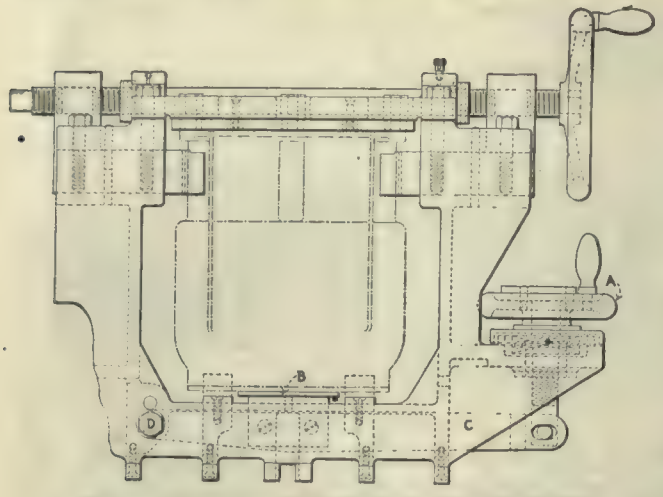


FIG. 3. DETAILS OF THE DRILLING FIXTURE

socket wrench at either end. This is really a chuck which centers and holds the cylinder block while being milled. As the future operations are positioned from this face, it is important that it be properly located and held during this operation.

Next comes the drilling of the bolt holes in the base flange, as shown in Fig. 2. This utilizes a similar fixture, although its construction is somewhat different and the lower pair of jaws is omitted. The cylinder base is first forced up against the under side of the top of the fixture by means of a wheel at *A*. The casting is then centered and held by the jaws *B* and *C* operated by the handwheels *D* and *E*, and locked in position by the setscrews *F* and *G*. Fig. 3 shows details of the upper plate and side clamping fixtures. The operation of the lower holding clamp is made clear when it is seen that the wheel *A* operates a screw which lifts the plate *B* by means of the lever *C*, the latter being pivoted at *D*. This holds the cylinder firmly in place during the drilling operation.



FIG. 4. ROUGH-BORING THE CYLINDERS

The cylinders are rough-bored on the Moline "Hole-Hog" shown in Fig. 4. Here again the casting is positioned by the face of the bottom flange, but in this and all future operations, the bolt holes fit over suitable dowels which position the cylinder with regard to the bore. The cylinders are raised against the upper plate by means of the handwheels *A* and *B*, these operating lifting pads, one of which is shown in *C*. Details of this fixture are shown in Fig. 5, which shows how these pads are elevated by means of a wormwheel operating as a nut. This is a very simple but efficient fixture for this purpose.

Details of the boring head are shown in Fig. 6. This has six blades which are adjustable on the 8-deg. angle shown. This boring head consists primarily of the central bar *A* which carries the boring head *B*, the latter being prevented from turning by means of the key shown The body *B* is held in place by the circular nut *C*, which is operated by a double-pin wrench. The

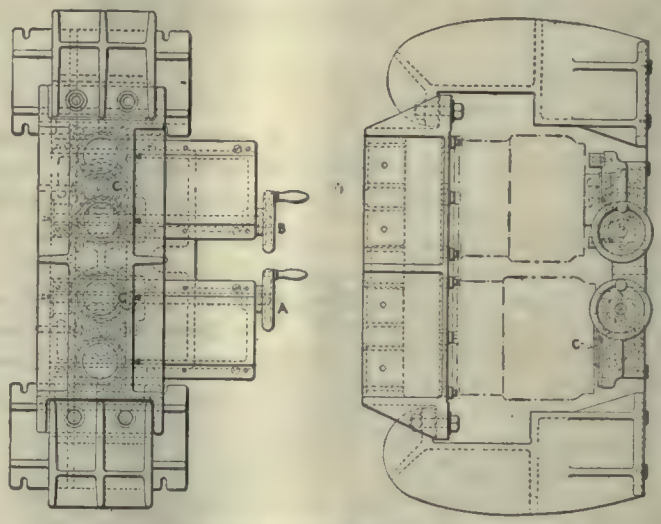


FIG. 5. DETAILS OF THE BORING FIXTURE

cutters *D*, which are also shown in detail, fit in suitable slots in the body *B*, and are adjusted for diameter by being moved up or down the incline. The front adjusting nut *E* and the rear nut *F* are both beveled so as to hold the cutters firmly in position. The end view shows the rake on the tooth of the cutting edge. Adjusting

OPERATION SHEET

No. 1. Snag and clean, 8 per hour.
No. 2. Sandblast, 14 per hour.
No. 3. Mill base, 8 per hour.
No. 4. Drill 6 holes in base flange, 36 per hour.
No. 5. Drill rough cover stud holes, 40 per hour.
No. 6. Bore cylinders, 12 per hour.
No. 7. Counterbore top of stud-hole bosses, 36 per hour.
No. 8. Mill top and side connections and spot cylinder, 10 per hour.
No. 9. Ream for grinding, 10 per hour.
No. 10. Recess top end of bore, 38 per hour.
No. 11. Drill holes for connections on 12-spindle drill, 24 per hour.
No. 12. Ream and tap valve cap holes, 6 per hour.
No. 13. Drill and ream valve-stem guide holes, 14 per hour.
No. 14. Counterbore valve-stem guide holes, chamfer bore, drill and tap pipe plug holes, 12 per hour.
No. 15. Countersink and face counterbore valve seats, 10 per hour.
No. 16. Tap connection holes and valve-spring cover, 30 per hour.
No. 17. Mill top of center bosses on base flange, 60 per hour.
No. 18. Grind cylinder bore, 2 per hour.
No. 19. Grind valve chamber, 18 per hour.
No. 20. Clean top end of bore, 12 per hour.
No. 21. File and chip, 3 per hour.
No. 22. File finish, 20 per hour.
No. 23. Retap valve cap holes, 20 per hour.
No. 24. Wash in soda and oil.

AUTOMOTIVE CONSTRUCTION

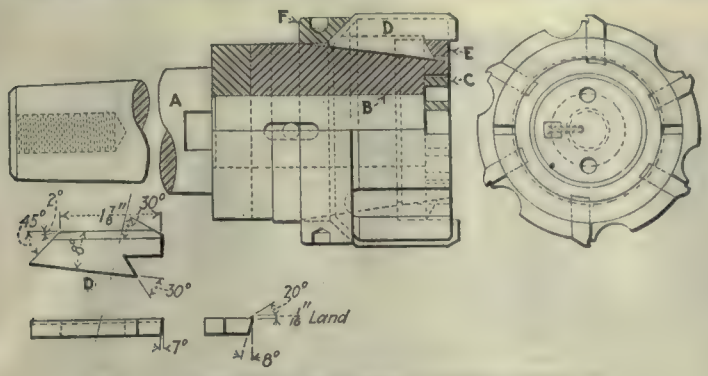


FIG. 6. DETAILS OF THE BORING HEAD

the two nuts *E* and *F* varies the diameter as may be necessary.

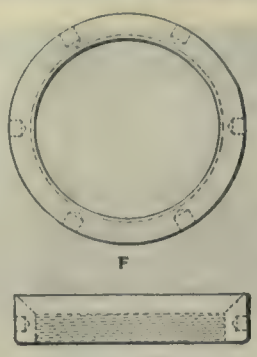
After being bored, the cylinder blocks are placed in the fixture shown in Fig. 7 and water pressure applied to the jackets. This fixture allows the cylinder to be swung in any desired position, there being an index and latch on the end of the trunnion.

A Large Double Milling Machine

The next operation is the milling of the tops and sides of the cylinder, this being done on a special double Beaman & Smith milling machine. This has two heads and also has four tables. Fig. 8 shows the front of the machine with two of the tables in place. An extra table is shown at *A*, where it can be loaded with the cylinder while the machine is running. Each table holds three blocks or six cylinders, which are positioned by means of the bolt holes already referred to and held firmly in position by the simple but substantial clamps shown. These form a part of the holding fixture *B*, the same thing being shown on the table which is in position on the milling machine.

As soon as the cuts have been taken, the table with the finished cylinders is lifted off by means of the sling shown, and brought back to the position of the empty table by means of an overhead trolley on which the air hoist used for lifting is fastened.

Fig. 9 shows the gage used for setting the milling



cutters in the proper position for work on the cylinder. This needs practically no description, it being fastened in position on the face of the milling fixture and the cutters adjusted to it. This same gage is also used for setting the milling cutters on the second head, which is shown in Fig. 10. This is a close view between the heads

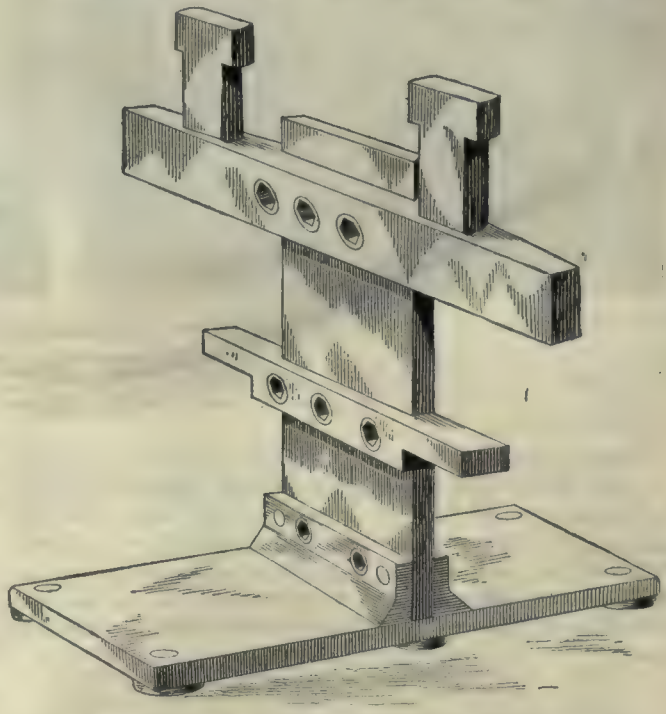


FIG. 9. GAGE FOR SETTING MILLING CUTTERS

of the machine, showing the large cutter on the top which finishes the upper surface and the two small cutters which mill the cylinder sides for the covers



FIG. 7. TESTING WATER JACKETS



FIG. 8. MILLING THE TOP AND SIDES OF THE CYLINDER

AUTOMOTIVE CONSTRUCTION

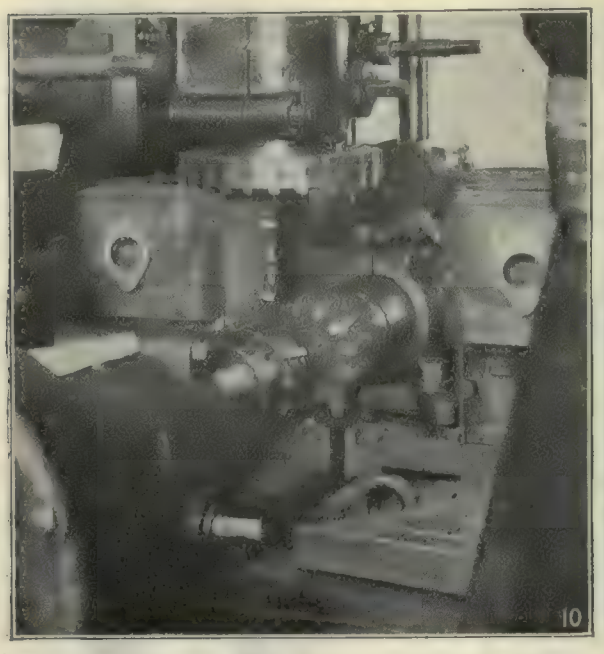


FIG. 10. VIEW OF THE SECOND MLLLING HEAD

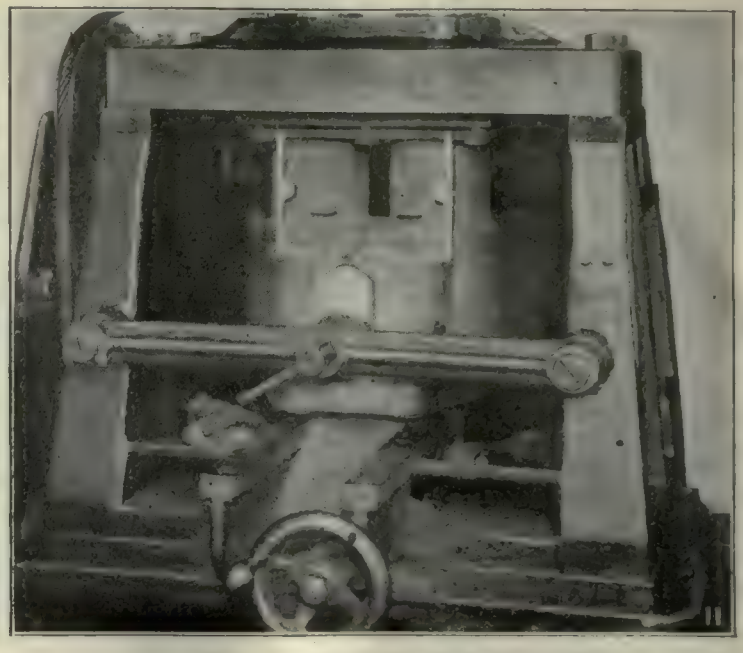


FIG. 11. REAMING THE CYLINDERS

inclosing the valve guides and push rods. This illustration also shows the type of clamp used in holding the cylinder.

The cylinders are reamed in the fixture shown in Fig. 11, this being a Foote-Burt machine. Here again the cylinders are located by dowels in the base, held up against the upper surface by a pad operated by the handwheel shown and clamped in position sideways by means of the cross-bar and screw shown. This leaves the bore ready for the final finish on the Heald grinding machine.

THE RECESSING TOOL

After reaming, the cylinder bore is recessed by the bar shown in Fig. 12. This consists of the body *A* carrying the plunger *B*, which has about an inch movement inside the bar. The latter carries the recessing cutter *C*, which is moved outward by means of the angular slot *D* in the end of the bar *B*. Collars *EE* are guides in the cylinder bore. The collar *F* rests against the flange end of the cylinder, the ball-thrust bearing *G*, held in position by locknuts *H*, determining the depth to which the bar can enter the cylinder. The collar *I* carries a pin through the upper end of the bar *B*, preventing it from turning but at the same time allowing end movement. With the bar in the cylinder, an end movement of the plunger *B* throws the recessing cutter *C* out into the cylinder bore and makes the necessary recess. The clamp *J* fits the outside of the spindle and aids the taper shank in driving.

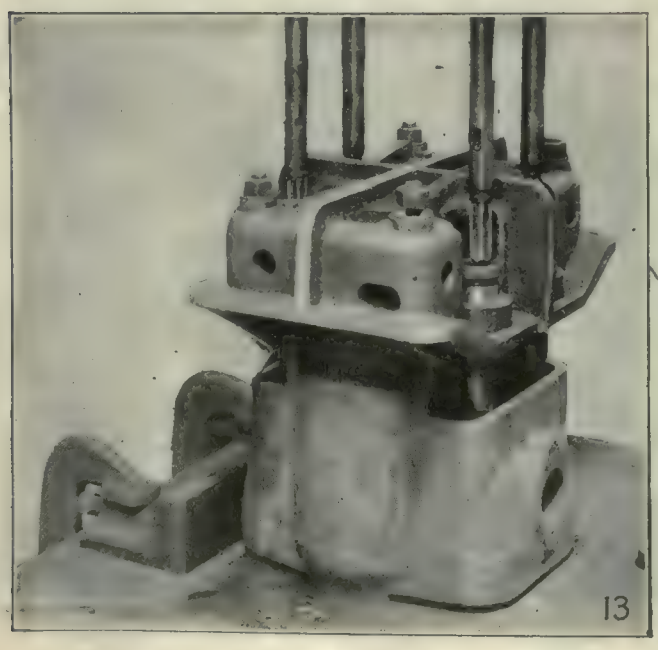


FIG. 13. REAMING THE VALVE-STEM GUIDES



FIG. 14. INSPECTING FINISHED CYLINDERS

AUTOMOTIVE CONSTRUCTION

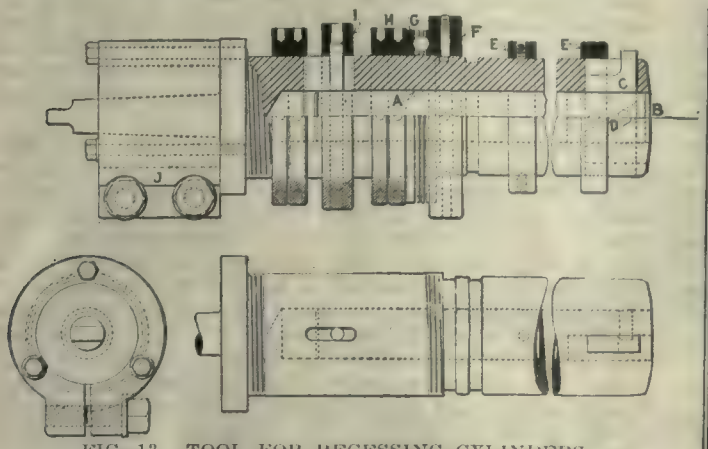


FIG. 12. TOOL FOR RECESSING CYLINDERS

Next comes the reaming of the valve-stem guide, using the box jig shown in Fig. 13, this being also located from the bottom of the cylinder flange. It will also be noted that an angle plate is clamped to the table of the drilling machine to assist in locating the casting in proper position between the four spindles.

Fig. 14 shows the final inspection of the cylinder to determine if the bore is at right angles with the flange. The inspection jig shown fits inside the bore, and the swinging arm, which is provided with a micrometer head, easily indicates the relations between the bore and the face of the flange. Fig. 15 is a corner of the inspection room where the pistons are gaged before being sen' to stock to be issued to the assembling department.



FIG. 15. FINAL PISTON INSPECTION

Convention of Employment Managers

IF ANYONE had previously doubted the growth of the vocation of Employment Manager, the attendance at the third annual Convention of the National Employment Managers' Association at Cleveland, Ohio, May 21 to 23, should dispel all question on the subject. An attendance of approximately 1500 men and women, nearly all of whom were members, representing many cities and a great variety of industries, compels the realization that the problem of securing and keeping an adequate working force is of much greater magnitude than we had hitherto realized. It is a problem which affects all industry in much the same way, even though the method of treatment may vary in some of its details. The establishing of a human, personal relationship; of building up confidence and coöperation in all things pertaining to the work and the worker has become necessary in all varieties of industry.

According to Dudley Kennedy, who is well known from his work of employment direction at the Hog Island shipyard, the first organized work along this line was probably done by B. F. Goodrich about 20 years ago, but it is only very recently that we have realized the need of restoring, so far as present conditions will permit, the personal relations between employee and employer that existed in the days of the small shop. We must realize that the workers are intelligent, if not always educated; that they cannot be fooled by pretended interest, or form or mummery of any kind; that back of all demands, even those which may be unreasonable or foolish, is the desire for self expression in matters which concern them; that they resent being known only by a check number instead of a name.

We must put interest and joy back into the work; we must consider the well-being of the worker, which is very different from the welfare work which has been done in the past. Mr. Kennedy also pointed out that the general public had a direct interest in the proper and efficient conduct of every business because they, as customers, paid all wages, profits and costs of production.

The question of the forms to be used in conducting employment offices was the occasion for considerable discussion, and general opinion deplored the tendency to increase the number of these forms, one case where 86 were used being cited as a horrible example.

George D. Halsey of the Cincinnati Milling Machine Co. advocated one card large enough for all records, so that all data pertaining to a man might be available at a glance in all cases where such reference was necessary. This card is letter size, 8½ x 11 in., and allows for a very complete record which covers all data for the visiting nurse and other service work which may be necessary.

Mr. Halsey warned against the danger of letting any method or system cause us to forget the human element and pointed out the necessity of trying to make every man feel that nothing has been left undone to give him a square deal; of showing why certain things cannot be done. He has found it helpful to check up decisions as to judgment of men to see how correctly we have picked them. Interviews should record impressions as a help in determining how well the employment manager's judgment is borne out in practice. Foremen should grade the men in their shop at least once in every three months.

Rodney Morrison, Jr., of the American International Shipbuilding Corporation, emphasized the fact that we must realize that forms and methods were but tools with which to perform certain necessary functions. What really counts is to know how to use them to best advantage. He advocated close coöperation with the foremen, familiarizing them with the whole policy of the organization, getting their complete coöperation in the whole plan of securing the best men for the various departments. Nor must we lose sight of the fact that the acid test of any plan or system or theory is, in the long run, that of economies. Does it pay? Not in cold cash or dividends alone but in net returns to the stockholders, the management, the workers and the community.

The employment men are dividing themselves into two

groups on the question of their relations with the foremen and other executives. One group believes that the employment office should select and hire the men and turn them over to the foremen much as the purchasing agent buys the material which they draw from the stock room. The others feel that, while they can perhaps secure men to better advantage than the department foreman, the final decision should rest with the man whose department record depends not only on the new employee as a mechanic but also on his adaptability to the particular environment and his ability to coöperate with others in the department. They feel that the case in no way compares with the purchase of material and cannot be argued from the same standpoint.

If, as all agree, the foreman must represent the firm to the workers, he must be treated with consideration and not be made to feel that he is a mere cog in the machine and that his judgment of men is of no consequence. While the autocratic foreman is a relic of the past we must not make a puppet of the present one and still expect him to correctly represent the firm to the men.

Earl Morgan emphasized the need of man-consciousness on the part of all and of suiting the men to the foreman, who should have the final selection. Unfortunately most foremen are not specially trained or fitted for their work but just "happen," from seniority or otherwise. There is necessity for the more careful selection of foremen with regard to their ability to understand and get on with men as well as to their mechanical ability. In fact some very successful managers consider the faculty of handling men of more importance to a foreman than is his mechanical training.

Mr. Morgan advocated the following up of men after they go into the shop to see how they progress, to check up mistakes of judgment in selection and to show the men that all interest in them is not lost the minute they have passed into the shop. In order to get satisfactory workers the employment office must know what qualifications are required. It is not enough to specify a $25-a-week lathe hand, but the qualities needed and not the price should be the guide if economical production is to be obtained.

The Returned Soldiers

Major Church, who is in charge of the section of the country east of the Ohio line, told of the work of getting the returned soldier back into industry, the work of his branch being to assist the organizations already in existence to do their work. When we realize that there are 55 such organizations in New York City alone, the need for coördination becomes apparent and the establishment of a clearing house becomes a necessity.

About 80 per cent. of the returned soldiers go back to their old jobs and there are few cases where they have been refused employment. About a third of the remaining 20 per cent. do not go back to their old locality but try to get work in the East. Major Church urged that the business men look upon the returned soldier as a good investment. The fighting blood in business is a good thing. He also urged that the country get busy in putting things back where they belong. Repairs and additions have been too long neglected. Let them be made now and provide openings for all who seek employment, particularly the returned soldier.

The possibilities of the motion picture in industry were brought out by Leslie W. Sprague of the Community Motion Picture Bureau. He showed how workers can be interested in their work, the psychological effect and the mental refreshment of well selected pictures. Either at noontime or in a ten-minute recess, the effect of a good film has proved to be beneficial.

One of the Ford industrial films was shown, that of making shoes in a modern factory. The titles given not only told the story but also the reason for high prices and how these could be lowered. When it is considered that we receive over 80 per cent. of our impressions through the eye, and that the motion picture presents the greatest opportunity for having the right kind of impressions given, their possibilities become apparent. He believed there was no question as to their being used as an aid to better understanding with the workers, but that nothing could take the place of good working and living conditions. Americanization, conciliation and coöperation all find the motion picture a useful medium.

Mr. Handy, vice president of the Bray Studios, showed some interesting examples of their work illustrating the mechanism and functioning of intricate machinery. These are invaluable in educational classes of all kinds and played no small part in instructing raw recruits both in the manual of arms and in the handling of the various kinds of arms and munitions.

The convention was strenuous in its schedule and some subjects naturally overlapped. L. P. Alford spoke on the "Employer, Employee, and the Public," tracing the relations from the days of the one-man shop to that of the absentee owner. He pointed out the need of considering the relation of any business to the community as well as to its stockholders. He suggested a reward for an employée's service to his fellows as well as to his employer, and quoted H. L. Gantt as saying that the use of "task and bonus" may give way to straight day work or piece work once more. Mr. Alford regretted that the Community Labor Boards had not had time to become really active before the armistice became effective and suggested that some sort of a substitute might be found desirable.

W. A. Grieves, assistant secretary to Jeffrey Mfg. Co., whose work in this line is well known, gave the results of their experience, which goes to show that the average man is both fair and honest; that confidence and the square deal are absolutely necessary; that morale cannot be bought, but must come as the result of right thinking, right action and right environment. He pointed out that we were not living in the same world as before the Kaiser lifted the lid; that the stage setting had changed. But he also urged against being stampeded, as the foundation was fairly solid and the new ideas can be assimilated.

He pointed out that the reactionary and the radical were equally dangerous but that the average worker thinks straight and can be depended upon. He warned against attempting to develop any committee system too rapidly, as only long experience in economic justice, mutual confidence and fair play will bring about real industrial democracy.

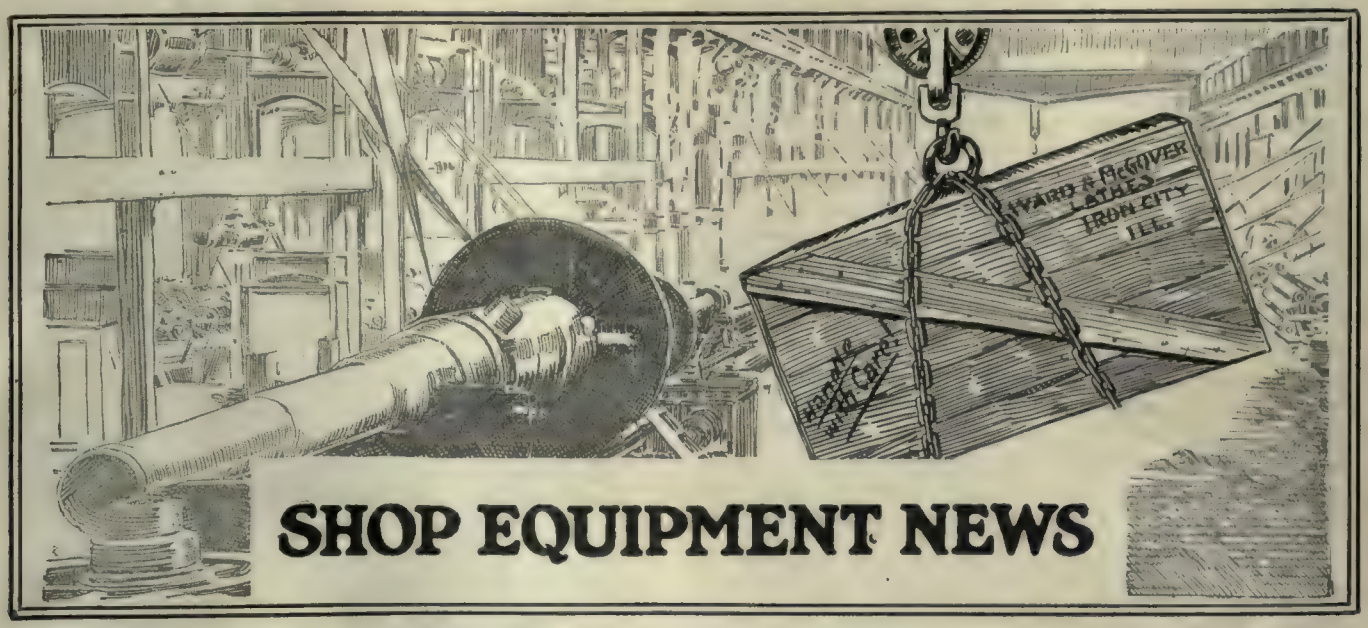
Other papers included the Measurement of trade skill; Training and placing disabled industrial workers; Safety as the employment executive should see it; Stabilizing the working force; Breaking in new workers; Profit-sharing; Insurance and bonus; Organizing the working force and the human relations department from the standpoint of the industrial physician.

At the banquet which followed, Cyrus McCormick, Jr., Works Manager of the International Harvester Company, spoke of the good results they had obtained from employee representation, of the benefits of labor's desire for a voice in industry and the recognition of the right to exercise self-determination.

He compared the older way with Frederick the Great of Prussia, a benevolent despot, who did what he believed was best for the people but did not consult them or give them any voice in its doing. He believed the men had a moral right to full representation from each department and that an easy channel of appeal should be provided whenever decisions seemed unfair.

This, and all other questions, should be settled on the basis of, "is it right?" and "does it pay?" A good system brings to the manager's attention abuses or bad practices, of which he has no knowledge and enables him to make speedy correction. No move of this kind should be taken hurriedly. Have joint conferences before you adopt a new measure as well as afterward, and go into it whole-heartedly. Unless it is sincere and truly democratic it will not succeed. Mr. McCormick told of one demand for wages which could not be met, but instead of making trouble it probably brought employer and employee closer together, for the men were shown the books of the company, shown the costs which would make a wage increase impossible, and the demand was readily withdrawn.

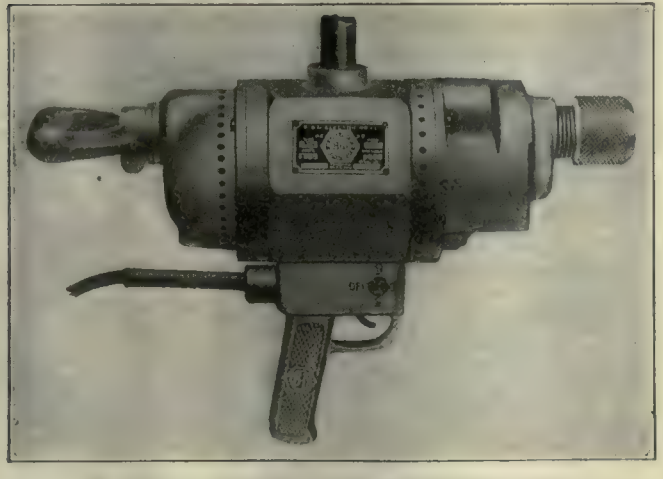
The whole tone of the convention was both hopeful and helpful, and the concerns represented were of such magnitude as to indicate a more widespread movement toward better understanding then ever before.



SHOP EQUIPMENT NEWS

Black & Decker Electric Drill

The Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md., has recently added a new size to its line of portable electric drills. The new machine is shown in the illustration, and has a capacity up to $\frac{9}{16}$ in. in steel, and is provided with a No. 1 Morse taper socket. It is stated the machine will drill a $\frac{9}{16}$-in. hole through machine steel at the rate of 1½ in. per min. without overloading the motor. The housing is of Magnalite, an aluminum alloy. The gears are packed in grease in a separate grease-tight compartment, and the drill spindle runs in a long bronze bushing, thrust being taken by a ball-thrust bearing. The motor is air cooled and will run continuously without overheating. The Morse taper socket is in the form of a separable sleeve secured in the drill spindle by means of a large knurled nut. By unscrewing this nut the entire taper socket is easily removed from the spindle. The drill shank protrudes slightly beyond the end of the taper socket, in order that the drill may be removed. This construction is used, for if it was necessary to leave room for the drift-pin slot the machine would be considerably less compact, and the end of the spindle would be some distance from the bearing. The machine has the customary pistol grip and trigger switch, which characterize Black & Decker drills. The machine weighs 21 lb., has a no-load speed of 600 r.p.m. and is supplied with interchangeable spade handle and breastplate, as well as electric connecting cable.

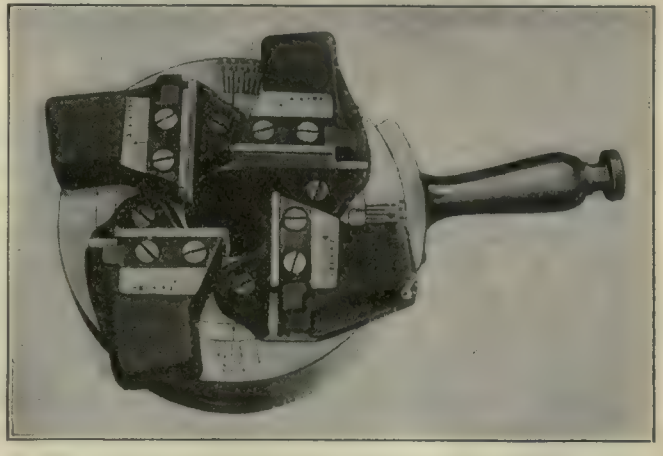


BLACK & DECKER $\frac{9}{16}$-IN. ELECTRIC DRILL

Landis Automatic Die Head

The Landis Machine Co., Waynesboro, Penn., has placed upon the market a new style of automatic screw-cutting die head which is different in design from other heads of this type in that the chasers are supported on the face of the head. This permits of easy access to the chasers when it is necessary to remove them for grinding or changing from one diameter to another. It is made of steel to insure a long life of hard service. The head is opened automatically by retarding the forward motion of the carriage, and is closed by hand. It is locked by the operating handle which contains a latch having a tongue milled on the lower end. This tongue is milled off center, thereby permitting of roughing and finishing cuts. To adjust the head for either roughing or finishing cuts merely requires a half turn of the latch to suitable graduations.

The head is graduated for all sizes of bolts and pipe, both right- and left-hand within its range. It is adjusted to size by means of a screw which engages the head body. Since the operating, adjusting and



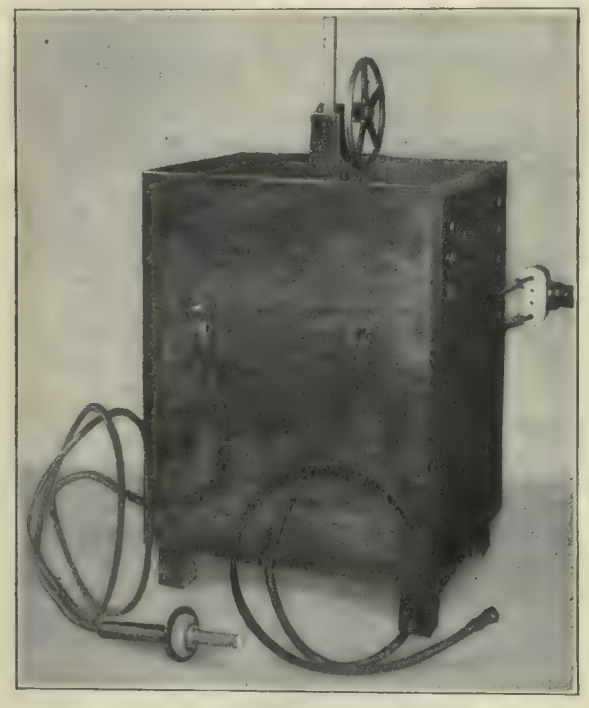
AUTOMATIC SCREW-CUTTING DIE HEAD

closing rings remain in a fixed position when the head is closed, the rotating of the head body within these rings gives the diameters within the range of the head. To set the head for left-hand threading, the screw which locks the latch pin is removed and the latch pin is rotated to the left-hand graduation. The locking screw is then replaced and the left-hand holders are put in place.

This head is applicable to practically all makes of screw machines and turret lathes which have sufficient space to swing heads of these diameters. The heads will be furnished with standard shanks, or special shanks will be furnished provided they will not be larger than the standard shanks. Where special shanks of dimensions greater than standard shanks are required a bushing can be used. This automatic die head employs the regular Landis chasers.

"Zeus" Arc-Welding Outfit

The "Zeus" arc-welding outfit is a product of the Gibb Instrument Co., 1644 Woodward Ave., Detroit, Mich. In this device the motor-generator customarily used has been supplanted by a transformer with no moving parts. It is stated that the current consumption is from 20 to 40 per cent. less than with the motor-generator type of outfit, and that it is particularly adaptable to overhead welding, and also to the welding



"ZEUS" ARC-WELDING OUTFIT

of cast iron. The outfit is built on the unit system, which allows the installation of a small machine, and if the work becomes heavier a duplicate set may be connected in parallel. One of the features of the machine is the arrangement for regulation. It is not necessary to change any connection for this purpose, as a wheel connected with a secondary and placed on the top of the case raises and lowers this secondary, and provides the regulation of current necessary for different sizes of electrodes. The inherent reactance of the outfit automatically stabilizes the arc for different arc lengths.

Manhattan Universal Casting Grinding Machine

The Manhattan Machine and Tool Works, 42-50 Market Ave., N. W., Grand Rapids, Mich., has recently placed on the market the universal casting grinding machine shown in the illustration. It is stated that the machine is easy and rapid to operate under the varying conditions such as are met in every-day use,



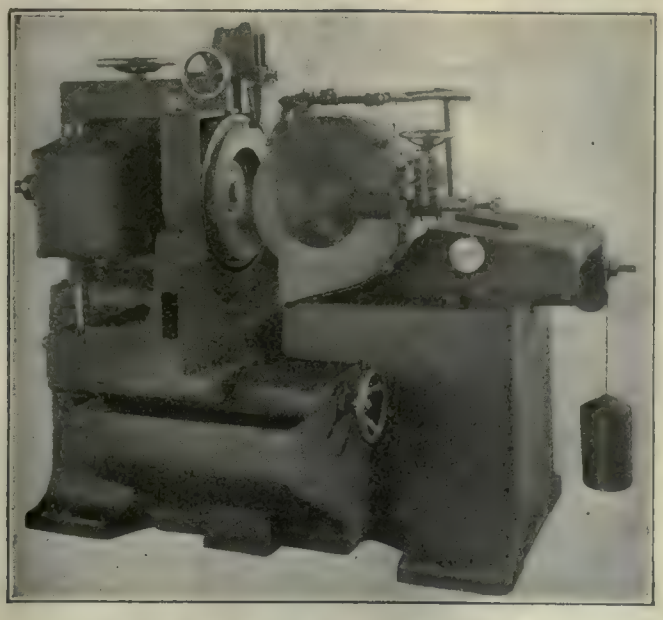
MANHATTAN UNIVERSAL CASTING GRINDING MACHINE

Wheel used, 12 in.; speed of wheel, 1600 r.p.m.; longitudinal travel, 12 in.; swing of wheel, 36 in.; length of swing shaft, 7 ft. 8 in.; shipping weight, 570 lb.

and that its rigidity, strength and flexibility are notable features. The universal movement is obtained by a universal coupling and sleeve, which gives a freedom of movement without undue loss of power. The long handle gives the operator a good leverage, so that the pressure applied to the grinding wheel can be easily regulated. Lubrication is taken care of by wick oilers and drip cups. The standard equipment consists of countershaft, counterweight, two pulleys for the counterweight cable and the machine itself.

"Reeves" Roll Grinding Machine

A machine for grinding rolls without centers up to 3 in. in diameter and from ¼ to 5 in. long has been designed by M. O. Reeves, and placed on the market by the Gardner Machine Co., Beloit, Wis. The working mechanism consists of a cutting or grinding wheel, shown at the right, rotating in a counterclockwise direction at ordinary grinding-wheel speed; and a ring wheel, at the left, of a fine, hard grain and grit, which is rotated in a clockwise direction at a speed of about 6 r.p.m. This wheel is known as the feeding wheel. Between the two wheels is a work rest which supports the rolls while grinding. This combination of wheels and work rest, when properly adjusted, causes the roll being ground to rotate with the same peripheral speed as the feeding wheel; and by placing the wheel rest so that the center of the roll is in contact with the feeding wheel along a line slightly above center of the feeding wheel, the roll is caused to advance past the cutting wheel at any predetermined speed. The process of grinding is continuous, one roll following another. The amount of stock removed at each cut depends upon the character of the metal and upon the finish required. The accuracy obtained under regular manufacturing conditions is stated to be from 0.0005 to 0.00025 inch.



"REEVES" ROLL GRINDING MACHINE

Capacity, work up to 3 in. in diameter and from ¼ to 5 in. long; speeds of grinding wheel, two, 1143 and 1800 r.p.m.; diameter of grinding wheel, 16 in.; speed of feeding wheel, 6 r.p.m.; speed of feeding wheel for dressing purposes, 378 r.p.m.; diameter of feeding wheel, 16 in.; sq.in. of surface ground per min., 60; reduction in diameter while roughing, 0.006 to 0.010 in.; reduction in diameter while finishing, 0.001 to 0.002 in.; floor space, 4½ x 6 ft.; weight, 4600 lb.

The cutting-wheel shaft is mounted in bearings supported by the slide shown at the right, the grinding wheel having feed motion for wheel wear only. If there is too much stock on the rolls being ground to be removed in one operation, they are run through the machine two or more times. Two wheel speeds are provided—1143 and 1800 r.p.m.—by a two-step cone pulley. A 16-in. wheel is used and the higher speed is used as the wheel wears down. The wheel slide is actuated either by a handle on the squared end of the shaft, at the extreme right, which is for a rapid motion, or by the small hand dial on the side of the slide which provides a micrometer adjustment and which is connected to the feed screw by means of a worm and wormwheel.

The wheel slide is counterweighted to take care of backlash in the feed screw and nut. A dresser is placed at the rear of the wheel hood. The handwheel at the top of this dresser is for a traverse motion of the diamond point, while the projecting knurled screw provides for the feed of the dresser.

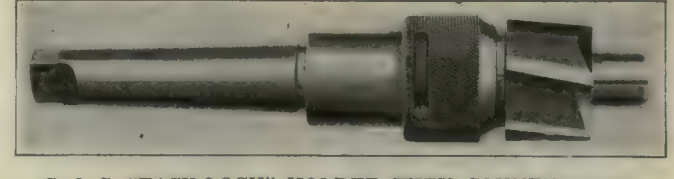
The feeding wheel at the left is mounted in a ring chuck and revolves at 6 r.p.m. Provision is made, however, for a change of speed for dressing, the dressing speed being 378 r.p.m. A dresser is a permanent part of the machine and can be seen in the cut. The feeding wheel is 16 in. in diameter, and the drive is from a pulley on the countershaft to the pulley at the rear of the machine. From this pulley the drive is through a pair of bevel gears and a worm and wormwheel for the slow drive, and through the same pair of bevel gears and an additional pair of bevel gears and spur gears for the fast motion for dressing. The change from the slow to the fast speed is made by disengaging a clutch on the wormwheel, which then runs idle on the spindle, and engaging the two spur gears mentioned.

The wheel is adjusted in a vertical direction by means of the handwheel shown mounted on the top of the head to the left, this adjustment taking care of the traverse motion of the roll. Locating studs are provided on the top of the work-rest casting—one in front and one in the rear of the machine—these studs forming the gaging points for the work rest, which is so set that the center of the work is central with the cutting wheel. The front stud can be seen in the illustration but the work rest is not in place. After the work rest has been so set that the center of the roll to be ground is properly adjusted with regard to the cutting-wheel center, the driving wheel may be adjusted to feed the roll past the cutting wheel at any predetermined rate of speed. The further down the driving wheel is adjusted, the faster will the roll be fed past the cutting wheel. This machine will grind approximately 60 sq.in. of surface per min. for each operation, each roughing cut reducing the diameter from 0.006 to 0.010 in. and each finishing cut from 0.001 to 0.002 in.

The base of the machine on which are mounted the grinding-wheel head, the driving-wheel head, and the work rest contains a pan with a strainer, the lower part of the base forming a reservoir for the cutting compound. The pump is driven from the countershaft by a separate pulley, and is of the propeller type, and is not affected by grit. An opening is provided at the bottom of the base for cleaning out the reservoir when required. At the right side of the pan, as shown in the illustration a handwheel is provided which actuates the work rest longitudinally, so that the latter may be placed exactly below the center of the roll to be ground. The machine occupies a floor space of 4½ by 6½ ft., and weighs approximately 4600 lb.

S. & C. "Easy-Lock" Holders and Interchangeable Counterbores

The illustration shows an S. & C. "Easy-Lock" holder with an interchangeable counterbore in place. These devices are both products of the S. & C. Manufacturing Co., 368 Mt. Elliott Ave., Detroit, Mich. The holders are made in four sizes, with either Morse taper shanks or straight shanks for screw machine work, and range from 1 1/16 to 2¼ in. outside diameter, and are for cutters from ¼ to 3 in. in diameter inclusive. To lock a cutter in



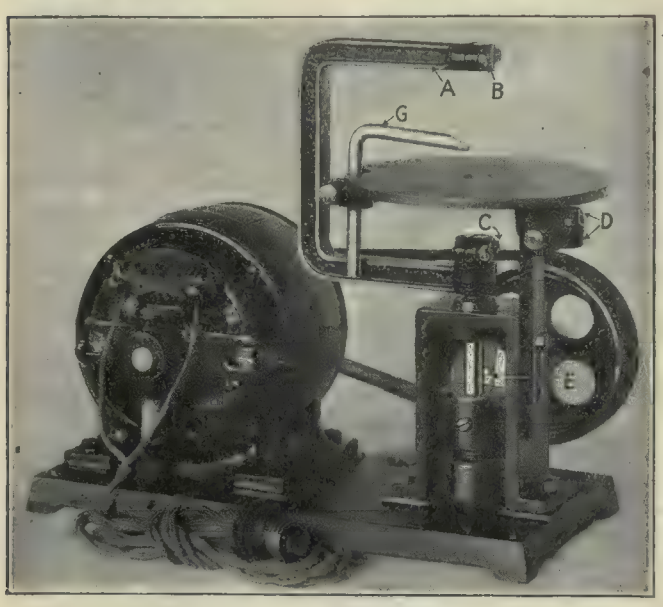
S. & C. "EASY-LOCK" HOLDER WITH COUNTERBORE IN PLACE

position it is simply necessary to insert the shank as far as the shoulder will permit and turn the knurled sleeve to the right. When the sleeve comes to a stop the cutter is securely locked. To unlock, it is simply necessary to turn the sleeve to the left; no spanner wrench being needed. A feature cited is that the shank of the cutter has a two-point drive instead of a setscrew drive, thus giving increased strength. The cutters are made in sizes of from ¼ to 3 in. and with pilots from 3/16 to 2½ in. in diameter. The pilots are held in the cutters by means of a shank that passes through the cutter, a split nut on the inner end serving to lock the pilot se-

curely in place. The advantage of this construction is that pilots of different sizes can be used in the same size cutter and it is also an easy matter to remove the pilot for grinding purposes. Another advantage cited is that the cutters can be held rigid in the holder for certain classes of work, or if desired, the cutter can be allowed to have play so that the cutter will float and the pilot follow the hole without cramping. The pilot shank is threaded for a considerable portion of its length in order to allow for the material used up in sharpening the tool. The "Easy-Lock" holders are also suitable for operation with tapered bridge reamers, which are also made and furnished by this company.

Bloomfeldt & Rapp Die-Filing Machine

The Bloomfeldt & Rapp Co., 108 North Jefferson St., Chicago, Ill., has recently placed on the market the die-filing machine shown in the illustration. This machine is driven by a ⅛-hp. motor of a type to suit the electric

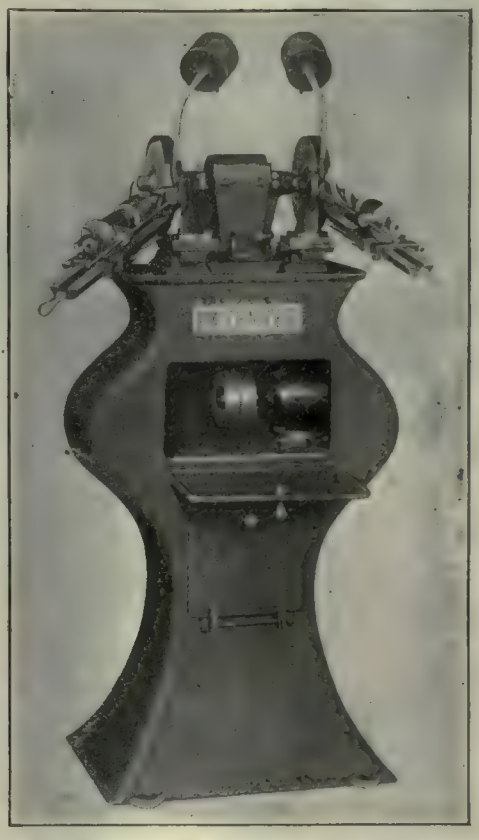


DIE-FILING MACHINE

power of the customer. The machine has a tilting table that may be placed at any angle and is clamped by means of the clamping screws shown at *D*. The arm *A* is of the double type, saws or thin files being screwed by clamps at *B* and *C*, while a heavy file is fastened at *C* only. The adjustment of the stroke is by means of the screw *E* while the arm *G* is adjustable for holding the work in place while sawing or filing. The machine is 14 in. long, 9 in. wide and 12 in. high and weighs 50 pounds.

Bellevue Semi-Automatic Drill-Grinding Machine

The Bellevue Industrial Furnace Co., Detroit, Mich., has recently placed on the market the semi-automatic drill-grinding machine shown in the illustration. On this machine the drills are ground on the face of the wheel instead of on the flat side, it being claimed that this construction gives greater wheel life and greater ease in truing or sharpening the wheel. The machine is driven by means of an electric motor contained in the pedestal and has two-step cone pulleys so that two speeds are available. The actual grinding of the drill lip is automatic, the drill being placed in a carriage and brought forward to a gage that indicates the correct grinding position; this gage being on a spring so that it automatically snaps out of position



BELLEVUE DRILL-GRINDING MACHINE

when the grinding is begun. When placed in proper grinding position, the drill is positively locked and a vertical movement of the drill holder moves the drill up and down against the circumference of the wheel, at the same time rotating it. This motion is accomplished by gears. When one lip has been ground, a lever movement turns the drill holder to grind the next lip, where it is again locked in position. The machine can be indexed to handle drills with two, three, four or five lips. The grinding machine is made in twin form with two carriages and two grinding wheels mounted on a single base, so that either right- or left-hand drills can be ground. Taper-shank drills or reamers are handled in the spindle while straight-shank drills or reamers are chucked.

Taylor & Fenn High-Speed Vertical-Spindle Milling Machine

The Taylor & Fenn Co., Hartford, Conn., is now marketing the high-speed, vertical-spindle milling machine with single-pulley drive shown in the illustration. This machine is intended for various light vertical milling cuts, using high cutter speeds, and may also be used for light profiling work.

The machine is of the self-contained type with single-pulley drive, the power being taken from the main line-shaft through a 2-in. single belt, connecting with a tight and loose pulley on the left side of the ma-

chine, from where it is delivered directly to the driving pulley at the back. The tight and loose pulleys are guarded and the belt shifter is of interest. This is entirely inclosed within the guard and slides on two shafts which keeps the shifter always in vertical position. Where motor drive is desired, a special bracket is furnished that may be attached to the base of the machine; the drive being through a belt.

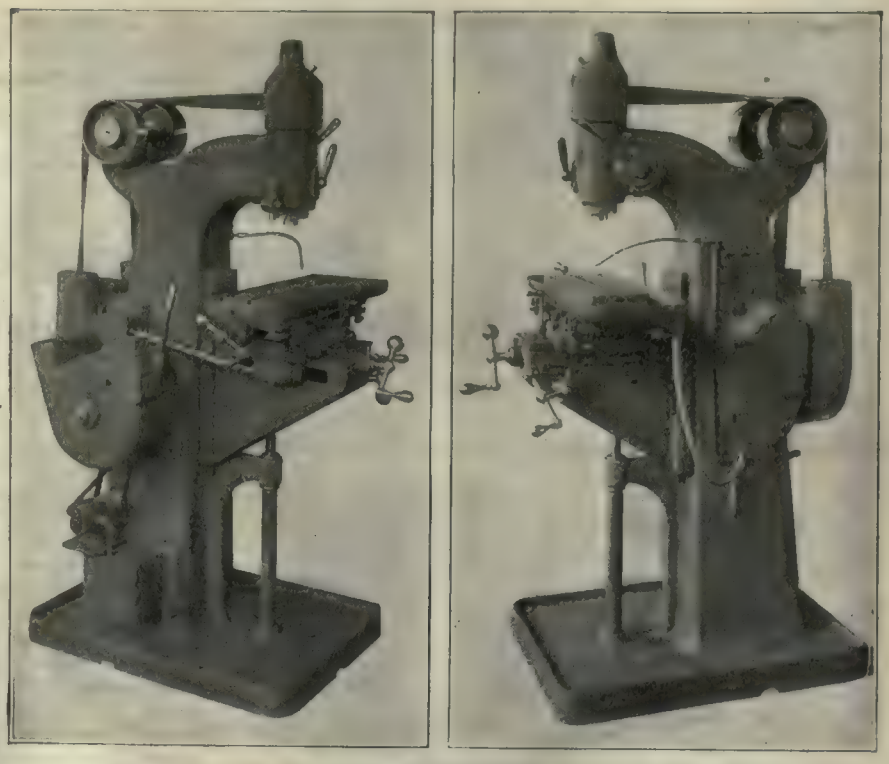
The base is a one-piece casting internally ribbed to insure rigidity. The main driving shaft extends through the machine and is connected with a spindle driving pulley on the back of the machine by a set of bevel gears. The spindle driving pulley is of large diameter and guarded. An endless belt extends from the spindle driving pulley over two idlers to the spindle pulley, and by removing the cover on the back of the guard this belt may be removed. The idler pulleys are adjustable to permit the proper belt tension to be maintained.

The various spindle speeds and the longitudinal feed of the table are obtained by means of change gears in the box on the right side of the machine. Adjustable stops are provided for cross and longitudinal feed and these operate whether hand or power feed are being used. The stops for the longitudinal feed are so designed that when the hand feed is being used the power feed cannot become engaged.

The oiling system is a feature of the machine and has been so designed that access is easy to all parts requiring lubrication. A central-reservoir system is provided in the table of the machine, from which the oil is conveyed through copper tubes to the bearings on the slides.

The lubricant pump is a self-contained unit, the tank to which the pump is attached extending inside of the column of the machine. The whole unit can be quickly removed and facilities are also provided for quickly filling or draining the tank. The belt runs from the main driving pulley directly to the pump pulley and is of the endless variety. The lubricant pipe ends in a section of flexible tubing so that the stream of compound can be directed as desired, and a convenient shut-off valve is placed within easy reach.

Eleven ball bearings are used in the construction of the machine. The spindle has a long bearing of large diameter and is counterbalanced by a spring working directly in connection with the rack for moving the spindle up and down. This spring may be so adjusted as to make the quick return of the spindle possible when this is desired. A stop is provided on the quadrant for feeding down to a given depth. Double-row thrust bearings are used on the table screw and ball-thrust bearings are provided on all elevating screws. The regular equipment includes pump, tank, pipes and connections, spindle driving belt, wrenches, change gears, etc.

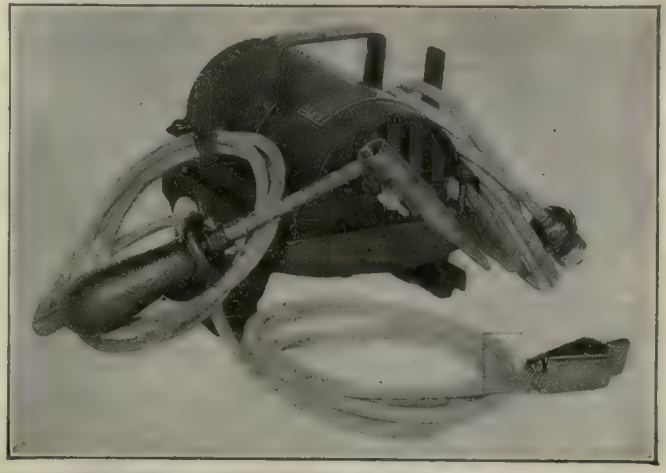


TAYLOR & FENN VERTICAL-SPINDLE MILLING MACHINE

Longitudinal movement, 11 in.; cross movement, 6 in.; vertical adjustment of knee, 10¼ in.; vertical movement of spindle, 2 in.; maximum distance from end of spindle to top of table, 10¼ in.; center of spindle to face of column, 9 in.; size of table over all, 10 x 27 in.; working surface of table, 6 x 18 in.; T-slots in table, ⅜ in.; number of power feeds, thirty-three, 0.0019 to 0.013 in. per spindle revolution; number of spindle speeds, thirty-eight, 500 to 3100 r.p.m.; taper hole in spindle, No. 7 B. & S.; size of hole through spindle, ⅝ in.; diameter of spindle pulley, 4½ in.; width of belt, 1¾ in.; speed of main drive shaft, 290 r.p.m.; diameter of tight and loose pulleys, 10 in.; width of belt, 2 in.; diameter of large driving pulley for spindle, 20 in.; floor space, 41 x 41 in.; weight, 1200 lb.

General Electric Lead-Burning Transformer

This lead-burning transformer, a recent product of the General Electric Co., Schenectady, N. Y., can be used for lead burning, soldering electric terminals, splicing wires and tinsmith jobs, and even brazing can be done by placing the work between a blunt carbon point and a piece of cast iron. The transformer is designed to be connected to the ordinary 110-volt, alternating-current lighting circuit. Heavy rubber-covered terminal leads are used to convey the low-voltage, heat-producing current to the work, one terminal ending in a clip for fastening to some convenient portion of the work while the other terminal has a carbon holder arranged with



GENERAL ELECTRIC LEAD-BURNING OUTFIT

an insulated handle. When the welding carbon is brought into contact with the work the pointed end becomes intensely hot and melts the metal over a restricted area. It should be noted that no arc is drawn, the end of the carbon point being heated to such a temperature that the metal in the vicinity is melted. The device uses about 800 watts while in actual use, the consumption dropping to 4½ watts when the point is removed from the work. It is stated that the device is very convenient in plumbing, roofing and tank-building jobs, as well as other such work. It also claimed that jobs can be done much faster than with gas.

A Business Man's Experience With Industrial Training

By E. A. BARNES
General Electric Co., Fort Wayne, Ind.

Here is a message of the greatest value for every manufacturer in America. It is from a representative of a firm which employs thousands; from a man who knows whereof he speaks. The war-emergency opened his eyes to the remarkable value of a training department such as was brought to his attention by the United States Training Service. At first it was temporary—for new employees. Then the writer and his associates saw the wonderful possibilities of a permanent training department. In a direct and most interesting way he tells, for the benefit of all who will read, just what his training department has done and what it proposes to do.

IN ALMOST every meeting of employers of labor the question which seems uppermost in the minds of factory managers, and which is almost sure to come up for discussion, is that of the enormous labor turnover in the last few years. Unquestionably this excessive turnover has been occasioned by unprecedented war demands for labor, which developed the practice of scalping and stealing labor from one community or plant by another throughout the country.

While this turnover is estimated to cost the employer from $25 to $100 per person, it is by no means the only loss in the factory that needs attention. The loss I have in mind is the loss due to the improper placing of men in the establishment and continuing, or attempting to continue, them in work for which they are not particularly fitted or in which they are not satisfied.

Few industrial establishments have a real system of hiring, selecting, training, inspecting, and upgrading their help. In too many cases the old system of lettng the shop foreman hire the men, without much consideration as to the applicants' ability and training, is still in effect, with the result that many of the new employees spoil work, ruin expensive machinery and tools, and really produce but little work that is perfect enough to be shipped.

First Step Toward Improvement

A systematic investigation of general conditions certainly is the logical first step in improving conditions. An investigation of this sort probably will uncover a great many shortcomings, that the management either has been unaware of or so used to, that they are not duly appreciated. But future industrial competition promises to be so keen as to make it imperative that all removable losses shall receive due attention. Therefore the company with which I am connected is giving a great deal of attention to the personnel of our plant and to the proper training and placing of the employees.

We conduct specialized training courses which may be divided into three groups.

First, the school for the graduate engineer. Here we give the young technical-college graduates an extensive course through the shops, laboratories, and testing departments, supplemented by lectures on special subjects.

Second, the apprentice school for machinists and toolmakers. In this school selected applicants are given a short preliminary course to see if they are likely to develop into efficient workmen. Those who pass this preliminary course sign a contract for four years (the time required for the completion of the course), during which the men are given one and one-quarter hours' daily instruction in such subjects as drafting, mathematics and business English. The other hours of the day are spent at the machine or bench, where they are under the direction of experienced instructors. These apprentice students are paid a fair and graded rate during the entire time, and at the end of the course are given a bonus if they pass their school examinations, and still a second bonus if they pass their mechanical examinations.

Third, intensive specialized courses. We have also found it exceedingly profitable to give an intensive training course in drafting for women, who, on completion of the course, are transferred to regular drafting work in the engineering and drafting departments. Women clerks in the factory also are given the advantage of special courses in blueprint reading and factory routine, which familiarizes them with the product and systems to the extent that they can readily grasp situations and intelligently carry on the work.

In general, we are prepared to give to special classes of our employees intensive instruction in subjects pertaining to their daily work that a few years ago would have been thought wholly unnecessary.

Temporary Training Department

Provision having been made for the training of the future engineers, special machinists, draftsmen, clerks, and future office executives it would seem that the training and upgrading of the man in the shop should be taken in hand and followed continuously and vigorously.

Our experience along this line extends over two years. When this country entered the war we were confronted with the common problem of obtaining adequate help to make up for the losses of young men entering the service, and were attracted by the bulletins put out by the U. S. Training Service concerning the vestibule school or training department. An investigation of some of the established schools developed the fact that they were in many respects similar to suggestions that we already had under consideration. We therefore decided to establish a real training department in which all classes of drilling machines, grinding machines, engine lathes, turret lathes, and automatic screw machines would be installed, and where competent instructors would take applicants for employment and train them a sufficient length of time to guarantee their being productive when transferred to the factory. The rates to be paid the trained workers were attractive, and steady employment was insured.

We ran this school until the armistice was signed, when the necessity for it in its inital form naturally ceased to exist. The reports from the foremen in the factory indicated that the employees who had been trained in this vestibule school were very efficient and desirable help; these trained operators were, in fact, much sought after and competed

for by our various manufacturing departments. These facts lead us to the conclusion that the systematic training system is a good thing, and that it should be installed permanently.

With such a training school in operation, it is our intention to refer to this school all newly engaged machine operators who cannot furnish evidence of having served time or worked efficiently in a machine shop. In this school the capabilities of such new employees will be gaged before they are allowed to get into the shop proper.

Before we hire any more help we feel that our present employees should receive close attention and we propose to have "instructors at large," who are bright mechanics, going around the shop picking out operators who, due to lack of initial training, are less efficient than their neighbors. Such operators will be sent to the training department for a short period and will then be returned to their regular departments much improved, we believe, because they will have received individual, intensive training which they cannot get in the shop itself.

In connection with this training department we expect to have classes in blueprint reading. Information will also be presented which will promote better relations between the employee and employer. Much of the general unrest that exists in shops today is brought about by the lack of appreciation of what the employer is doing, or would like to do, for the men. We feel sure that much benefit will be derived from an understanding of the situation that comes with practical demonstration. In other words, we will upgrade and educate our less fortunate employees, and in the hiring and selecting of new ones we will attempt to launch them into the factory world with a better knowledge of what is expected of them than has been possible in the past.

Systematic training may appear to be an exceedingly expensive enterprise in which only a few concerns can afford to embark. This is by no means the case. Our statisticians have shown us that it costs from $25 to $100 to train each employee. If, therefore, this system of scientific training enables us to cut our turnover in two, or even reduce it by one-quarter, the amount saved would be unbelievable.

If business conditions should not warrant a continued hiring of new help, the training department, equipped as it is with modern machinery, can be used to advantage to test out applicants for better positions. It has been developed that as soon as some systematic training system is put into effect, operators who under ordinary conditions would be satisfied to stay on one particular job, become ambitious to advance, and if the opportunity is held out to them through the medium of these "instructors at large," etc., their applications for advancement and trial elsewhere can be given much better consideration.

[Note: This article is from a bulletin issued by the United States Training Service, 618 Seventeenth St., N. W., Washington, D. C. Copies of this and other bulletins, also free expert advice on establishing training departments may be secured on request to Charles T. Clayton, Director, at the above address.]

Machine-Tool Prices

By S. Owen Livingston
President Grand Rapids Grinding Machine Co.

There is one point of view in the matter of machine-tool prices that, it seems to the writer, is not receiving as much consideration as it should.

Some machine-tool buyers seems to expect that all machine-tool prices should be reduced, irrespective of the amount of advance that was made in those prices during the war, and because some lines of machine tools have been reduced in price, these buyers seem to expect that *all* prices should be reduced.

It would be a comparatively easy matter for any purchaser of machine tools to ascertain what the price of a corresponding machine was, say three and ten years back. It is a well-known fact that many machine tools have not only doubled, but in some cases, more than trebled in price in the last three years. The contention that such prices should come down cannot be successfully combated. There are other machines, however, which it can be easily shown, have only increased a total of less than 50 per cent. in the last ten years and less than 33⅓ per cent. in the last three years. Makers of these lines obviously cannot be expected to follow the cuts in the lines that made the abnormal increases. Expecting such a reduction is a poor way of showing gratitude for the reasonable prices maintained during the strenuous times just past, and it obviously is not possible.

Labor and material have advanced in round figures 100 per cent. and all the other incidental expenses of doing business have also gone up proportionately. The increase in cost is so much in excess of 50 per cent. that the manufacturer, whose prices are today only 50 per cent. higher than they were ten years ago, is entitled to an increase, rather than a decrease in his present prices.

The writer has no desire to see machine-tool prices remain at an unhealthy altitude, but his plea is that in looking for reductions, the prospective buyer separate the sheep from the goats or, perhaps it may be expressed in the wish that the buyer refrain from trying to make those who have been the sheep, the "goats" in the present situation.

The editorial by Mr. Colvin in a recent number of the *American Machinist* calls attention to the incontrovertible fact that the machine-tool industry at the present time contributes more to the financial and mechanical advantages of this country than any other industry, and with all, for a very much smaller percentage of profit. The meager profits make it impossible to train and hold that high grade of mechanics which must be utilized if America is to maintain her position, to say nothing of making progress in the machine-tool industry. While that condition is true, it is folly for machine-tool builders or buyers to figure on any greater reductions than will serve to eliminate the excessive advances which were based on supply and demand, irrespective of cost of production.

How Would You Prevent This Grinding Trouble?

By A. E. Holaday

On page 705 of *American Machinist*, John Vernon asks how he can avoid the warping of a cold-rolled steel plate to which is riveted a cast-iron bracket. He further states that cold-rolled steel is not a prime requisite, providing he can get other material with reasonably smooth surfaces.

Why not cast the piece of semi-steel or malleable iron? By casting the piece complete he would avoid the operation of riveting on the already cast bracket. I know that it would be entirely practical, as we are now casting a large tonnage of similar work, which must have a fine surface suitable for nickel plating. It would be necessary to allow but one degree of draft on the sides to make it practical to mold.

A year or two ago an inquiry appeared in the *American Machinist* [page 604, Vol. 44] as to how you would make a certain nail which was there illustrated, and I suggested casting in malleable iron. We are now making the nail in millions from this material.



Sparks from the

Foundrymen Are Perfecting Plans for Annual Meeting

A Local Committee, Formed in Philadelphia Has Secured More Than 25 Technical Papers for the Professional Sessions

Plans for the twenty-fourth annual meeting of the American Foundrymen's Association, which will be held in Philadelphia during the week of Sept. 29, are rapidly being perfected. Several delegations of British, French and other European foundrymen are expected to attend as the result of arrangements now being made in Europe by A. O. Backert, president of the Association. Special stress, therefore, will be laid on both the entertainment and technical features of the program this year. Considerable progress already has been made in both directions.

A local entertainment committee has been formed in Philadelphia and over 25 papers and addresses have already been secured for the professional sessions which will probably open on Tuesday, Sept. 30, concluding Friday, Oct. 3. Simultaneous sessions are being planned for Wednesday and Thursday, Oct. 1 and 2, with special sessions as usual for the discussion of gray iron, steel and malleable foundry practice. The customary exhibition of foundry and shop equipment will be held in the Commercial Museum where unusually satisfactory facilities are available, and the advance reservations for space already received indicate that the exhibition this year will be the largest ever held.

The Philadelphia local committee was formed at a recent meeting of the Philadelphia Foundrymen's Association. Thomas Devlin, Thomas Devlin Manufacturing Co., president of the Philadelphia Association, and Howard Evans, J. W. Paxon Co., secretary, are ex-officio members of this committee. The other members include G. H. Clamer, Ajax Metal Co., Philadelphia; C. R. Spare, American Manganese Bronze Co., Holmesburg, Penn., H. W. Brown, Tabor Manufacturing Co., Philadelphia; Frank Krug, White & Bros., Inc., Philadelphia, and J. D. Hibbs, J. W. Paxon Co., Philadelphia. It is expected this committee will be considerably enlarged and its work organized through the medium of subcommittees a little later on.

Unusual historical interests are attached to the forthcoming convention, since it was at Philadelphia in 1896 that the American Foundrymen's Association was organized as a result of a movement led by the Philadelphia Foundrymen's Association. It is expected that the entertainment program which is being prepared for the coming convention will emphasize the prominence of the Quaker City as a foundry center. The details are still to be worked out but it now seems assured that one of the features of the program will be a shad dinner of the variety for which Philadelphia is famous. Other unique entertainment features are contemplated.

Among the technical papers for which arrangements already have been made are the following: "Results of an Investigation of Steel Castings on German Submarines," by Prof. William Campbell, Columbia University, New York; "Training Men for Foundry Work," by C. C. Schoen, training section, U. S. Department of Labor, Washington, D. C.; "The Comparative Qualities of Electric and Converter Steel Castings," by John Howe Hall, Taylor-Wharton Iron and Steel Co., High Bridge, N. J.; "Experiments With Melting High Sulphur Malleable Scrap," by A. W. Merrick, General Electric Co., Schenectady, N. Y.; "The Side Blow Steel Converter and Its Possibilities for the Gray Iron Foundry," by George P. Fisher, Whiting Foundry Equipment Co., Harvey, Ill.; "Micromotion Study for Foundrymen," illustrated by moving pictures, by Maj. Frank B. Gilbreth, Providence, R. I.; "Electric Furnaces for Foundry Use, Specially for Annealing Steel Castings," illustrated by motion pictures, by T. F. Baily, Electric Furnace Co., Alliance, Ohio; "Methods for Determining When Malleable Iron Is Over or Under Annealed," by Maj. W. P. Putnam, Detroit Testing Laboratory, Detroit; "Relation Between Machining Qualities of Malleable Castings and Physical Tests," by Edwin K. Smith, Wisconsin Malleable Iron Co., Milwaukee; "How to Secure Best Results in Combining Hoisting Apparatus With Molding Machines," by W. C. Briggs, Shepard Electric Crane and Hoist Co., New York City; "Concrete Foundry Floors," by H. H. Haley, American Foundry Equipment Co., New York; "Personnel Problems of Modern Industry," by C. D. Dyer Jr., consulting engineer, Philadelphia; and "Foundry Sand-Handling Equipment," by H. L. McKinnon, the C. O. Bartlett & Snow Co., Cleveland.

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Machinery Club of Chicago Holds Dinner

The Machinery Club of Chicago held a dinner on Thursday evening, May 22. The dinner was followed by an illustrated lecture by Sergeant Luders upon the subject of the Battle of Gallipoli and the Suez Canal.

Allied Machinery Co. of America Increases Capital Stock

The Allied Machinery Co. of America has increased its capital stock to $5,000,000. This was made necessary by the decision of the American International Corp. to group all of its machinery export-selling subsidiaries under one head. This move contemplates the complete absorption of the Allied Construction Machinery Corp. by the Allied Machinery Co. of America. The Allied Machinery Co. de France and the Allied Machinery Co. d'Italia will retain their corporate entities but their parent corporation will be the Allied Machinery Co. of America rather than the American International Corp. as before. This is also true of the Horne Co., Ltd., of Japan, which was purchased early in the year by the American International Corp.

All shares of the Allied Machinery Co. of America will, as before, be owned by the American International Corp.

The Allied Machinery Co. of America was formed in 1911 by interests associated with the National City Bank of New York to sell machine tools in Europe. In 1916 it was taken over by the American International Corp. which immediately set about to expand and organize the business on a larger scale. The business has increased rapidly and today the company is operating in 14 countries.

J. W. Hook will continue as president of the Allied Machinery Co. of America, in general charge of the business. F. A. Monroe, S. T. Henry and T. G. Nee have been elected vice presidents. Mr. Monroe is in charge of the administrative affairs of the company. Mr. Henry is in charge of sales and advertising and Mr. Nee is at present in Japan devoting his attention to the affairs of the Horne Co., Ltd. Mr. R. P. Redier is general sales manager of the company, with headquarters at Paris.

* * *

Wages Rise 107 Per Cent.

According to the New York *Times*, a report just issued by the New York State Industrial Commission says that during the four years since March, 1915, wages have increased 107 per cent. and the number of employees 18 per cent. In March, 1919, there were 9 per cent. fewer workers in the factories of the State than in the same month of 1917, but the payrolls were 27 per cent. larger. In many industries there were more workers than were employed in February, when the decrease in employment appears to have been at a lower point than for a long time previously.

World's Industrial Forge

By E. C. Porter, News Editor

Training Helps Workers to Help Themselves

Three-fourths of the industrial workers in America are handicapped by lack of proper training in their respective tasks, according to the U. S. Training Service of the Department of Labor. The work of the Service is to increase the efficiency of this "insufficient three-fourths," rather than to stimulate the output of the one-fourth already producing at a satisfactory rate, says a bulletin entitled, "Some Advantages of Industrial Training," now being distributed free by this branch of the Government.

Bringing about a big increase in output of the average plant, the Government contends is wholly within the possibilities, if the following steps are taken: (1) A careful analytical survey of the operations in the plant to ascertain where existing methods can be improved; (2) the formulation of a definite program of training, either in a separate department or "on the floor" in direct conjunction with production; (3) the instruction of those workers who are most in need of it, and (4) the upgrading of those in the next higher strata. A training department helps workers to help themselves.

Another question of keen interest to the working man and the employer alike, taken up in this bulletin, is the effect of training on labor turnover. It points out that the turnover for the country at large is at least 250 per cent., placing an annual burden of $1,250,000,000 on our manufacturing industries. Basing his claim on the experience of several score of plants where training has been installed, the author maintains that such instruction in a factory causes a big reduction in turnover. The trained employees can more readily find suitable work and are more easily retained in a plant. Training contributes to a better spirit among employees and develops better teamwork with the employers. This bulletin is one of a series, all of which can be had for the asking. Requests should be addressed to the U. S. Training Service, care of the Department of Labor at Washington.

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High Record for April Foreign Trade

April exports surpassed the previous high record by nearly $100,000,000, according to recent announcement made by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Exports for the month totaled $715,000,000, as compared with $623,000,000 for January, the previous high mark. For March of this year the total was $605,000,000, and for April a year ago, $501,000,000. For the 10 months ended with April the exports were valued at $5,705,000,000, as against $4,884,000,000 for the corresponding period last year.

Imports for April totaled $273,000,000 in value, a gain of $5,000,000 over the $268,000,000 announced for March, and a decrease of $6,000,000, as compared with the $279,000,000 for April of last year. Imports for the 10 months ended with April are put at $2,474,000,000, as compared with $2,362,000,000 for a similar period in 1918.

* * *

Convention of American Boiler Manufacturers

The thirty-first annual convention of the American Boiler Manufacturers' Association will be held at Lafayette Hotel, Buffalo, on Monday and Tuesday, June 23 and 24.

This Association consists of all builders of high-pressure steam boilers, of both water-tube and fire-tube types. An interesting program has been arranged. Full information can be had by addressing H. N. Covell, secretary, at 191 Dikeman St., Brooklyn, N. Y.

* * *

Industrial Safety Council Organized

The Geneva Industrial Safety Council, Geneva, N. Y., has been recently organized with E. R. Dobbin, Empire Gas and Electric Co., chairman; E. Ridley Burroughs, Standard Optical Co., vice chairman; Russel Allen, Tay & Bowen Engine Co., secretary, and H. D. Tarbell, Geneva Cutlery Co., treasurer. Practically all the industrial and manufacturing interests in and about Geneva have coöperated in this new Industrial Safety Council which purposes to obtain for all employees the maximum of personal safety, comfort and contentment while at work.

* * *

Contracts for New Building

The O. R. Adams Manufacturing Co., Inc., Rochester, N. Y., has increased its capital stock from $30,000 to $150,000 and has awarded a contract for a new building for the manufacture of the Adams Short-Cut lathe. The new building will provide about 4500 sq.ft. of floor space and will cost approximately $15,000.

F. H. Brown, formerly sales manager of Sherritt & Stoer Co., Philadelphia, has been appointed president and general manager. O. R. Adams is secretary and treasurer.

Seventh National Foreign Trade Convention

Will be Held in San Francisco on May 12-15, 1920. It Will be the First of These Conventions to Be Held on the Pacific Coast

The seventh National Foreign Trade Convention will be held in San Francisco, Calif., on May 12-15, 1920. It will be the first of these important conventions to be held on the Pacific Coast, previous conventions having been held at Washington, D. C., New Orleans, St. Louis, Pittsburgh, Cincinnati and Chicago. In deciding on San Francisco for the convention city, the National Foreign Trade Council was influenced by the growing importance of the Pacific Coast in the foreign commerce of the country, and by the enthusiastic support which the Far West has given all previous foreign-trade gatherings.

Manufacturers from the East welcome the prospect of a San Francisco convention at which the problems of the "Twentieth Century Ocean" will be fully discussed. With many of the markets of Europe restricted by embargoes, it is natural for manufacturers to expand their trade in South America, and to look toward new fields among the great populations of China, Japan, India, Siberia and Australasia. The importers of the country, both merchants and manufacturers, have a special interest in the trade of our western ports. Shipping men will find on the Pacific a marine situation of national interest, brought about by the development of a large Japanese merchant fleet aided by government subsidies and low labor costs. Traffic managers from the interior of the country will be enabled to see and judge at first hand the ports through which much of their sales will be routed in the future.

While the convention itself will be held in San Francisco, it will really be a Pacific Coast gathering, and the cities of Seattle, Tacoma, Portland and Los Angeles will share with San Francisco in the attention of the visiting delegates.

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Railroad Blacksmiths Will Hold Convention in Chicago

The International Railroad Master Blacksmiths' Association will hold its annual convention in Chicago, Aug. 19, 20 and 21. This organization has been recognized and encouraged by the railroads on account of its educational value. All master and foremen blacksmiths that can be spared from the various railroads without detriment to the service will be in attendance.

Business Items

The executive and sales offices of the Max Ams Machine Co., Bridgeport, Conn., have moved to 101 Park Ave., New York.

The Tacony Steel Co. has opened a Cleveland office in the Swetland Building under the direction of W. W. Keefer, district sales manager.

L. V. Estes, Inc., industrial engineers and accountants, has removed its offices to the Century Building, 202 South State St., Chicago, Ill., where it will occupy the entire 15th floor.

The Waterloo Cement Machinery Co., Waterloo, Iowa, has changed its name to the Waterloo Construction Machinery Co. H. B. Lichty is president and L. A. Kliebenstein is secretary.

M. C. Green has discontinued his general repair and machine work to specialize in preheating devices, experimental and research work, also acting in the capacity of a consulting engineer. The office and demonstration plant is located at 325 Campbell St., Williamsport, Penn.

The Monometer Manufacturing Co., Ltd., Birmingham, England, announced that during the war it has equipped the English government aircraft factories with its system of melting furnaces and also has equipped the most important government factories with furnaces for the melting of all ferrous and non-ferrous metals.

The Collins Rotary Safety Razor Sales Co. has under construction a factory located on West St., between 43rd and 44th Aves., Chicago, Ill. The size of this building is 158 x 200 ft., two stories high; it is of brick, concrete and steel construction and is expected to be completed by July 1. H. A. Hassalquist has been appointed superintendent and production engineer of the new building. He has been identified with a number of large concerns during the past 29 years.

Meyer, Strong & Jones, Inc., has succeeded to the engineering practice of Henry C. Meyer, Jr. and Bassett Jones, associated, and of William E. S. Strong. Mr. Strong was connected for many years with the American Raditor Co. as chief engineer. During the past year he has been engaged in war work, with MacArthur Bros. Co., in connection with the United States bag-loading plant No. 2 at Woodbury, N. J.. Mr. Meyer and Mr. Jones have been engaged in consulting work in New York City since 1903. Messrs. C. A. King, H. E. Meeker, H. F. Richardson and J. J. Ruckers who have been associated with Messrs. Meyer and Jones for a number of years, will be in charge of the work in the new organization. The new firm will act as consulting engineers for steam and electrical work, power plants, etc., and will have offices at 101 Park Ave., New York City.

Trade Currents

Cleveland Letter

The last week of the month has proved to measure up better in volume of machinery and machine-tool business in the Cleveland and northern Ohio district than expectations at the beginning of May would have warranted. While no large individual orders have come forward during the period, there has been an increase in the number of individual items of equipment called for. Much of this has been of the staple variety, grinding machines, shears, punches and similar equipment constituting the main business.

Japanese Firm Places Order

The outstanding feature of the week is the entry into the Cleveland market by a big Japanese manufacturing firm, which is about to place an order totalling $35,000 for miscellaneous equipment of small machinery and tools, with which it plans to equip a machine shop to be operated in conjunction with its manufacturing establishment.

Aside from this inquiry the best development is the larger number of orders being received for new machinery. Not since the now memorable Nov. 11 has there been such interest in new equipment, in the opinion of more than one leading distributor, as there has been in the last two weeks. Orders placed in the last few days of May show that an equal amount of new material and used machinery is being taken. The Cleveland trade is well satisfied with the manner in which the Government is easing off in the disposal of used equipment, for this method is taken as the best means of indicating there will be no immediate falling off in prices. It is largely this belief that is keeping consumers backward in the placing of their orders, machinery interests say, and because they now realize there will be no early reductions, the reasons for optimism for the next few months in the trade are well founded.

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Import Restrictions on Emery Removed

The War Trade Board announces that all existing restrictions upon the importation of emery and emery ore have been removed, and that shipments of such commodities may hereafter be entered under General Import License No. PBF-37, described in W. T. B. R. 726, issued May 8, 1919.

Shipments of emery and emery ore now in the United States, entered under import licenses which were issued upon the condition that such emery or emery ore would not be used for consumption until a period of 60 days had elapsed from the date upon which the restrictions against the importation of emery and emery ore were removed, are released for immediate use, and such condition need not be further observed by the holders of such licenses.

Personals

O. T. Smith, for several years connected with the Colonial Steel Co. in the New England district, is now associated with the Aborn Steel Co., Boston, Mass.

P. F. Sheeran has returned to the organization of J. J. McCabe Lathe and Machinery Corporation, N. Y., and has resumed his duties as sales and advertising manager.

C. H. Parr has been appointed chief draftsman in the engineering department of the Hart-Parr Co., Charles City, Iowa. H. E. McGray is chief engineer of this department.

F. W. Shumard, supervisor of the machine and tool branch of the Motor Transport Corps, Washington, D. C., has left the Government service and is now superintendent of the Arnold Hellmuth Manufacturing Co., Brooklyn, N. Y.

Walter E. Flanders, pioneer in the automobile industry, has resigned his connection with the Maxwell Motor Co., of which he was for many years president and more recently chairman of the board of directors. His future plans have not been made known.

Lieut. H. J. Williams, Engineering Division, Ordnance Dept., U. S. A., recently discharged, has been appointed engineer of the Beacon Falls Rubber Shoe Co., Beacon Falls, Conn. Prior to his entry into the service, Mr. Williams was consulting and mechanical engineer and also on the teaching staff of Pratt Institute, Brooklyn, N. Y.

Charles T. Fallon has been appointed sales manager of the Tacony Steel Co., which has recently opened offices in the Oliver Building, Boston, Mass. Mr. Fallon has been in the U. S. Naval Reserve Flying Corps for two years and prior to his enlistment was connected with the Wheelock Lovejoy Co.

I. Hall, managing director and engineer of the Monometer Manufacturing Co., Ltd., Birmingham, England, will sail for this country in the course of another month to make arrangements for the organization for the manufacture of all kinds of Monometer furnaces for melting, annealing, carbonizing and heat-treatment of steel.

* * *

Want to Represent American Firms in France

The Société Francaise D'Action Economique, 1 rue des Italiens, Paris, France, which is represented here by Daniel T. Pierce, 149 Broadway, New York, reports that it has inquiries from French firms who desire to secure American agencies in France for building hardware, portable wooden dwellings, automatic machinery, electrical supplies, and oil and lubricants for industrial purposes.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Stands, Electric

United States Electrical Tool Co., Cincinnati, Ohio.

"American Machinist," May 15, 1919



Made in one- and two-horsepower capacities, driven by Westinghouse electric motors and can be furnished for direct current of 110 or 220 volts or alternating current of 220 or 440 volts, 60 or 25 cycles, for either two- or three-phase circuits. The weight of the smaller machine is 360 lb. while that of the larger is 480. The diameter of the emery wheel on the smaller machine is 10 in., and the diameter of the emery disk is 12 in. On the larger machine the diameter of the emery wheel is 12 in. with 1¼-in. face, and the diameter of the emery disk is 12 in. SKF ball bearings are used and ball-thrust bearings are fitted on the emery disk side of the motor to take care of the end thrust from the emery disk. The speed of the alternating-current machine is 1700 r.p.m. while that of the direct-current is 2900 r.p.m.

Micrometer, Quantity-Production

J. T. Slocomb Co., Providence, R. I.

"American Machinist," May 15, 1919



The quantity-production micrometer shown is intended for use where a large number of pieces are to be made of one size, the micrometer saving eye-strain and allowing accuracy in inspection. The graduated portion is clamped to the micrometer spindle and the indicator is clamped to the sleeve or stationary part of the micrometer, the attachment being so adjusted as to read zero at the correct size and 0.002 in. on each side, plus or minus. The distance between the thousandth marks is $\frac{5}{16}$ of an inch. The parts are made of aluminum for lightness and are furnished to read in half thousandths or in tenths of thousandths.

Gage, Plug, Double-End Detachable

American Gage Co., Bridgeport, Conn.

"American Machinist," May 15, 1919

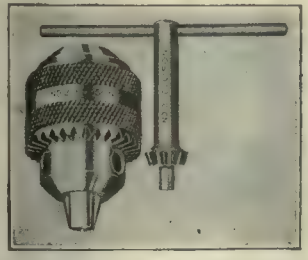


The handle is drilled through and drilled and reamed to a specified depth in each end to fit the shanks of the plugs. The plugs are held in place by hardened-steel screws. The plug holes are countersunk to prevent difficulty from burring in case the gage was used with only one plug in place and roughly handled. The plugs are carried in stock heat-treated, seasoned and rough-ground, and are finish-ground and lapped to the customer's specifications when the order is received.

Chuck, Drill, "Ellison"

American Machine Co., 104 Wellington Ave., Hartford, Conn.

"American Machinist," May 15, 1919



These chucks are made at present in three sizes: No. 1 has a capacity for drills up to $\frac{7}{32}$ in.; No. 2, up to $\frac{1}{2}$ in. and No. 3, up to $\frac{47}{64}$ in. Two other sizes will be ready by July 1. No. 4 will have a capacity of from $\frac{1}{16}$ to $\frac{3}{4}$ in., and No. 5, from $\frac{3}{8}$ to $\frac{1}{8}$ in.

Plier Wrenches

A. C. Allen, 6441 Eggleston Ave., Chicago, Ill.

"American Machinist," May 15, 1919



The wrenches are convenient to manipulate, quick acting, and take a firm grip on the object clamped in the jaws. At any opening the jaws are parallel. The slotted opening for the fulcrum pin permits adjustment for three sizes of openings. In wrenches Nos. 3 and 4 a different type of adjustment is used with a curved slot for the fulcrum pin. It is claimed that with these plier wrenches a ratchet motion may be obtained on nuts and pipes by releasing the handle and taking a new grip.

Truck, Type M "Singlelift"

Lewis Shepard Co., 48 Binford St., Boston, Mass.

"American Machinist," May 15, 1919

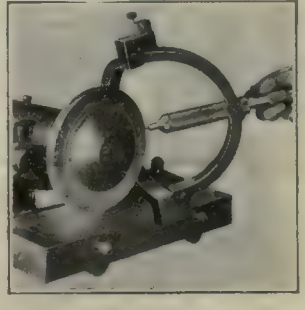


This is a light-duty model elevating truck, designed to handle loads up to 2000 lb. only, and the elevation of 2 in. is accomplished by one stroke of the handle. To raise the load it is simply necessary to press the foot pedal which engages the lifting handle with the load. To lower the load, the pawl is thrown back with the foot but the load cannot be lowered until the operator takes the weight of the load on the handle to control its descent, this feature insuring that the operator must be ready to control the load before it can be lowered. Made in 9 styles. Heights, lowered, 6, 7 and 9 in.; diameter of wheels, 6, 7 and 9 in.; width, 17¼ in.; overall lengths, 40 to 61½ in.; wheel bases, 31½ to 51½ in.; wheel face, 2½ in.; lengths of carrying platforms, 28 to 48 in.; net weights, 140 to 170 lb.

Dresser, Grinding-Wheel

W. T. Smith Manufacturing Co., Bridgeport, Conn.

"American Machinist," May 15, 1919

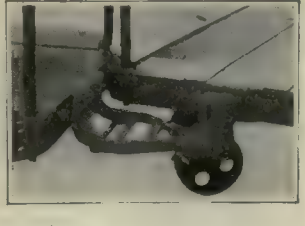


A grinding-wheel dresser, so made as to produce the proper form of wheel for grinding various radii. Its main feature is a diamond holder mounted in a trunnioned yoke. With the cutting point set to the correct radius on the micrometer scale it is only necessary to swing the movable arm through 90 deg. for a radius and through 180 deg. for a half circle. Thus no templet or cutter is required and the time of the operation is materially reduced. The tool is shown set for cutting an inside or concave radius. For an outside or convex radius the point of the tool will be drawn back to the other side of the center line. In either case the exact radius is determined by the micrometer adjustment under the fingers of the operator. The micrometer is graduated in thousandths of an inch for radii.

Trailer Coupler, "Carlton"

Lansing Co., Lansing, Mich.

"American Machinist," May 15, 1919



The illustration shows a coupler built to join industrial trailers together and to the tractor drawing them. It is built of malleable iron and permits trucks to be operated at any angle up to 90 deg. to each other as shown. When uncoupled the drawbar clears the floor or remains up against the load when placed in that position.

Patented Aug. 20, 1918

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Firms in Belgium desire to purchase machine tools, belting, coal-mining machinery, accessories for railroad cars and locomotives. Agencies are also desired. No. 29,372.

The purchase of machinery and equipment for a complete bottle-making plant, with capacity for making annually 15,000,000 bottles, and also window glass, is desired by a company in Spain. Quotations should be given f.o.b. New York. Terms, cash against documents through bank in New York. Correspondence should be in Spanish. References. No. 29,374.

An agency is desired by a firm in Switzerland for the sale of tools, machine tools, and articles for metallurgical industry in general. Correspondence should be in French. Reference. No. 29,385.

A merchant in France desires to secure an agency for the sale of motors of all kinds, gas engines, combing, spinning and weaving machinery and accessories. Correspondence should be in French. Reference. No. 29,375.

A steel plant in Italy which is about to increase its capacity will require blast furnaces, steel furnaces, blowing engines, boilers, trains of rolls for plates, beams and rails, and steel construction for building. Heretofore, these products were supplied by Germany, but now it is suggested that an American with a knowledge of the Italian language be sent to Italy to make estimates for this work. No. 29,411.

The purchase outright or an agency is desired by a firm in England for the sale of tools, chiefly joiners' and engineers', but particularly those used by ironmongers and hardwaremen. Reference. No. 29,415.

A man in India is desirous of obtaining machinery for the extraction of oil from oil seeds, and wishes to be placed in communication with firms who can supply these machines. No. 29,421.

The director of a locomotive and marine engine manufacturing establishment in Italy desires to purchase American machine tools. An opportunity is hereby offered for the introduction of American machine tools in that country. No. 29,427.

Tractors, other agricultural machines, copper sulphate, and sulphur and instruments for treatments of plant diseases, are required by a company in France. Terms, cash. Correspondence should be in French. Reference. No. 29,448.

The purchase of all kinds of metals is desired by a firm in Sweden. Correspondence may be in English. Reference. No. 29,451.

Electrical supplies of all kinds, transmission belting, axles, machine tools, electrical cables, etc., are desired by a firm in Norway. Quotations should be given f.o.b. American port of shipment. Terms, cash against documents. Reference. No. 29,452.

New Publications

Motor-Vehicle Engineering. By Ethelbert Favary. Three hundred and thirty-three 6 x 9-in. pages, 133 illustrations and 34 tables. Bound in green cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price, $3.

The object of this book is to give in a concise manner and in simple language, the information needed by the designer and the automobile engineer in their everyday work, and with only the simplest mathematics. The book is also intended for draftsmen, technical graduates, mechanics and others engaged in different branches of engineering, who wish to obtain a technical training in motor-vehicle engineering, including design and testing. Throughout the volume, the higher mathematics have been eliminated, as the author has found from practical experience that a majority of those seeking information on engineering subjects are conversant with elementary algebra only, and perhaps a little trigonometry. The subject matter may therefore be followed easily by those whose knowledge of mathematics is limited, or has become rusty from disuse. An endeavor to bring the subject fully up to date is apparent, and it includes data of the latest designs specially gathered for the purpose from the leading manufacturers. Truck-engine design is treated in an unusually exhaustive manner owing to the present increasing importance of this subject.

The various chapter headings are: Engine Principles; Compression, Combustion and Expansion of Gas; Cylinder Clearance and Compression; Theory of Four-cycle Engine Disclosed by Indicator Diagram; Cylinder Dimensions; Valves; Valve Timing, Cams, Camshafts; Camshaft and Accessory Drives; Pistons; Connecting-Rods; Crankshafts, Engine Balancing; Kinetic Forces; Flywheels; Crankcases; Lubrication of Engines; Offset Cylinders; Manifolds; Engine Cooling, Combustion Chamber, etc.; Power of Engines, Efficiency, Torque; Brake Horsepower Tests of Automobile Engines; Mean Effective Pressure; The Manaograph; Brake Horsepower Test by Electric Dynamometer; Brake Horsepower Test by Hydraulic Dynamometer; Tractive Effort and Power for Motor Vehicles; Tractive Factor, Torque, etc.; Materials; Hardening Steel; Methods of Testing Hardness of Metals; Index.

Standard Wiring for Electric Light and Power. By H. C. Cushing, Jr. Two hundred and sixty-seven 4 x 6¾-in. pages with illustrations, tables and diagrams. Bound in flexible black leather, handbook style. Published by H. C. Cushing, Jr., 8 West 40th St., New York. Price $1.50.

This book contains the latest information and suggestions for light and power wiring. The author, in collaboration with Ralph Sweetland, secretary of the electrical committee of the National Fire Protection Association, has made it his aim in compiling this book, to set forth as clearly as possible the essential rules and requirements for safe and efficient exterior and interior wiring and construction for electric heat, power and light. The object is to standardize, as much as possible, all work of this nature, and to suggest to the electrical engineer, architect, house-owner, contractor and wireman, just what is required by the Fire Underwriters' inspectors throughout the United States. The arrangement of the book makes it easy to find almost any subject relating to wiring and its numerous problems.

Trade Catalogs

Ideals and Convictions. Frank D. Chase, Inc., Chicago, Ill. Booklet; pp. 30; 5 x 6 in.; showing reprints of advertisements to illustrate what the company is doing as industrial engineers and also its convictions regarding the present industrial situation.

Gisholt Products. Gisholt Machine Co., Madison, Wis. A condensed catalog of its products such as turret lathes, automatic turret lathes, vertical boring and turning mills, universal tool grinding machines, boring bars, etc. A complete catalog on each product will be sent free upon request.

Sprague Electric Fans. General Electric Co., N. Y. A 16-page booklet, illustrating and giving volts, sizes and list prices of the Sprague electric fans.

Bulletin No. 263. Walter A. Zelnicker Supply Co., St. Louis, Mo. Circular; pp. 4; 3⅝ x 8½ in.; describing its various products which are listed as follows: Portable hand-power pipe-threading machines, lamps and copying presses. Also specifications of its steel bodies (for manufacturing and industrial purposes) and dimensions of the "Mosler" safe.

Booklet 137. Works and Products. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. A 62-page booklet in condensed form describing and illustrating its capacity for producing a variety of machinery and detailed information about the company's plant and products.

Chesapeake Electric Traveling Cranes. Chesapeake Iron Works, Baltimore, Md. Catalog, p. 28, 9 x 11 in.; giving cuts and specifications showing the use of the Chesapeake crane in the large machine shops. A representative will call, upon request, to confer regarding the crane requirements.

Forthcoming Meetings

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 West 5th St., Peru, Ind.

The American Society of Marine Draftsmen will hold its eight annual convention at the Hotel Brunswick, Boston, Mass., on June 20 and 21. B. G. Barnes, 1596 North Ave., Bridgeport, Conn., is the secretary.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 21 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

The Second Pan-American Commercial Conference will be held at the Pan-American Building in Washington, D. C., from June 3 to 6, 1919. John Barrett, Pan-American Union, Washington, D. C., is the director general.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Vise, Quick-Acting Cam

F. C. Sanford Manufacturing Co., Bridgeport, Conn.

"American Machinist," May 15, 1919



This is a milling-machine vise which is operated without tools. The jaws are brought to the work by a chrome-nickel steel screw running in a steel floating nut and operated by a fluted handwheel. They are closed on the work by a quick-operating cam operated by the hand lever shown. The movement of the lever is from either side toward the center so that it may be operated by either hand. The screws which hold the jaws are readily accessible, thus making the changing of jaws a simple matter. The company is prepared to supply special jaws. The base and movable slide are made of semi-steel and the slide, handle and gibs, of steel. The jaws are of hardened and ground tool steel. Accuracy sufficient to meet all the demands of the toolroom is claimed by the maker. Reciprocating parts are hand scraped, including the base in which key slots are provided fitted with hardened movable keys. The vise is clamped by a tee-bolt with hardened tee-slot nut.

Swivel Base for Milling Vises, Etc.

F. C. Sanford Manufacturing Co., Bridgeport, Conn.

"American Machinist," May 15, 1919

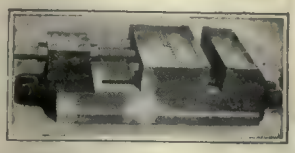


A swivel base particularly designed for use with the vises made by this company but may be adapted to other uses. A keyway and graduations are provided, the hold-down bolts serving to lock the swivel top in any desired position.

Vise, Heavy-Duty Milling

F. C. Sanford Manufacturing Co., Bridgeport, Conn.

"American Machinist," May 15, 1919



This is an all-steel vise and is made for the heaviest work that a triple back-geared milling machine can handle. The movable jaw is operated by a 24-in. socket wrench working on a 1½-in., 6-pitch, nickel-steel screw. This vise is made with either a 4-in. or 9-in. opening.

Gage, Micrometer Adjustable Snap, "Scusa"

Lowry-Knise Co., 211 West Adams St., Syracuse, N. Y.

"American Machinist," May 15, 1919

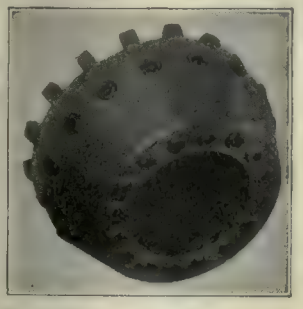


Embodies the usual features of the ordinary adjustable-limit snap gage and in addition provides a ready means for determining the exact amount of stock to be removed to permit the piece to enter the limit gage. The micrometer attachment is similar in construction to the ordinary micrometer. The frame is made of cast iron with two strengthening ribs which afford an easy grip and is finished in black enamel, baked on. The two hardened measuring plugs on the same side with the micrometer head are ground and pressed into accurately reamed seats until they rest on two headless screws which are sealed in place. The three plugs on the opposite side are ground and lapped to have a tight friction fit and are adjustable.

Milling Cutters

R. W. Runde Machine, Tool and Die Works, Detroit, Mich.

"American Machinist," May 22, 1919

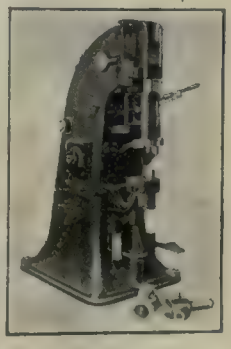


The mills are made in sizes as desired and adapted for various types of milling machines. The advantages claimed are, that the cutter always maintains its original diameter automatically; the individual blade adjustment permits grinding the blades by hand without removing the body from the machine; there is a comparatively small surface to be ground; both ends of the blades can be used allowing the ends to be made with different shapes if desired; only five minutes are required to grind and replace a set of blades; blades too short for use in the cutter can be used in lathe, shaping-machine, or planing-machine toolholders; additional sets of blades may be obtained without excessive cost, and a hardened body making for long life.

Riveter, Electric Type C

Thomson Electric Welding Co., Lynn, Mass.

"American Machinist," May 22, 1919

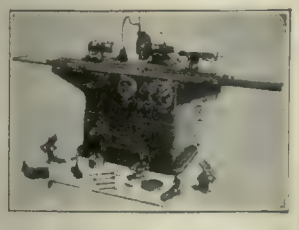


Will handle any commercial lengths of rivets successfully from ⅜ up to ¾ in. in diameter. The rivet is first set in place in its hole and the work is then laid on the lower die so that the under head of the rivet rests in a small pocket in the face of the lower die. The copper heating die is forced into contact with the upper end of the shank to be heated. Pressure on the push button turns on the current and heats the rivet. When the rivet is heated to the proper degree the pressure on the hand lever is released and the head swung to the right, bringing the steel heading die in line with the rivet. The foot treadle is then depressed, engaging a clutch that causes the heading die to make one full down stroke only and return to its starting position when the clutch is automatically disengaged.

Grinding Machine, Universal

Warren F. Fraser Co., Westboro, Mass.

"American Machinist," May 22, 1919



Made in four sizes, No. 2-C 10 x 30 in., No. 2-AC 12 x 30 in., No. 3-C 10 x 42 in. and No. 3-AC 12 x 42 in.; automatic crossfeeds, 0.00025 to 0.005 in.; size of wheel, 10 in. in diameter with 3-in. hole and thicknesses up to 1½ in.; graduations on swivel table, up to 6 deg. on each side or up to 2½-in. taper per foot in both directions; wheel speeds, three, 1910, 2300 and 2875 r.p.m.; table speeds, eight, 10 to 165 in. per min.; work speeds, eight, 17 to 340 r.p.m.; diameter of front spindle bearing, 1¾ in.; diameter of spindle nose, 1 7/8 in.; taper hole in spindle, No. 2 Morse; speed of internal grinding fixture, 25,000 r.p.m.; weights, No. 2-C machine, 3300 lb., No. 3-C machine, 3700 lb.

Hammer, Air or Steam "Utility"

Sullivan Machinery Co., Chicago, Ill.

"American Machinist," May 22, 1919



Specifications: Throat from center of die to face of column, 15 in.; will take work up to 2 in. thick; hammer is capable of 600 strokes per min.; net weight, 1675 lb.; overall height, 6 ft. 6 in.; depth of base, 29 in.; width of base, 16½ in.; hammer cylinder, diameter, 55 in.; hammer cylinder, stroke 5¾ in.; air pressure required, 80 to 100 lb.; air consumption at 90 lb., 93 cu.ft. per minute; total striking weight, 100 lb.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$30.75
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	26.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅜-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.50	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.40	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.35	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.30	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	5.90	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/4, 11/32, 3/16, 1/8, 7/32, 5/16 No. 8, 9/32 and No. 10	25.50 to 33.00	5/16 by 12 in. long	14.00
1/4		1/4 by 19 in. long	12.00
No. 12		3/16 by 19 in. long	10.00
3/32, No. 14 and 1/16		1/8 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/4	33.00
Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.		5/32	30.00
		1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	3/8 to 1 1/8	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	3/8 to 1 1/2	39½%	24½%
1/2	51½%	39%			
3/4 to 1 1/4	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
3/8 to 3 in. steel butt welded	47%	31%	46½%	31 %	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.50	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	5.25	5.25	7.00
Spelter	6.60	6.55	7.00
ST. LOUIS			
Lead	5.00	5.00	6.80
Spelter	6.25	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

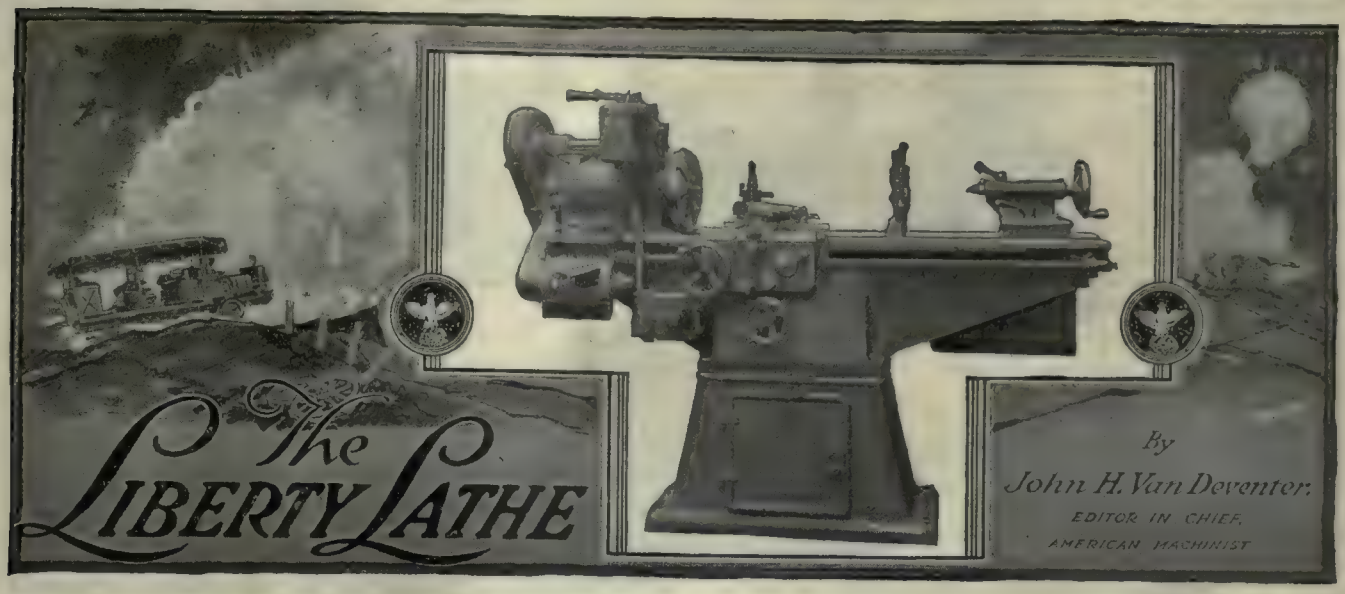
	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	23.00	22.50	31.50–33	24.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	24.00	34.00	22.00	31.00
Brass sheets	20.50	23.75–28	30.75	24.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	31.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	43.00	41.25	39.00	55.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00½	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

June 12, 1919 American Machinist Vol. 50, No. 24



The Liberty lathe came into being in answer to the call of war—not as a war baby—but to satisfy the difficult requirements of motorized machine shops. So well did it meet the demands for rigidity and minimum floor space that its creators, the Davis Machine Tool Co., Inc., of Rochester, N. Y., after building more than eight hundred of these twelve-inch lathes for the Government, have decided to continue the manufacture of this machine both in belt- and motor-driven types.

MAJ. W. L. KERLIN dropped into the *American Machinist* office the other day on his way home from France. Most of his year "over there" was spent in running mobile repair shops. The Major, as befits a man who has been born and brought up in a machine shop, is a go-getter.

During the time that Kerlin was stationed in Washington, before getting overseas, it was necessary to build (overnight) a dark room so that manufacturers of war materials could get photostats. It would have taken seven years to have gotten the order for lumber for this "odd job" through the intricacies of the War Department. This did not faze the Major who went on a still hunt through the streets of Washington until he found a load of lumber being unloaded. By virtue of nerve and the moral effect of a brand-new uniform, Kerlin hornswoggled the reluctant driver into reloading this lumber and depositing it at 1330 F St., N. W. Probably that load of lumber is one of the Government's unsettled claims at the present date, but anyway the dark room was completed, and manufacturers got their photostats.

Later on in France our friend, Kerlin, who had the job of keeping the guns of a certain sector in firing order, found it necessary to get some spare "cradles" for 75's. At the base depot he encountered an officer of superior rank who in a former incarnation had evidently been a rigid adherent to scientific system. This officer informed Kerlin that the order he had brought with him for these cradles was made out on the wrong kind of a form.

"Do you see that truck over there?" inquired Kerlin.

"Yes," assented the scientific-system disciple.

"That's my truck," Kerlin informed him. "Do you see that gang out there in the yard? That's my gang. These cradles are your cradles, I'll admit, but they are going on my truck, system or no system, and if you don't believe it, call out *your* gang and we will see who wins the argument!"

Kerlin got the cradles without going back for another order form.

But what has all this got to do with the Liberty lathe? At least it gives you an idea of the kind of go-getters who ran these motorized machine shops and that such men would not spare wear and tear of equipment to get results. These shops had the hardest kind of usage. They were as likely to land in a ditch or a plowed field as to continue on the road. A level floor was the one thing you could never expect. Thus the ordinary four-legged lathe rested uneasily on such a variable foundation.

In answer to the Government's requests, the Davis Machine Tool Co. designed a single pedestal-leg lathe for this exacting service. It is shown in the title illustration of this article. George E. Randles who was in charge of the Maintenance Division of the Motor Transport Corps christened it the "Liberty lathe." Of course it was motor driven as were all of the tools on these portable machine-shop units. It was a lathe that would preserve its alignment and do accurate work in spite of the shaking and pounding inevitable in this service, and at the same time so simple and easy to operate that

the rookie machinist could make good on it. To reduce the strain and the tendency to spring to a minimum it was necessary to develop a cantilever type of bed which, when all parts were attached, would bring the center of gravity of the unit directly over the single cabinet leg. In following this plan, contrary to the usual practice on motor-driven lathes, the motor and as much other weight as possible was removed from the top of the headstock. The motor was mounted on the back of the bed about in the center as shown in Fig. 1. It drives through a long heavy shaft supported at the headstock end by a bracket bearing, thence through a Morse chain drive in an oil-tight guard to a jackshaft in the hood over the tailstock and thence to the spindle of the machine through a system of gearing.

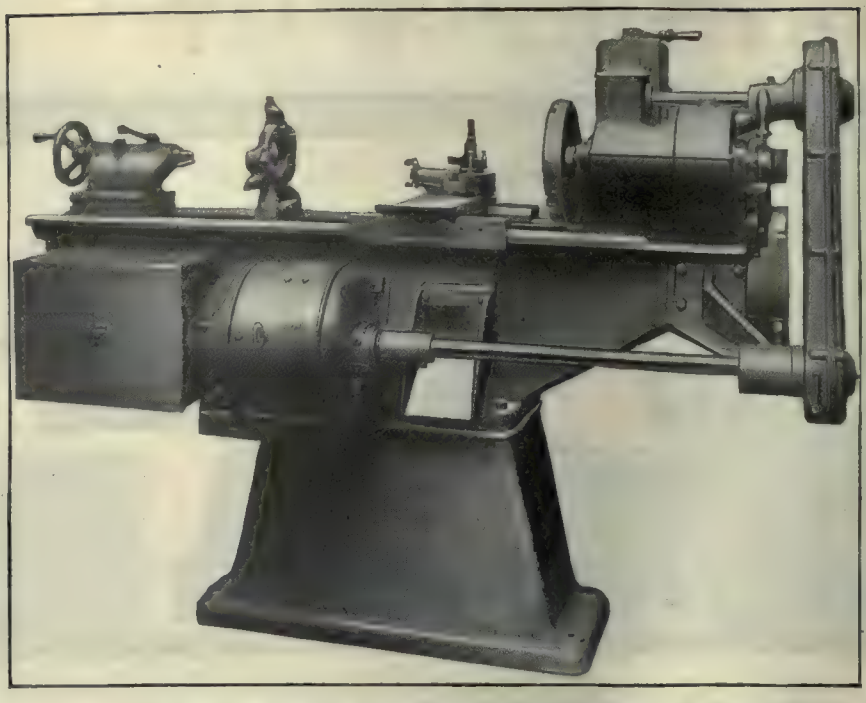
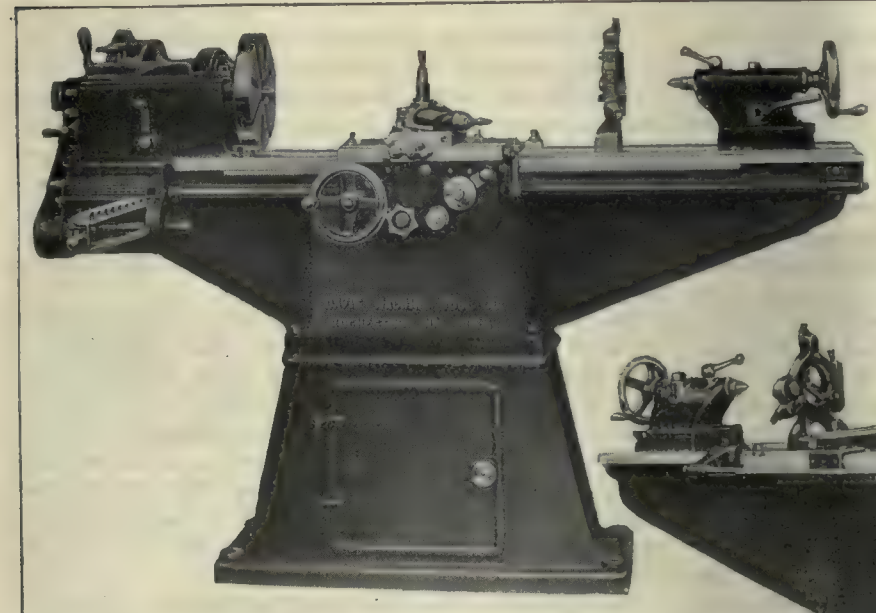
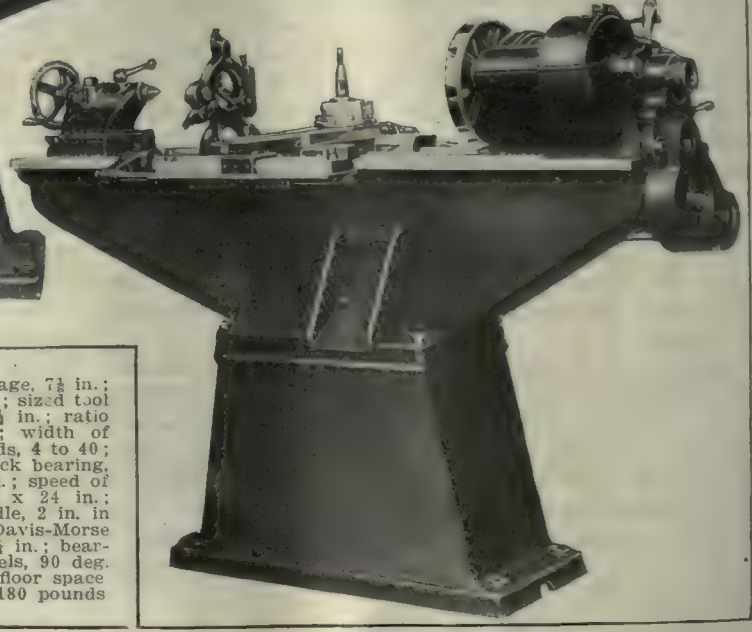


FIG. 1. REAR VIEW OF DAVIS 12-IN. LIBERTY LATHE, MOTOR-DRIVEN TYPE, AS FURNISHED FOR MOTORIZED MACHINE SHOPS

This location of the motor as you see it in Fig. 1 made it possible to economize space by getting the motor to go into the space under the driver's seat. This pedestal type of lathe with its cantilever-shaped bed enabled the introduction of another feature which is both an innovation and convenience. This is a chip chute. All chips falling between the ways follow the inclined surfaces of the bed box and come out of this chute insuring freedom from chips. The motor has an armature speed control of three to one and is controlled by the hand-wheel located in the bed below the apron. Starting, reversing or brake action is secured by the starting box lever which you can see just above the headstock.

This lathe as it was used on motorized repair shops did not include the lower pedestal. The cabinet leg of





FIGS. 2 AND 3. FRONT AND REAR VIEWS OF LIBERTY LATHE ARRANGED FOR BELT DRIVE. NOTE CANTILEVER BED CONSTRUCTION AND CHIP CHUTE

Specifications: Length of bed, 6 ft.; swing over carriage, 7⅛ in.; swing over ways, 13⅛ in.; takes between centers, 42 in.; sized tool ordinarily used, ½ x 1 in.; capacity of center rest, 3½ in.; ratio of back gears, 8½; cone diameter, 6¾, 5 1/16, 4⅜ in.; width of belt, 2 in.; diameter of tail spindle, 1 5/16 in.; cuts threads, 4 to 40; hole in spindle, 1 7/16 in.; front bearing, 1⅜ x 2¾ in.; back bearing, 1½ x 1⅞ in.; size of pulleys on countershaft, 8 x 3¼ in.; speed of countershaft, 290 and 350; base of cabinet leg, 13 x 24 in.; height from top of base to ways, 17 in.; nose of spindle, 2 in. in diameter, 8 threads per inch and bored to No. 4 Davis-Morse taper; spindle, 23 to 500 r.p.m.; tail spindle travel, 5¼ in.; bearing of carriage on ways, 14⅛ in.; compound rest swivels, 90 deg. either way; size of box for export, 31 x 55 x 80 in.; floor space 28 x 76 in.; net weight, 1481 lb.; boxed for export, 2180 pounds

the bed was bolted with four screws to a special wooden bench with drawers containing tools and supplies.

As a peace-time product the Davis Machine Tool Co. is putting this lathe out in two forms, belt and motor driven. The latter corresponds to the design which has just been described. The belt-driven machine follows the same general design and dimensions and retains the chip-chute feature while of course discarding the motor and the auxiliary jackshaft. In the belt-driven machine the drive is through a three-step cone and there are double back gears shifted with the lever shown mounted on the top of the headstock in Fig. 2. There are 18 spindle speeds ranging from 23 to 500 r.p.m. in geometric progression, with a double-speed countershaft running at 290 and 350 revolutions per minute.

A quick-change gear box operates in conjunction with the feed lever and is located on the front side of the headstock. It permits a change of threads or feeds ranging from 4 to 40 per inch and includes 30 steps. Feed reverse is operated by a tumbler lever on the side of the headstock and can be safely thrown while the machine is running. The tailstock is offset to allow the compound rest to swivel parallel to the bed and is provided with a set-over for turning tapers. Some of the principal dimensions and characteristics of this machine are given in the specifications.

This step in lathe design toward a pedestal and cantilever bed construction appears to be more in the right direction. The rigidity and compactness of this machine should make it useful not only for any kind of portable service, or where there are vibrating floors, or on shipboard, but also for toolrooms and production departments.

Shop Democracy and Dividends

By Harry Senior

I am writing under the above title, not because I have anything to say about democracy or dividends, but because my friend John R. Godfrey (who didn't say anything about them either) chose this title for his letter on page 586 of the *American Machinist*. Mr. Godfrey's real subject is the foreman, and in that subject I am interested, for I believe that wherever the present-day machine shop has fallen down, it has been largely due to the limitations of the "old man," as we used to call him.

"The foreman of the little old shop of yesterday was an autocrat with a capital A." So he was—Heaven bless him—and if he isn't today—and tomorrow—he isn't a foreman, but please remember that the very best and most efficient form of government in the world is that of an autocrat with brains and a soul inside of him; splitting up the autocracy into a dozen or more personalities and leaving out the "works" isn't an improvement.

The kaiser (please spell this with a little k) was never an autocrat; he was the mouthpiece of a heartless, soulless, and in some respects brainless, oligarchy. He was an egotist of the most obnoxious type, and, standing alone, would not have lasted six months as the head of a government. The same kind of personality in the little old shop of yesterday would not have lasted even that long. The conditions with which he had to deal would put him out of business.

He could not control good men. He could not depend upon the willing coöperation of other people with whom he was obliged to do business; suppliers, transporters, bankers, and such. The boss in the other little shop down the street, he whose iron rod of autocracy was thickly coated with the diplomatic velvet of consideration for other people, the man for whom others did things because they liked him entirely aside from any cash remuneration, could put it all over the former in the matter of workmanship and prices because his place was full of good workmen who were all enthusiasts for the success of "our shop."

If by any chance a shop existed that was presided over by a foreman who would "fire the best man on the premises because he didn't like the color of his necktie," the best man was probably such a grouch that he couldn't hold a job elsewhere, and his necktie, if he wore any, was very likely something fierce.

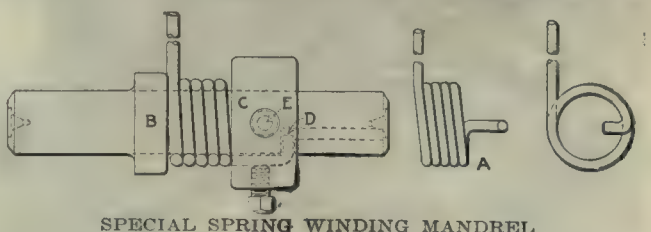
The little old shop of yesterday has become a department in the big new shop of today. The old autocratic (?) foreman has become a minion who has no right to opinions and ways of his own, but must reflect the policies of the oligarchy that controls his destiny as well as the destinies of the men who are responsible, not *to* him but *through* him to IT. Business, from being a means of making a living, has become the exponent of power, a juggernaut to crush everything before it that opposes its progress, and at the same time a shield behind which men with the will but not the ability to become autocrats may take refuge from the remnants of their conscience under the plea that a "corporation has no soul."

This condition may make for efficiency—the German government did—but it also leads to such things as I. W. W., Bolsheviki, Spartacusses, etc. As a writer in these columns in dealing with this subject (Vol. 49, page 143) once said: "We are not running shops as we did 40 years ago." Truly, we are not—neither did we have any of the things mentioned above. Is it not possible that the conditions that produced them in Germany are in some way related to the conditions that produce them here? For the love of Mike—if that happens to be his name—let us take a little more human interest in, and show a little greater consideration for, the other fellow, whatever his station.

A Mandrel for Winding Special Springs

By H. D. Chapman

The sketch shows a mandrel for winding special springs, of which we had a large number of the shape shown at *A*. The mandrel was made as shown at *B* with the collar *C* a sliding fit. The wire was about 0.128 in.



SPECIAL SPRING WINDING MANDREL

in diameter and was cut to length so it would wind into the required length and shape of spring without waste.

There is a hole in the mandrel at *D* into which the wire was placed and bent down flat on the mandrel. The collar, which has a groove or channel through its bore to fit over the wire, was pushed over it and held in position by the taper pin *E*. A setscrew in the collar clamped the wire so it would not draw out of position, while it was being wound.



Electric Screw-Jack Coach Hoist

THE installation shown is for speeding up the removal and replacement of trucks on railroad, interurban or street cars. It was built by the Whiting Foundry Equipment Co., Harvey, Ill., installed in a large car shop in St. Louis, Mo., and does away with the hydraulic or hand jacks customarily employed, overcoming the risks usually incurred in this operation. The machine consists of four screw jacks, two of which may be moved along the track to accommodate cars of different lengths, each jack being equipped with a heavy step that is operated by a screw mechanism. After the four steps have been adjusted to the car sills, all four jacks are connected by clutches, and when the power is turned on, rise at the same speed, thus keeping the car level. The equipment is electrically operated and is said to be a great time saver.



Tools for Locomotive-Valve Parts

By FRANK A. STANLEY

The tools here described include the equipment for machining parts of boiler check valves and oil-feed valves and are made up of box tools, boring tools, valve-seating reamers, taps, dies, etc. They are covered fully by the illustrations reproduced from line drawings and photographs.

OF THE many lines of work done at the Sacramento shops of the Southern Pacific Co. the one that claims the present attention is the manufacture of oil-feed valves, boiler check valves and other devices of similar character used on the various kinds of locomotives employed by this system.

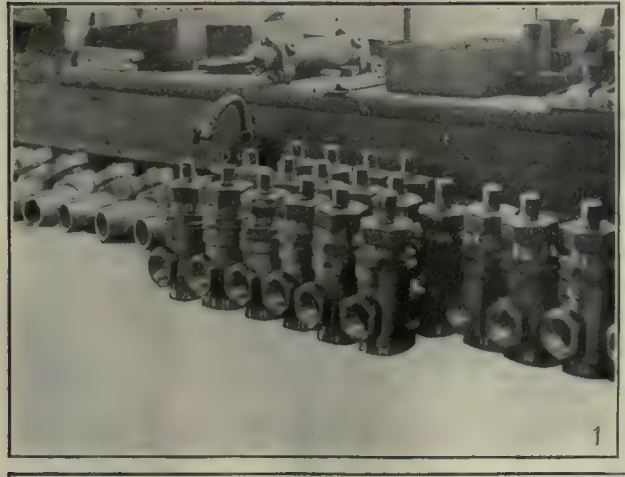
The two views, Figs. 1 and 2, of one of the benches in the brass shop of the plant, show a number of oil-feed cocks assembled, and in the foreground of Fig. 2 are the body and plug of one of the cocks and a pair of taper reamers for finishing the body to receive the taper plug.

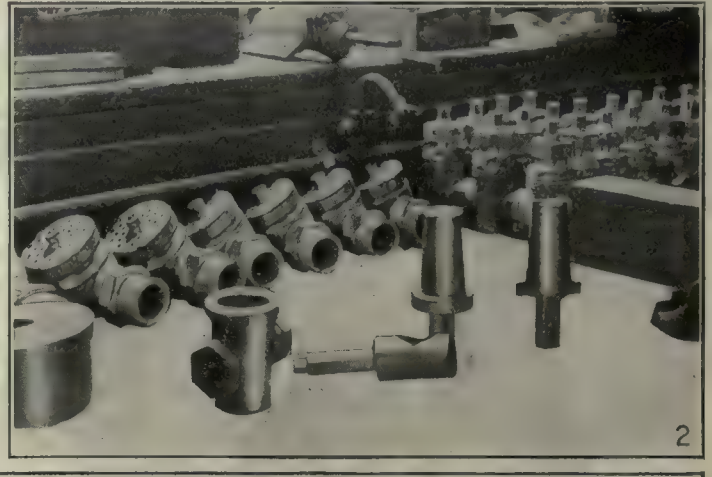
One of these oil-feed cocks is shown complete in Fig. 3, and the tools for all parts are reproduced in Figs. 4 and 5.

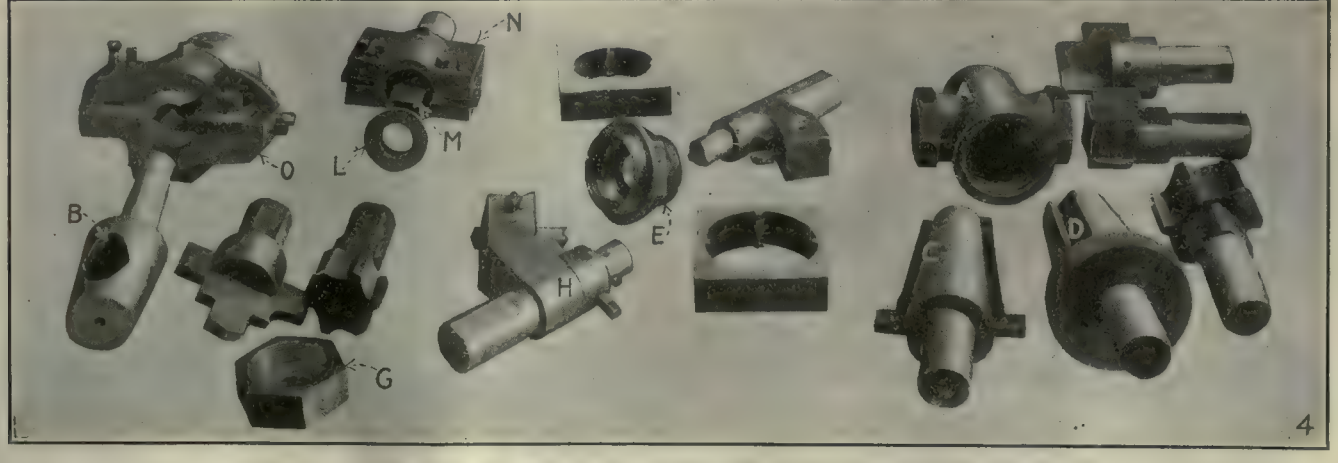
In Fig. 4, *A* is the body of the valve, and *B* the taper plug. The operations on the body are performed with the casting held in special chuck jaws, but the plug is turned on the lathe centers. The taper hole in the body is produced with the two reamers *C* and *D*, Figs. 4 and 5.

Reamer *C* is made with two $\frac{5}{16}$-in. tool-steel blades inserted in a solid taper body $1\frac{1}{2}$ in. in diameter at the small end, or $\frac{3}{8}$ in. under the blade diameter. The inserted blades are formed near the rear ends to bore out the $3\frac{1}{8}$-in. diameter for tapping to $3\frac{1}{4}$ in., and to face off the end of the work for the guide for the stem. Reamer *D*, which is the finishing reamer, is made with two plain taper blades inserted in a taper body carrying at opposite sides a pair of fiber strips, as indicated, which steady the reamer in the hole and prevent it from chattering.

The guide *E* for the valve stem is bored in front for the $1\frac{1}{8}$-in. stem, chambered out to $1\frac{3}{4}$ in. and formed with the 30-deg. seat for the packing by means of the







FIGS. 1, 2 AND 4. OIL-FEED COCKS AND THE TOOLS FOR MAKING THEM
Figs. 1 and 2—Bench in brass shop showing work and tools. Fig. 4—Group of tools for oil-feed cocks

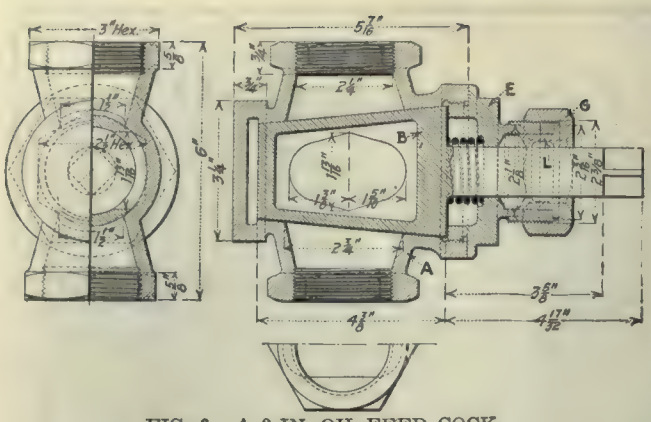


FIG. 3. A 2-IN. OIL-FEED COCK

boring cutters in the tool *F*, which carries also a turning tool for machining the outside of the neck to $2\frac{3}{8}$ in. for threading to receive the nut *G*. The same combination toolholder carries a crosswise cutter for facing the outer end of the stem guide to length. The $1\frac{5}{8}$-in. chamber for the end of the spring in the front of member *E* is bored out by the combination tool *H* carrying a cutter of that length in front, a $\frac{7}{8}$-in. facing cutter further back and a turning tool at *I* for the large diameter that is afterward to be threaded. The pilot of toolholder *H* is $1\frac{1}{8}$ in. in diameter, which is the size of the hole bored in an earlier cut by the tool in the outer end of holder *F*.

Chambering and Facing

The nut *G* is bored out, chambered and faced at the inner side by the tools *J* and *K*, the latter establishing the depth of chamber for the gland. The gland *L* is bored and faced to an angle of 30 deg. by tool *M* in holder *N*, and the outside turned to a diameter of $1\frac{3}{4}$ in. by the flat cutters in the sides of the box tool *N*, these also facing the shoulder of the gland. The box tool at *O* is used for turning the stem of the plug *B* and for facing off the end to length; also for putting in a center and countersinking it.

The various dies and taps in the views referred to are readily identified with the threads they are used for producing.

Another piece of work made in quantities is the boiler check valve for locomotive injectors illustrated in section and elevation in Fig. 6. This is another case where special chuck jaws are a great convenience in holding the main casting while performing various operations in the lathe, the body of the valve having a spherical form with connections leading off at right angles to each other.

The valve body is shown at *A*, Fig. 7, all the tools shown being used for the body and ball joint nut, while the set of tools for the valve and the cap are shown in Figs. 10 and 11. Fig. 8 shows the tools for the body and for the connection, Fig. 9.

Boring and Reaming Tools

Referring to Figs. 7 and 8 the tool *B* is used for boring the hole in the top of the valve body for the cap *C*, Fig. 6, and for boring the chamber under the valve seat and forming the seat *D* for the cap; the

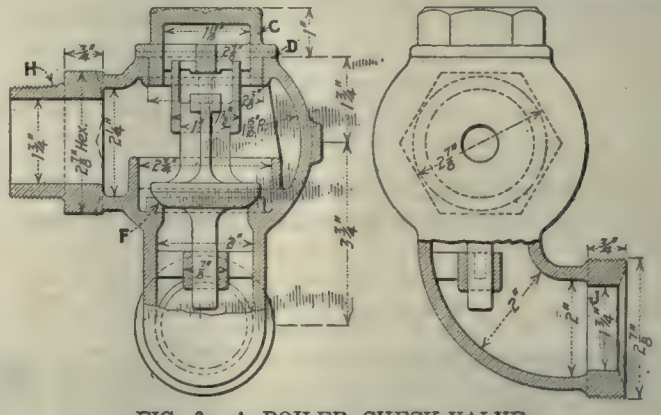


FIG. 6. A BOILER CHECK-VALVE

same tool also drills the valve-stem hole. The latter is done with a $\frac{33}{64}$-in. twist drill carried in the end of the boring bar. A cutter $1\frac{3}{4}$ in. long bores the neck for the valve chamber, and another cutter $2\frac{1}{64}$ in. across bores the hole in the top of the body for the threading

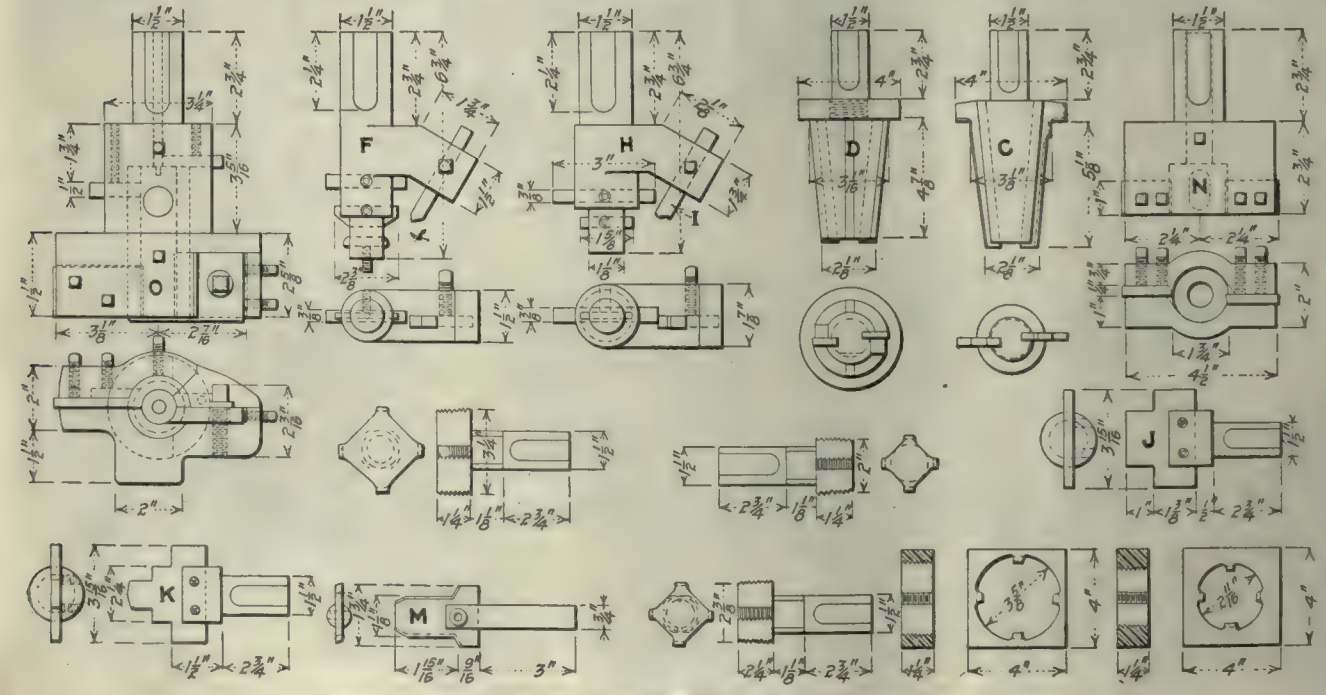


FIG. 5. DETAILS OF LATHE TOOLS FOR OIL-FEED COCKS

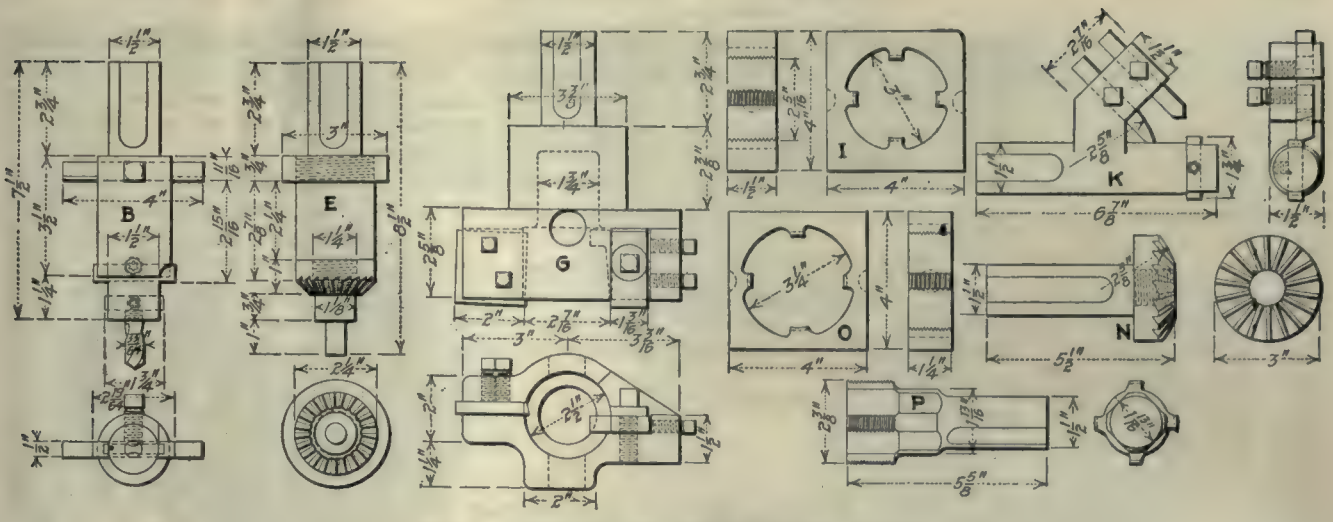


FIG. 8. DETAILS OF CHECK-VALVE TOOLS

for the cap. The same bar carries the 4-in. cutter for facing off the seat for the cap.

A second tool of similar proportion is shown at *E* for forming the valve seat at *F*, Fig. 6. This cutter is 2¼ in. in diameter, and the seating tool is formed with 19 teeth. The outer end of the bar is provided with a ½-in. pilot threaded on its enlarged shank and screwed into the end of the bar. The pilot is guided in the hole drilled in the lower part of the valve body for the valve stem. The tap for threading the top of the body for the cap is shown at *F*.

Finishing the Pipe Connection

At *G*, Fig. 8, is shown a box tool that is utilized for turning and facing the 2-in. pipe connection *H* at the side of the valve, Fig. 6. The broad-faced cutters are set at an angle in the holder corresponding to the taper of the pipe thread, and the inner end of one of these cutters has a projecting lip to form and finish the outer end of the connection. The die at the side at *I* is for threading this connection.

Ball-Joint Tools

The ball-joint connection at *J*, Fig. 6, is first bored, turned and faced to a radius by means of the tool *K*, Figs. 7 and 8, which carries a 1¾-in. boring cutter near the outer end, a turning tool for sizing the outside for the thread at *L*, and another tool at *M* for roughing-out the ball seat to a radius of 2⅝ in. These two tools are placed at an angle so that they can be readily adjusted to hold the work to the required diameter and depth of radius.

The finishing tool for the spherical seat is shown at *N*, Figs. 7 and 8. It is a solid tool cut with 18 teeth, all to the radius of 2⅝ in. and secured to the shank by a threaded end on the latter. The die for threading the joint for the coupling nut is shown at *O*.

The coupling nut is shown by the detail, Fig. 9. It is also seen at *P*, Fig. 7. It merely requires threading internally, and the tap for the purpose is indicated at *Q*, Fig. 7.

Finishing Valves and Caps

The shape of the valve and some of its dimensions are seen from the drawing, Fig. 6. Also two views are given in Fig. 10, which also shows two box tools used for turning the two ends of the brass casting

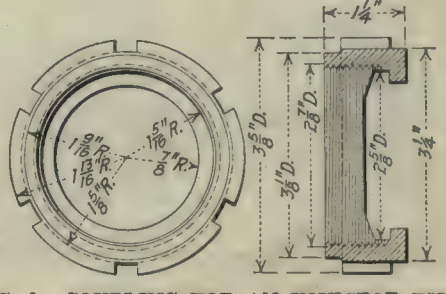


FIG. 9. COUPLING FOR AN INJECTOR PIPE

which forms the valve. The box tools are shown in Fig. 11.

The tool at *R*, Figs. 10 and 11, is for turning the winged end, or spindle, of the valve, facing off the outer

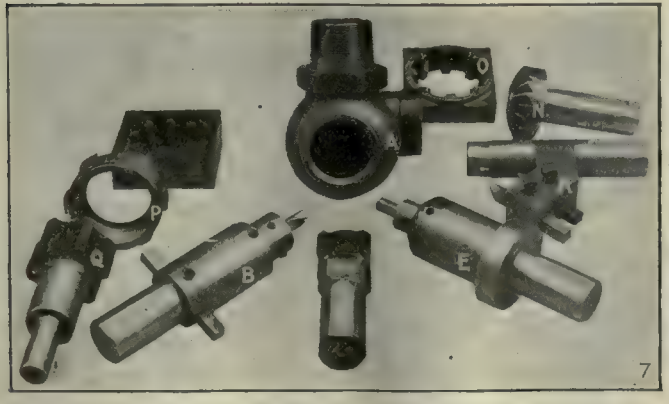


FIG. 7. TOOLS FOR THE BODY

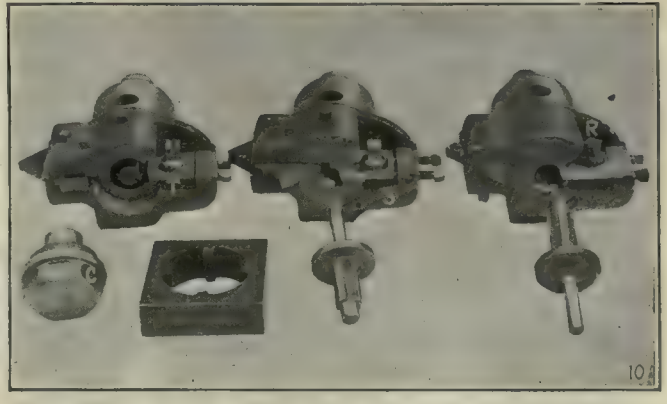


FIG. 10. TOOLS FOR THE VALVE AND CAP

end, and turning the outside diameter of the valve disk itself. The next tool *S* is for facing off the side of the valve, turning the stem to ½ in. in diameter and forming the seating surface to an angle of 45 deg. The cutter that does the turning and facing of the under side of the valve is a broad-faced tool with a ⅜-in. round corner to produce the fillet in the stem.

The Valve-Cap Tools

The box tool at *T*, Figs. 10 and 11, is for machining the valve-guide cap *C*, Figs. 6 and 10. In this box tool the cutter *A*, which has three shoulders, accomplishes

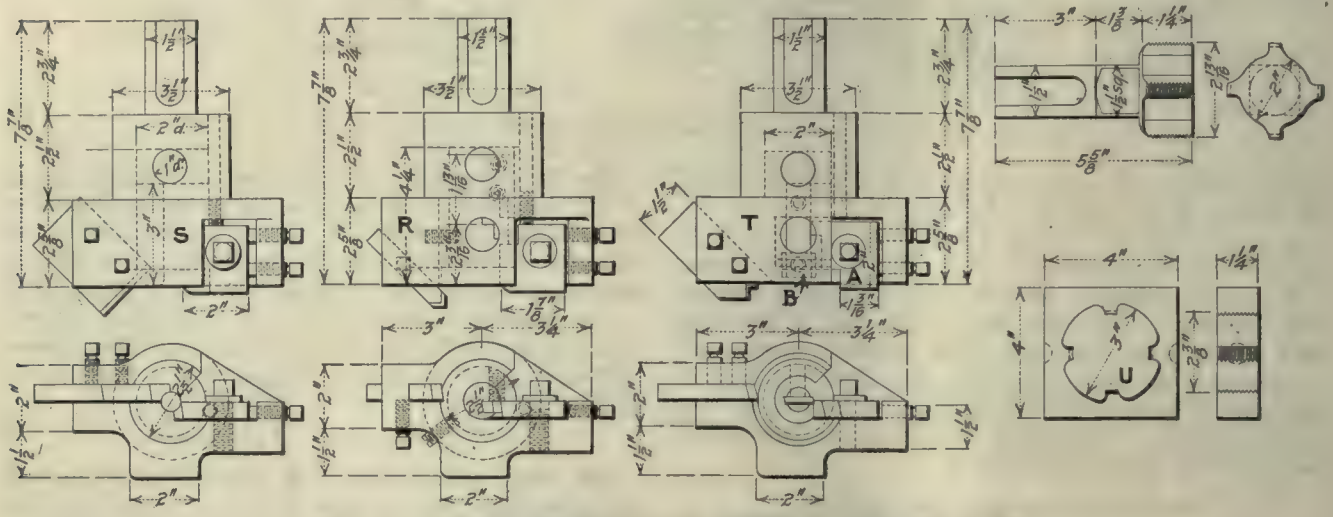


FIG. 11. DETAILS OF TOOLS FOR CHECK-VALVES AND CAPS

the turning and facing of the pilot on the valve-guide cap, which has a diameter of 1⅜ in., and it also turns the body for threading to a diameter of 2⅜ in., at the same time facing the under side of the flange on the cap. Simultaneously with the outside-turning operations the inside of the cap is bored out to a diameter of 1 in. by the cutter *B*, which is carried in a round shank inserted in the center of the tool as represented.

The die at *U*, Fig. 11, is for threading the lower end of the cap. The cap to the left is for tapping out the ball-joint cap, and it has been described elsewhere in this article.

A Few More Jots of a Journeyman

By M. L. Lowrey

In an article on page 483 of *American Machinist* F. L. Ess asks what a journeyman should do with any ideas he might have relative to the work in which he is engaged, either to improve the quality or increase the quantity of the product. The experience of 35 years as journeyman machinist, toolmaker, and foreman has taught me that, on account of the innate cussedness of human nature, these ideas are very dangerous things for a man to fool with if he wants to stay long in one place.

To begin with there is, unfortunately, a great deal of jealousy among the workmen, and those with little inventive genius view with suspicion the man who has an idea, particularly if he is a newcomer, and immediately start the report that the new man is trying to curry favor with the foreman.

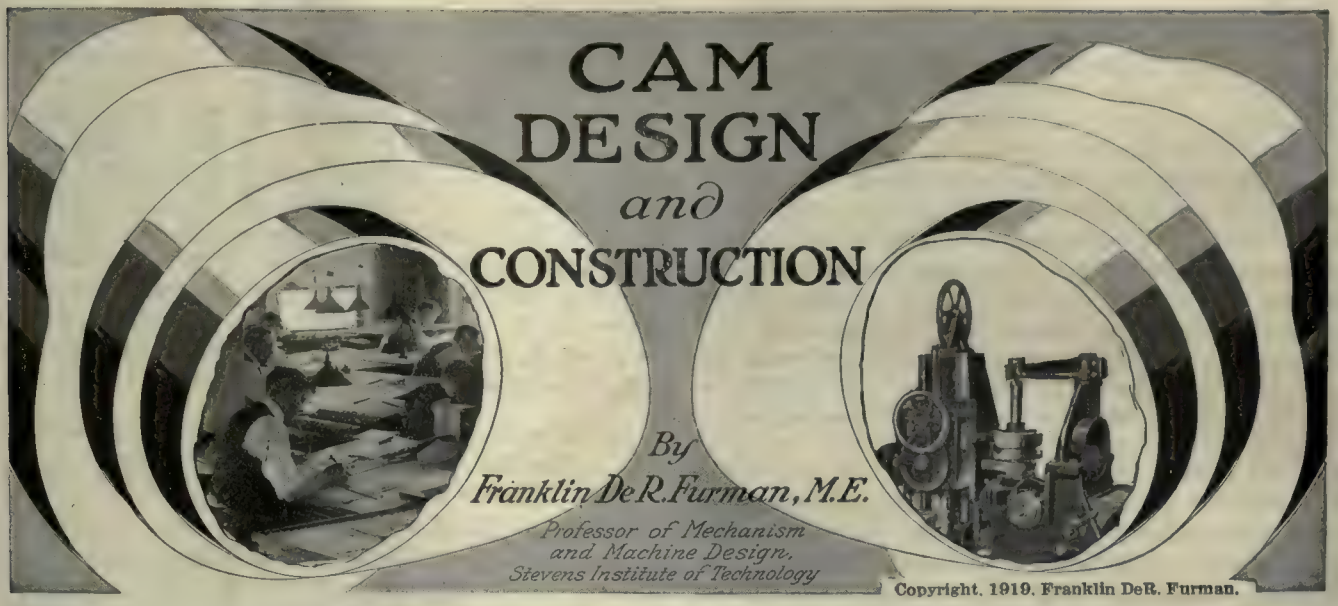
One such man once said to me: "How much stock have you in this company anyway? and what a brainy man you must think you are; we have made these things this way for the last 10 years, and a plenty good enough way it is too, and now you come here and cut down the time and will be getting some of us laid off for lack of work if you keep on."

When this feeling gets all through the shop, it is almost impossible for the man with ideas to stay unless he is fortunate enough to get into the toolroom. Even a toolmaker, however, must be very careful as, again unfortunately, too many foremen regard an idea coming from one of their men as a reflection on their intelligence, or at least their attention to the business, and immediately snow it under until they can get rid of the man and then spring the idea as their own. Again, if a man takes his idea to the manager without consulting his foreman—*goodnight.*

As I am one of those who are blessed or cursed with ideas and just *have* to work them out, I have adopted a plan that works fine, although there is not much money in it, and for the benefit of the craft I give it here as the best I have after working at the trade all these years. When I am working at a job that I don't like and don't expect to stay long, and have an idea, I make a note of it in a book that I keep for that purpose for future reference and that ends it so far as that shop is concerned. If I do like the job and want to stay, I wait until my superior officer, be he foreman, superintendent, or manager, is in what I think the proper mood. I then attract his attention, usually by having the piece I wish to improve upon, or the drawing of it, where he can see that I am studying it. When he asks what I am doing, I talk of the various operations to be performed on it and artfully (?) lead him (here is where the fine work comes in) to make the suggestion that I want him to make, then I say: "*That is a bully idea,* you just let me go ahead and work that out." Then having his permission I work it out in my own way and everybody is happy.

The men in the shop think it is all right, as the idea came from the higher ups; the boss is pleased with his invention and thinks that I am a man of superior intelligence to catch his idea so quickly; and I get to do the work that I most enjoy, besides having the knowledge that I have helped the company that employs me.

In conclusion I wish to say that I am not a grouch or pessimist, nor is my experience at all exceptional. "'T is true, 't is pity; and pity 't is, 't is true."



V. Cams With Swinging Arms

This, the fifth installment, deals with swinging follower arms with both roller and sliding contact, pointing out the special nature of the pressure angle in each case, the results that follow from differently locating the center of the swinging arm, the method of finding the length of shoe for the sliding arm, and the limited use in general of flat surface followers.

IN THE previous problems the motion of the center of the follower roller has been in a straight line. When the center of the roller moves in a curve a different method of construction is used to advantage. Cams with swinging followers are illustrated in Figs. 45 and 46, the arc of swing AV of the follower having its extremities on a radial line in the former illustration; and on an arc which, continued, passes through the center of the cam in the latter illustration. These two forms of construction, although apparently differing in only a slight detail, give quite different results, and each has its own particular field of usefulness. A comparison of the results will be given after a problem in each case has been worked out.

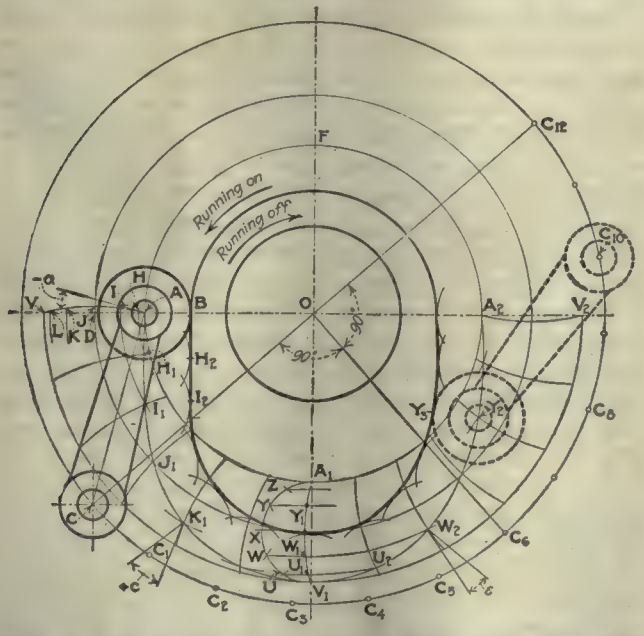


FIG. 45. PROBLEM 8, CAM WITH SWINGING FOLLOWER ARM, ROLLER CONTACT—EXTREMITIES OF SWINGING ARC ON RADIAL LINE

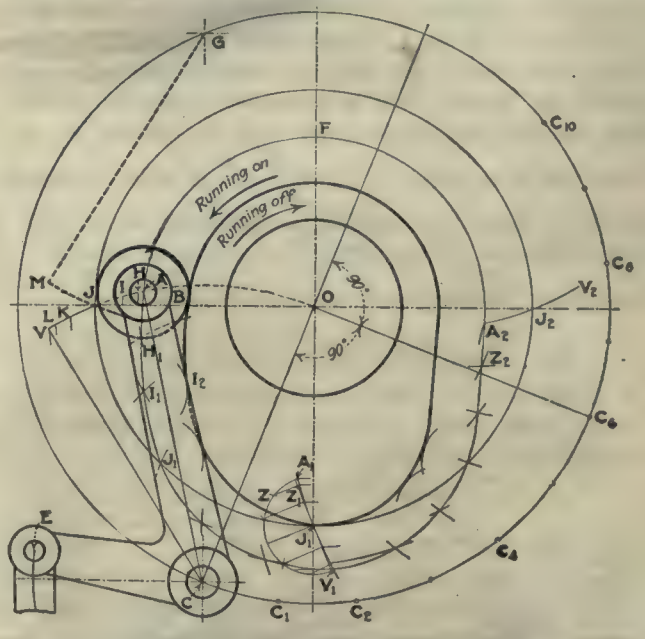


FIG. 46. PROBLEM 9, CAM WITH SWINGING FOLLOWER ARM, ROLLER CONTACT—SWINGING ARC, CONTINUED, PASSES TROUGH CENTER OF CAM

Problem 8. Required a radial periphery cam to operate a roller follower where the follower arm swings about a pivot and where the two extreme positions of the center of the roller lie on a radial line. The chord of the swinging arc of the roller center is to be 4 units and the length of the follower arm 8 units. The follower arm to swing: (a) Out full distance in 90 deg. on parabola curve; (b) in full distance in 90 deg. on crank curve; (c) and to remain at rest for 180 degrees.

A different method of construction from any thus far employed is used in problems of this kind because it gives the simplest and most accurate layout for the pitch surface. Briefly, the method to be used consists

in revolving the follower arm through the 360 deg. around the cam while the cam remains stationary, and drawing the follower in a number of its phases while on the way around. One of the phases is represented in full by the dash line $C_1 Y_2 Y_3$, Fig. 45.

The angle which causes pressure against the follower bearings is also different in this form of cam from any of the others. An inspection of Fig. 45 will show that in general the normal line of pressure AV at A between the cam surface and the roller is not at right angles to the position of the follower arm, and therefore that the resultant total pressure has a component along the arm, tending to place it in compression and throwing a corresponding pressure on the follower bearing at C.

The pressure angle at A is shown by $-a$, the minus sign indicating compression in the swinging arm. When K_1 is at K the pressure angle will be $+c$, the plus sign indicating tension in the follower arm. A disadvantage of the sign changing from + to —, etc., is that as soon as the bearings wear there will be noise at that point.

The detail for the construction of problem 8 is taken up by computing the diameter of the pitch circle first, as in previous problems. This computation, however, serves only as a guide, for the assigned pressure angle will be both increased and decreased by amounts depending on the radius of the follower arm and the characteristics of the base curve which is used. For computing the pitch circle then, an assigned pressure angle factor for 30 deg. will be assumed in the expectation that the final maximum angle will not exceed 40 deg. From the formula $d = 114.6 \frac{h \times f}{b}$ in which h equals stroke of follower, f equals pressure angle factor, and b equals number of degrees of turn of cam allotted for the stroke, as explained in Article 1, $d = 114.6 \frac{4 \times 3.46}{90}$ $= 17.62$ for the parabola curve; and $d = 114.6 \frac{4 \times 2.72}{90}$ $= 13.86$ for the crank-curve assignment. Since the larger value thus found must be used the radius of the pitch circle is found to be 8.81 units.

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of f				
	20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

Having determined the radius OD, Fig. 45, for the pitch circle the given chord of 4 units is laid off with equal parts on each side of D, thus locating the ends of the swinging arc AV on the radial line OD as required. With A and V as centers and a radius of 8 units for the length of the follower arm, strike arcs which will intersect at C and give the fixed center for the follower arm. The arc AV showing the path of the center of the follower roller is now drawn.

Points on the pitch surface AV_1A_2F, Fig. 45, are found in brief by revolving the arm CA around O, swinging it a proper amount on its center C as it revolves. In detail this is accomplished by laying off the arc CC_6 equal to 90 deg., and dividing it into a number of equal parts, say six. Divide the arc AJ into three unequal parts, as at H and I, for the parabola curve. Lay off the points L and K in the same way. Then with CA as a radius and with C_1, C_2 . . . as centers draw the arcs passing through H_1 I_1. . . . Again, with O as a center, swing arcs through H, I . . . until they meet the arcs already constructed. The intersections of these arcs, as at H_1, I_1, J_1, . . . will be the points on the desired pitch surface AV_1. The determination of the pitch surface for the crank curve is found by laying off the second 90-deg. assignment from C_6 to C_{12} and dividing it into six parts. The arc $A_1 V_1$ is divided by projecting the points U, W . . . of the crank circle to the points U_1, W_1, on the arc. The constructions for the points U_2 W_2 . . . are the same as for the previous part of the pitch surface as described above.

Cam with Swinging Follower Arm, Roller Contact—Swinging Arc, Continued, Passes Through Center of Cam

Problem 9. Required a radial periphery cam to operate a roller follower where the follower arm swings about a pivot, and where the center of the follower roller moves on an arc which, continued, passes through the center of the cam. The chord of the swinging arc of the roller center is 4 units and the length of the follower arm 10 units. The follower arm to swing: (a) Out full distance in 90 deg. on parabola curve, (b) in full distance in 90 deg. on crank curve; (c) to remain at rest for 180 degrees.

The procedure for this problem is the same as for problem 8 in all respects except the layout of the arc of swing for the center of the follower roller. The pitch circle is drawn with radius OJ, Fig. 46.

With the center of the cam O and the pitch point J as centers draw arcs which intersect at C, the radius being equal to the length of the follower arm. Lay off JA and JV equal to each other and so that a chord drawn from A to V equals the four units assigned. A bent rocker ACE is introduced in Fig. 46 simply to change the direction of motion.

Effect of Location of Swinging Follower Arm Relatively to the Cam

When the swinging follower arm is mounted so that the extremities of the arc of travel of roller center are on a radial line, as in problem 8, the pressure angles on the out and in strokes will be the same, but in reverse order. When the follower roller center moves on an arc which, continued, passes through the center of the cam, as in problem 9, the pressure angle will be larger, on the average, on the one stroke than on the other. Consequently the type shown in problem 8 would have an advantage where equal amounts of work were to be done on both strokes, and the type shown in problem 9 would be of advantage where heavy work was to be done on one stroke only. Either the out or in stroke may be selected for heavy work, according to the position taken for the center C or G of the swinging arm, Fig. 46, the direction of turning of the cam being the same. In many cases the type shown in problem 9 allows the pressure angle to be maintained on one of the strokes so that there is pressure in only one direction on the shaft C. Cams operate smoother when "running off" than when "running on." A cam is said to be running off when the point of contact on the working surface of the cam is moving away from the fixed center of the swinging follower arm. A cam of the type

illustrated in problem 8 will have an axis of symmetry where the same data are assigned for the out and in stroke, whereas the cam illustrated in problem 9 will be quite unsymmetrical for same data.

Positive-drive face cams—The pitch surfaces for face cams are laid out in exactly the same manner as pitch surfaces for radial periphery cams regardless of whether the pitch point of the follower moves in a straight or curved path. The only additional feature of construction is that a working surface is drawn to touch each side of the roller.

Cam with Swinging Follower Arm, Sliding Surface Contact

Problem 10. Required a radial periphery cam to operate a swinging arm having a construction radius of 9 units. Sliding surface contact between cam and follower. The arm to: (a) Swing up 4 units on the crank curve base while the cam turns 120 deg.; (b) swing down 4 units on the crank-curve base while the cam turns 120 deg.; (c) remain at rest for 120 degrees.

This type of cam and follower is illustrated in Fig. 47. The line of pressure between cam and follower is

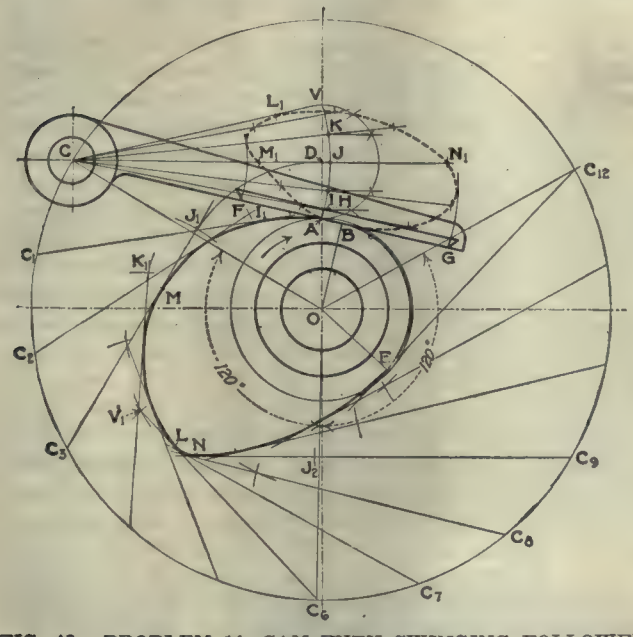


FIG. 47. PROBLEM 10, CAM WITH SWINGING FOLLOWER ARM, SLIDING CONTACT

always normal to the follower surface and consequently there is no component of pressure in the bearing at C due to pressure angle. This cam is therefore independent of a pitch circle based on pressure angle, and the pitch circle may be taken any size. Where one has no special guide in assuming a starting size for the cam, the usual computation for pitch circle for a 30-deg. pressure angle may give good average results. According to this the pitch radius OD will be

$$4 \times 2.72 \times 3 \times \frac{1}{3.14} \times \frac{1}{2} = 5.2 \textit{ units}$$

AV equals 4 units and AC equals 9 units. The point A is taken for construction purposes as a point on the follower arm where the angular velocity of the arm is measured. It will be at the points H, I, J, . . . on the arc AV at the end of equal succeeding intervals of time.

The method of constructing the cam in this problem is identical with the method used in problem 8 in so far as the follower arm is swung around the cam and its position with respect to the cam center at equal time intervals is drawn. The departure from the method of problem 8 consists in drawing the cam outline as an envelope to these follower-arm positions. For example, in Fig. 47, at the end of the third time interval the pivot C has been revolved to C_3 and the point A of the follower arm has moved out to J_3. The point J_3 is found at the intersection of two arcs, one obtained with CA as a radius and C_3 as a center and the other with OJ as a radius and O as a center.

When a number of positions of the follower arm, such as C_3J_3, have been obtained, the smoothest possible curve is drawn tangent successively to each of them, and this curve is the working surface of the cam. This curve is tangent to C_3J_3 at M, and if the distance C_3M is laid off at CM_1 the point M_1 will be the actual point of tangency between the cam surface and follower arm when the arm is halfway through its swing, or when A is at J. Similarly when C_9 is at C the point of tangency between cam and follower arm will be at N_1.

The locus of the point of contact between the cam and follower relatively to the frame of the machine is shown by the dash closed curve through M_1 and N_1. By drawing arcs tangent at the extremities of this dash curve, using C as a center in both cases, the points F and G on the follower surface are obtained and the distance FG will be the part of the follower exposed to

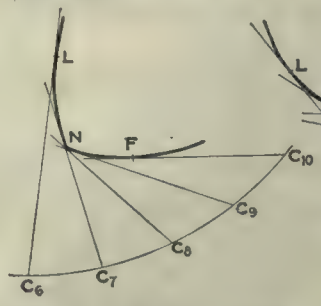


FIG. 48. LIMITING CASE FOR STRAIGHTEDGE FOLLOWER WITH SLIDING CONTACT

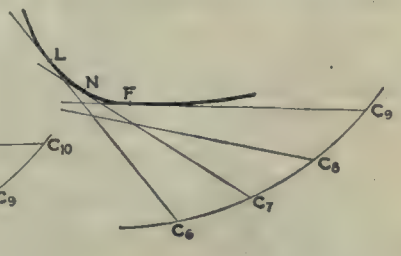


FIG. 49. IMPOSSIBLE CASE FOR STRAIGHTEDGE FOLLOWER WITH SLIDING CONTACT

wear from the rubbing of the cam. This part of the follower arm may be designed with a shoe, as indicated, which may be replaced when worn.

It should be specially noted that the shortest radius of the cam is not OA, but OB. The point B is found by drawing a perpendicular to CG through O.

The very decided lack of symmetry should also be noted, the curve BL being used to lift the arm, and the curve LE to lower the arm, the swinging velocities of the arm being the same in both directions.

Data Limited for Followers with Sliding Surface Contact

The data for this type of cam construction are extremely limited when the swinging velocity of the arm is assigned. The limitations are that the working surface of the cam must be drawn tangent to *every* construction line *in succession*, and that it must be convex externally at all points. In most arbitrary assignments the construction line through C_9, for example, Fig. 47, would intersect the line through C_7 before it cut the line through C_8. In this case it would be impossible to draw a smooth

working curve tangent, successively, to the lines through C_7, C_8 *and* C_9. This is illustrated more clearly in Fig. 49 and will be more evident after the limiting case is described.

The limiting case for flat surface followers with sliding contact occurs where three or more of the construction lines meet in a point at *N* in Fig. 48. In this case the working surface of the cam would have a sharp edge. In this type of cam it is necessary to use more construction lines than in other types because it is possible to have the construction lines so far apart that such a case as is shown in Fig. 49 might not evidence itself at all. For example, if the distance C_9C_7 were the unit space for construction lines, instead of C_9C_8, the smooth convex curve *FNL* could be drawn tangent to lines through C_9, C_7 . . . without the error showing itself.

If it is required of this cam only that it shall swing a follower arm through a given angle in a given time, without regard to the intermediate velocities of the arm, it may be as widely used as any other type of cam. In this case only the innermost and outermost positions of the arm would be drawn, as at *CA*, C_6V_1, and $C_{12}E$, Fig. 47, and a smooth convex curve drawn tangent to these lines. Such construction, however, might give an irregular or jerky motion to the follower. Whether it did or not could be readily determined by laying off a number of equal divisions, as at C_1, C_2 . . . C_{12}, drawing lines, such as C_3J_1, tangent to the assumed smooth convex working surface, and revolving C_3J_1 back to *CJ*. After doing this with other construction lines a series of points, such as *H, I, J* . . . would be determined and the spaces between them would represent the distances traveled by *A* on the follower arm during successive equal intervals of time.

Toe and Wiper Cams

In this form of cam construction the cam, or wiper, oscillates or swings back and forth through an angle of 120 deg. or less, instead of rotating continuously the full 360 deg. as it does in all cams thus far considered. The follower, or toe, is usually a narrow, flat strip resting on the curved periphery of the cam and moving straight up and down. The form of the cam for a toe follower is found in the same general manner as for a cam with a mushroom disk follower, as described in Article IV, and therefore its analysis and construction need not be given here. In a later installment this type of cam will be considered in connection with specific follower and sliding velocities.

Know What the Other Fellow Is Doing

By John R. Godfrey

It's a mighty good plan to know the good points of the other fellow's machine as well as your own. In fact, it is an equally good plan to know the weak points of your own machine as well as of his, although it may not be advisable to enlarge on this point when it comes to enthusing the salesmen at the annual get-together, in which you sell them your product.

We may have a perfectly legitimate reason for building our machine as we do, but we quite frequently find that it pays to know the other fellow's ideas on the same subject, and there seems to be no better way of learning this than to have one of his machines where we can look it over and find out its good points as well as its disadvantages. Perhaps one of the best examples of this is in the automobile field, where even the chief boosters of this particular game are advocating the importation of a few thousand foreign machines to act as a sort of yeast to the industry in this country.

We are at the point where everyone admits without argument and without asking proof, that the American motor car and motor truck industry is supreme when we consider quantity production. Our Fords and Lelands and Whites and Rikers and a host of others have designed cars and trucks and perfected manufacturing organization so that we could produce them at a lower price than any other country. But the very fact that we have had the American market by the tail and that no one else had even a fraction of a look-in, may have had its drawbacks. We have effectually kept out cars and trucks of other countries while at the same time we have induced them to buy and use thousands of our own. But in keeping out these foreign cars we have also kept out many of their ideas, and as the secret department of any shop is usually the most inefficient, this has prevented us from absorbing some mighty good ideas both in design and construction.

The Buzz-Wagon of Early Days

In the early days of the buzz wagon, gasoline was very cheap in this country, so that fuel consumption hardly needed to be considered. After the first spasm in which we practically fastened a small motor into a buggy, we were bitten with the desire for high-speed and great hill-climbing ability. As a result we have the present high-powered car in which we all boast, and not always truthfully, about being able to take every hill on high. The increasing cost of gasoline and the decreasing miles per gallon are putting us into something of the same condition as our friends in England and France, and it is quite probable that we could study some of their cars to advantage.

Instead of loading down the car with a motor with sufficient power to save us the necessity of shifting gears except in extreme cases, we may well consider the adoption of a lower-powered motor which will probably handle 75 per cent. of our driving in high gear and perhaps change our standards of pride and respectability. These may even yet be so changed that to own a car in which we occasionally shift into second speed will not be a mark of utter depravity.

Smaller motors mean more than might appear at first thought. They mean lighter cars and lower tire expense, both of which mean that we will pay less tribute to the oil kings and the emperors of the rubber industry. Such a change ought to reduce the wear and tear on the highways, unless this is more than offset by the ever-increasing traffic of motor trucks.

It is also barely possible that we might study comfort rather than style to advantage, and this will probably come when we get to the point where we will consider the family automobile in the same way as we did the old horse and the family phaëton.

It is more than probable that a similar study of various machine tools might show us that for some classes of work we have gone too far in high-powered machines. The importation of a few of the best machine tools from the other side might be advantageous in several ways and we must not forget that our greatest danger is in being too well satisfied with what we have already accomplished.

ARMY ORDNANCE NEWS

Hydraulically Operated Shell Machines

By P. B. COCHRANE

While the shell-making machines here illustrated finished their particular jobs with the signing of the armistice the principle underlying their design might well be applied to machines of a more peaceful type. The simplicity of arrangements and the rugged character of the parts are worthy of note; also the comparative novelty of the hydraulic control of shifts and feeds.

THE special 6-in. shell machines shown in the illustrations were designed and built by the Symington Chicago Corporation with their several moving parts actuated by hydraulic means on account of the simplicity, flexibility and general economical operation. In all machines the work is gripped by the standard design of pull-rod cylinder which revolves as a part of the spindle unit and receives hydraulic pressure through a special revolving distribution coupling. The spindles are of cast iron running in babbitted bearings, and each carries an oiling chain fed from a large well. The machines are motor driven through a worm and gear, the motor being connected by a belt to a clutch pulley on the worm-shaft. The clutch pulley is shifted by a 2-in. hydraulic cylinder and the belt tension is regulated by an idler-pulley unit. The control valves are the heavy cock type, and in most cases regulate the slide action by throttling, thus making a variable-speed mechanism which reduces the operating time. Each

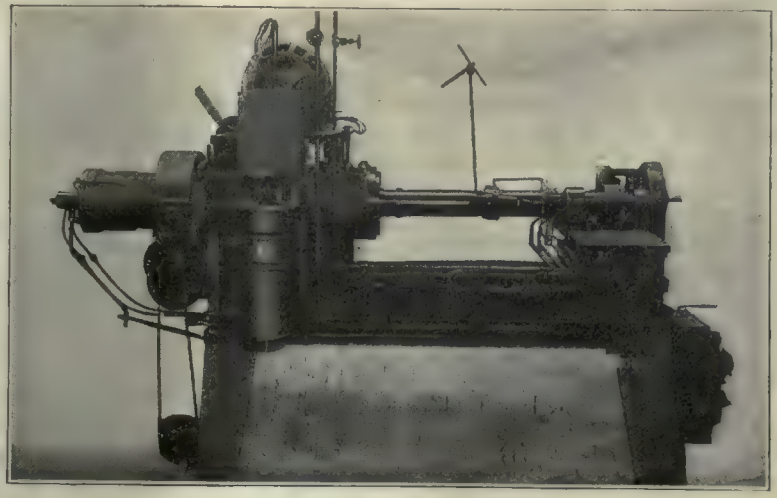


FIG. 1. CENTERING MACHINE

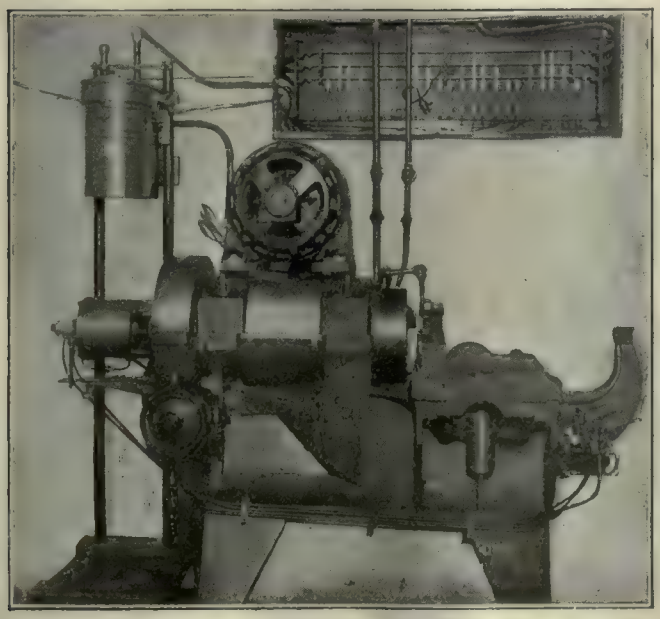


FIG. 2. CUT-OFF MACHINE

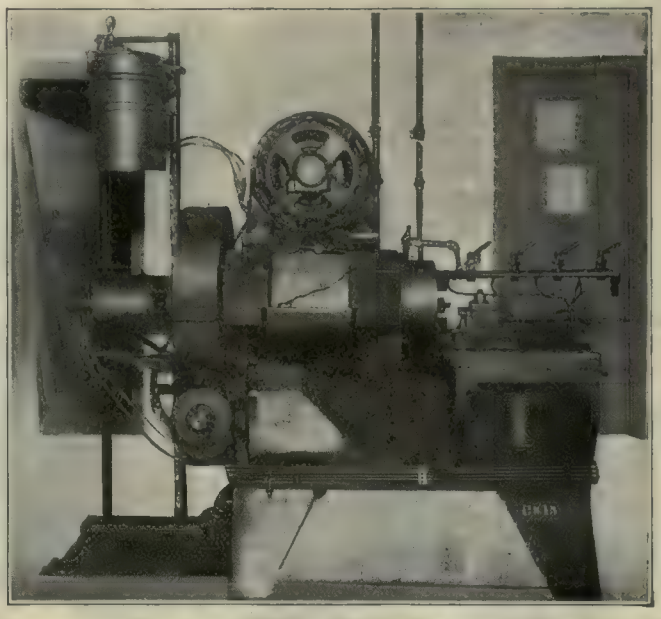


FIG. 5. ROUGH-FACE BASE MACHINE

ARMY ORDNANCE NEWS

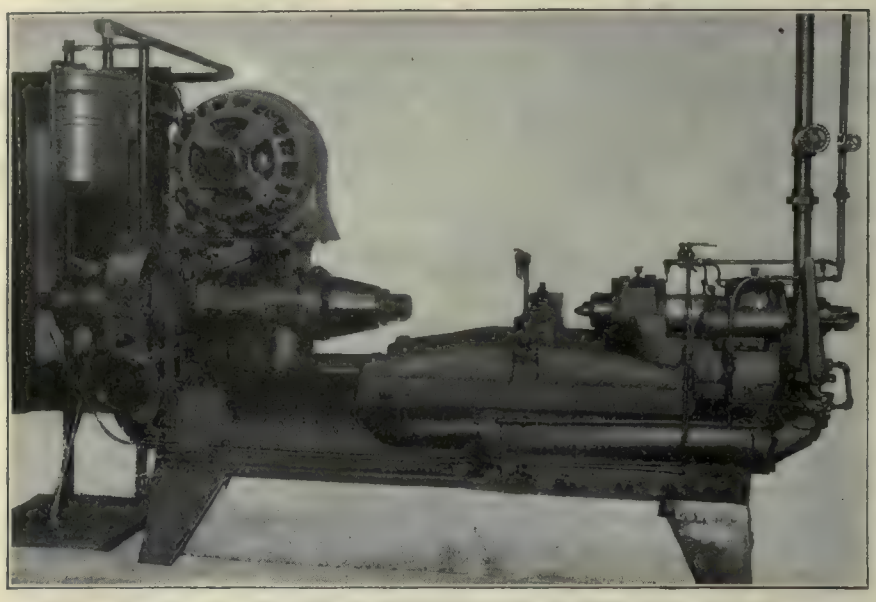


FIG. 3. ROUGH-CUTTING LATHE

machine is equipped with a hoisting davit and special shell sling so that the operator has no heavy lifting to do.

Thirteen of the operations in the manufacture of the shell were taken and machines of four different types designed to perform them as follows: Type A for end-facing, cut-off and boring the nose; type B for turning; type C for profile boring and reaming, and type D for centering, cutting band groove and turning copper band. Water pressure of 200 lb. per square inch is used for all operations except cutting the base and band grooves, and is generally carried through $\frac{1}{8}$-in. pipe.

Machine Used for First Operation

Fig. 2 shows the type A cut-off machine, which performs the first operation. The forging is held in a hydraulically operated three-jaw chuck fixed in a 12-in. diameter spindle driven by a 10-hp. motor. Two cut-off tools are carried in separate slides which are operated simultaneously by a 7½-in. cylinder just visible over the top of the slide. The heavy bracket at the right is to mount a work stop not shown.

The type D machine in Fig. 1, as set up for the centering operation, carries a spindle holding a mild-steel arbor with two sets of three-point support dogs. The tool slide is shifted transversely by a 3-in. cylinder at the back and carries another 3-in. cylinder to operate the centering-drill advance lever. The drill is belt driven at high speed by a 1-hp. motor.

In Fig. 3 the type B rough-turn lathe carries an 8-in. cast-iron spindle driven by a 35-hp. motor. In the spindle is an expanding arbor operated by the cylinder seen at the extreme left, the piston in which exerts a pull of 8000 lb. The tail spindle can be moved **6 in.** by the two cylinders coupled to the yoke at the extreme right. The carriage mounts heavy tools at front and rear and is moved by the long hydraulic units shown at the side.

Finish-Turning

The spindle design of the type C rough-point tool machine in Fig. 4 is similar to that shown in Fig. 2. The heavy carriage is advanced by units similar to those in Fig. 3 and carries a stout boring bar mounted on a cross-slide, the motion of which is controlled by a cam and roller device to get the desired profile on the inner surface of the shell.

Inside finish-turning is done on the type C lathe shown in Fig. 6. It differs from the machine in Fig. 4 in having two 4¼-in. boring bars which go to position against stops. The carriage is moved longitudinally as in Figs. 3 and 4 and transversely by the 4 x 16-in. cylinder shown at the right. The arrangement of control valves is well shown in this figure. The first valve from the left controls the hoisting davit, which has been removed from this machine but is shown in Fig. 4; the second valve controls the spindle chuck; the third the driving clutch, which is behind the spindle, and the fourth the cross-slide cylinder.

Orifice Valve Governs the Speed

The small valve in the feed line farthest to the right is an orifice valve which governs the speed of the cutting feed and prevents crowding the machine beyond reasonable limits. The three-way valve takes pressure through the orifice valve and controls the feed mechanism.

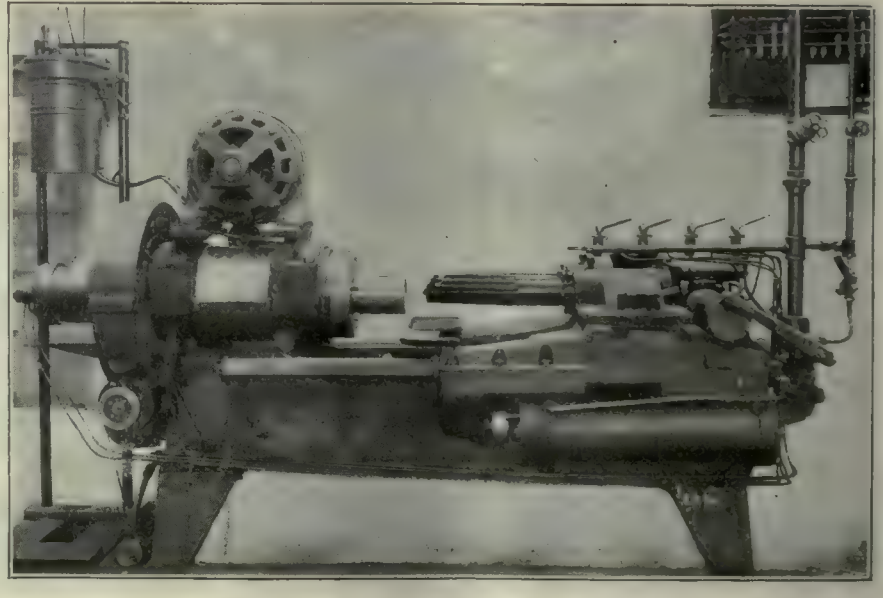


FIG. 6. INSIDE FINISH MACHINE

ARMY ORDNANCE NEWS

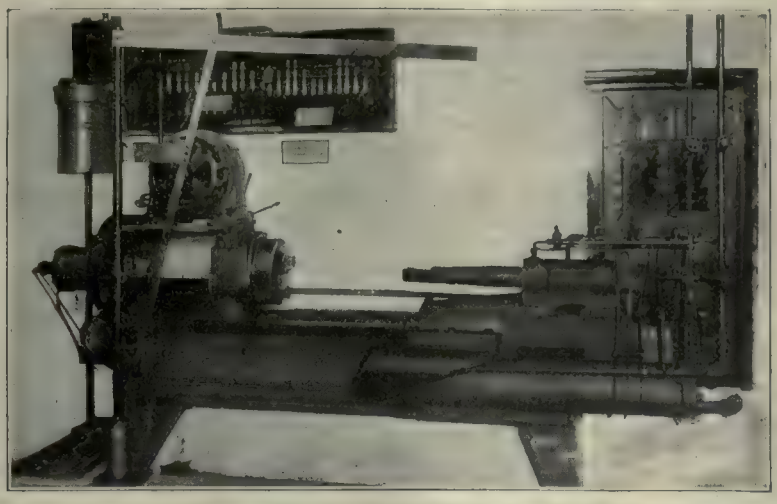


FIG. 4. ROUGH POINT TOOL MACHINE

Fig. 5 shows the rough-face base machine, type A, which is essentially the same as the one shown in Fig. 2 except that a single slide and tool only are used instead of double ones.

PERSONALS

Lieut.-Col. William E. Marble, who was commissioned Captain in October, 1917 and twice promoted, was discharged on his return to America from overseas. Col. Marble was with the Army of Occupation while abroad. His home address is Greenwich, Conn., and he was formerly with the R. G. Corset Co., of New York City.

* * *

Maj. Louis A. Pierrong, who was commissioned Captain in November, 1917, was discharged on his return from overseas. His duties have had to do with the purchase of hardware, small tools and the like. His home address is Euclid Ave. and 105th St., Cleveland, Ohio. He was formerly engaged in dealing in iron and steel products.

* * *

Maj. Andrew C. Vauclain, whose address is 2416 North 54th St., Philadelphia, Penn., has been discharged. Major Vauclain was commissioned in December, 1917 and served in the Inspection Division. Before being commissioned he was employed by the Baldwin Locomotive Works.

* * *

Maj. Wheeler Lord, who was commissioned in November, 1917, and served as Army Inspector of Ordnance at the Midvale Plant, has returned to civil life. Major Lord's home address is 5015 McKean Ave., Philadelphia, Penn. He was formerly engaged in the iron and steel business in that city, and is a graduate of Lehigh University.

* * *

Capt. Wm. Thomas Alliger, 15 Lodees Land, Cynwyd, Penn., has been discharged. His duties have been in connection with the operation of U. S. Nitrate Plant No. 2. He is a graduate of the University of Michigan, and in civil life was chemical and mechanical engineer for Harrison Safety Boiler Works, Philadelphia, Penn.

* * *

Capt. Lewis E. Tifft, whose home address is 4 Ridgewood Terrace, Springfield, Mass., was discharged on his return from overseas. Capt. Tifft was on duty in both France and England in the Finance Section. He attended Williams College and was formerly a member of Tifft Brothers, investment securities, Springfield, Mass. He was commissioned in August, 1917.

* * *

Maj. Reamy E. Field, recently discharged, has been on Claims Board work since the armistice was signed. Major Field is a graduate of the University of Lebanon. His home address is 3436 Vista Ave., Cincinnati, Ohio. He was formerly in the brokerage business.

* * *

Capt. Wm. H. Richard, 24 Fruit St., New Haven, Conn., has been discharged. Captain Richard's service has had to do with small-arms inspection and repair. He was superintendent of the Storage Division and Ordnance Property Officer at Augusta Arsenal. In civil life he was rifle and ammunition tester and demonstrator for Winchester Repeating Arms Co., New Haven, Conn.

* * *

Maj. Rupert L. Penney, who was appointed Captain in August, 1917, and who has been in charge of Armory Shops, and especially on installation of new heat-treatment equipment, has returned to civil life. He is a graduate of the Stevens Institute of Technology and before entering the service was a Testing Engineer with the Winchester Repeating Arms Co., New Haven, Conn. His permanent address is 126 Willard St., New Haven. Conn.

* * *

Capt. Louis I. Reichner, who has been on duty in the Civilian Personnel Section, has been discharged. He is a graduate of the University of Pennsylvania and Princeton. Previous to entering the service, Captain Reichner was a lawyer with the Fidelity Trust Co., Philadelphia. His permanent address is 1709 Rittenhouse St., Philadelphia, Penn.

* * *

Capt. Arthur P. Pain, who was commissioned First Lieutenant in August, 1917 and who has been on duty at the Savannah Proving Ground, has returned to civil life. He is a graduate of Amherst College and in civil life was a designer of automatic machinery. His permanent address is 369 Washington Ave., Brooklyn, N. Y.

* * *

First Lieut. Warren J. Keyes who was appointed Second Lieutenant in November, 1917, was discharged on his return from France recently. His duties have been with the Requirements Ammunition Division. He is a graduate of Yale and Harvard and is an accountant. On his return to civil life he is to be with the American International Corp., New York City. His home address is 723 South 6th St., Terre Haute, Indiana.

Export of Industrial Products*

By EDWARD PRIZER
President Vacuum Oil Co.

The story of the nations that have succeeded each other in preëminence has been the story of enterprise in external trade. With the decline of foreign commerce decay sets in. The Phoenicians, the first great traders, lost their power when they lost their trade; Venice, mistress of the then known seas, succumbed to the enterprise of her rivals; Portugal had her day of power when she reached India by sea; Spain broke down her strength when she expelled the industrious Moors, and the aggressive Flemish hand-workers of Northern Europe continued their prosperity only so long as they maintained their external commerce. Of the great nations existing during that remarkable era of trade and expansion at the time Columbus discovered America, England alone survives as a great power.

THE United States, during the early years of its history, was too deeply engrossed in the vast opportunities for development at home to give serious consideration to overseas trade. At the outbreak of the Civil War some real beginnings had been made, and our glorious fleets of clipper ships were becoming the carriers of ocean bound commerce, and our flag floated in all the great harbors of the world; but the ravages of four years of war on our own soil wasted our wealth and dulled our energies; and in the healing of our wounds we lost for a time our vision of international opportunities.

During the progress of the world war our exports of industrial products have been measured only by our capacity to produce and steamship space to transport. This was not the case before the war, and is not the case now; and we are face to face with a vast expansion in our manufacturing capacity which must be consigned to idleness and rust unless we expand our markets to absorb our potential output.

The export of raw or semi-finished articles unquestionably adds to national wealth but gives little aid to industry. We must export cotton in fabrics and not in the bale; iron and steel in machinery and implements; leather in shoes and other finished articles; use our coal under our own factory boilers; and in every way multiply the overseas movement of products of hand and brain which our recognized manufacturing and inventive skill, unequalled by any other country of the world, so eminently fit us to produce.

Accurate Knowledge of Foreign Markets

We are largely a provincial and insular people. Our vast expanse of territory and the great seas stretching between us and the outside world, have shut off contact on the part of the great body of our citizens with foreign peoples.

There is danger therefore that we may visualize the peoples of the old world in terms of the new. Efforts for overseas trade based on lack of first-hand and accurate knowledge of foreign markets will be wasteful, ineffective and disappointing.

At home we have a flexible and intelligent market. The great body of buyers are educated and alert. New things are readily introduced, and improvements or betterments meet with a quick response.

In the great markets abroad, however, different conditions exist. Behind the great buying public, centuries of custom and prejudice exist. National habits are fixed and more or less unchangeable.

New things are not impossible of introduction and sale in time, but an effort to change established habits as relates to staples of use and demand is an almost hopeless undertaking. The great body of consumers in many of the markets of largest promise are uneducated, and resentful of change.

The most remarkable feature of modern-day industrial development was that of Germany before she staked her all on a war of world conquest and went down in ruin. While there was much in her methods and practices we cannot in self-respect follow, it is none the less true that her great success was not accidental, but based on underlying fundamentals which we must adopt to insure a like success. With painstaking thoroughness the Germans studied the foreign markets they designed to invade, and definitely ascertained in advance what would find ready sale. They catered to established needs and existing preferences.

I was told of a group of German industries, organized somewhat as our Webb-Pomerene law now permits of, combining and employing a small body of experts, who were sent to South America simply to study and report on existing trade opportunities. For two years these experts made a painstaking survey, reporting fully to their employers. Every detail was examined and analyzed. Where necessary, samples were sent back home. The question of credits, terms of sale, and like essential matters were carefully gone into. They even discovered what others hitherto had not known, that the colors and designs of certain fabrics worn by a considerable group of people were semi-religious in significance, and hence nothing else would be saleable irrespective of improvement in quality or cheapness in price. It is needless to state that when this combination of German manufacturers moved on the markets they thus studied, their progress was invincible.

The Germans also developed the fact that there was a material demand for machinery in interior places remote from railways. So they made their machines in sections small enough to be transported on mule back. On arriving at destination, these were bolted together and ready for quick use. American machines designed for similar service never got beyond the seaboard, for while more efficient than the German make, they were in too large units to be handled.

Choice of Representatives

The personal equation is an essential factor of commercial success. In competition the agreeable and acceptable representative generally wins against an opponent not equally gifted. But representatives of American concerns for foreign fields should be chosen with great care, and rigidly trained for their required duties. They should be those desirous only of establishing a more or less permanent foreign career; if going to a foreign-language country, they should be able to speak the tongue or quickly to acquire it.

Business is generally done abroad in a certain leisurely fashion sometimes irritating to the American hustler; important transactions are frequently originated or completed in café or club. Too great haste or undue immediate pressure frequently defeats itself.

There is also more or less undercurrent of suspicion as to so-called "Yankee smartness." Great tact, patience, straightforward action, unquestioned integrity, and unfailing courtesy are fundamentals. After all, it is character that tells. Confidence when fully gained counts for more in permanence of commercial relations abroad than at home, for as a general rule the foreign buyer is slow to change and adheres with much tenacity to those firms or individuals which have won his full trust.

The American exporter will find foreign fields already occupied with trained and capable representatives from other countries, and it will be idle for him to send abroad as contestants any other than our best.

I do not think it an unfair statement that for some years

*From an address delivered at the Sixth National Foreign Trade Convention, Chicago, Ill., Apr. 24, 1919.

prior to the war the attitude of our lawmakers toward industry was one of ill-disguised hostility.

There had been an era of muck-raking, in which popular writers found a ready sale of mis-statements, half-truths and direct abuse. Our politicians saw opportunity to curry popular favor by joining in the hue and cry against successful business enterprise. The greater the measure of success the louder the abuse. The successful business man did not know whether to be proud or ashamed. Mr. Bryan, our great American economist, proposed to measure the extent of criminality by the per cent. of the total business a firm or individual secured.

The Department of Justice announced at the entrance of this country into the war that all prosecutions under the anti-trust act had been postponed, leaving the plain inference that then existing combinations must function unhampered if the war was to be won.

This same Department recently announced in the public press that the combinations in all essential industries forced by the Government as war measures would be prosecuted if continued after the declaration of peace. Are the underlying principles of economics so unstable that they shift as between war times and peace?

The Webb-Pomerene bill legalizes combinations when operative beyond the shore line. It, therefore, recognizes the principle of combination. Could not this law be so broadened as to permit such consolidations at home as are economically sound and fundamentally proper and just, and which would result in great savings in cost of manufacture as well as distribution, so that the American producer would not be forced to enter the foreign field with a heavy initial handicap?

England has never been afraid that any of her industries would grow too large in scope or operation. Newspaper dispatches advise she already is planning to enter industry as a governmental enterprise, and to bring about consolidations of such magnitude as to be fraught with great danger to American industries of like character. Is it wise practice to limit our industries to small and uneconomical units by preventing by law just combinations of enterprise, capital and skill?

Congress itself needs a new vision. In England, leaders of industry are made peers of the realm, boards of trade have legislative functions, and foreign commercial operations are carefully watched over and safeguarded. I believe it is the practice of the French government, when any of her citizens are seeking foreign concessions, to send a governmental commissioner with them to make sure every legal right is fully protected.

Before the war, however, when our relations with Mexico were under discussion in Congress, one of the members asserted that American investors, with all the opportunities that existed at home, had no justification for going abroad, and if they did so, the risk should be theirs alone, without expectation of assistance or support from their government. Such an attitude can hardly be regarded as encouraging to foreign-trade enterprises.

Legislation by Foreign Governments

There are evidences that certain foreign governments are now considering the adoption of legislation which may be highly detrimental to American concerns already established and operating within their boundaries, or to others that may later desire to do so. Our own Congress should give serious heed to this tendency and demand that American industry and capital shall be granted the same rights abroad as are granted to foreigners in our own markets. Some of the measures already being discussed for legislative enactment abroad by governments unchanged in form by the war are fraught with positive danger to American export trade.

Our consular service should be safeguarded from the blighting shadow of political control or preference, and there should run through it to the remotest sections of the world the certainty that capability is prized and that merit will be recognized and rewarded. It should be trained in business conditions and methods, and encouraged to be constantly alert to business opportunities for American industry. Periodical consular reports of a general character, while interesting and helpful, are not alone sufficient. There must be concreteness of information and directness of support.

A gentleman told me that at a certain South American port he found great difficulty in obtaining any really useful information to assist his sales effort; so almost in despair, he appealed to the German consul, who courteously aided him in his dilemma. He found this consul had prepared a complete card index of commercial conditions. It covered not only the usual statistics of imports, consumption, etc., but went into such intimate details as to the standing and credits of individual merchants, lines of products they already handled, or might be induced to carry. It was his practice to send to his government at home all this information which was available for the German exporter. What was being done by him at this port was doubtless being duplicated at hundreds of other centers of commercial opportunity.

Intelligent Control and Operation of Our Shipping

Nothing more fully illustrates our apathy toward foreign trade prior to the war than our national attitude concerning overseas shipping. We saw small countries like Holland, Denmark and Norway becoming great maritime powers; we saw Germany, throwing aside all restrictive legislation, constructing and operating a tonnage that was the marvel of modern times; we saw England, grim and determined, never ceasing her efforts to remain the mistress of the seas; we saw our own harbors congested with ships flying foreign flags.

And yet we were so unconcerned that we adopted new restrictive legislation more crippling than that previously in force so that our flag was fast disappearing altogether from the open seas in merchant service.

We have now embarked on a great national shipping adventure—and we are as yet mere novices at the game. It is not too strong a statement to make, that our national prosperity in export commerce will depend upon the wise and intelligent operation of our merchant marine. All other things being equal, the nation that controls shipping controls export trade.

Our vessels are being constructed at the maximum of cost, and export commerce cannot bear the load of charges necessary to yield a profitable return on the investment. Therefore, the charging off of the extreme costs to a normal basis must be a national burden assumed for the common good. Otherwise exports will languish. Already England has set the pace in reduction of rates, and other countries have large tonnage constructed at pre-war costs.

Uncertainty of Delivery Fatal to Export Sales

The movement of vessels as relates to trade routes must be worked out with great care. Nothing is more fatal to export sales than uncertainty as to delivery.

The Germans, with great foresight, after carefully considering trade possibilities, definitely assigned vessels for periodical sailings; and these ships sailed as advertised whether fully loaded or otherwise.

Nothing before the war and even now has been so harmful to our operations in South America as the uncertainty of transport of goods and mail. Regular sailings and quick movement alone will permit our securing the preëminence in the markets to the south of us, which our location and our facilities warrant.

While this address was being prepared I received a letter from our general manager for South America, written at Buenos Aires under date of Feb. 23 and requiring some six weeks to reach New York, which contains the statement that since Dec. 1 there had not been a single week at that port during which two British mail and passenger steamers had not arrived, this being quite outside of arrivals of purely British merchant vessels. Mails were being delivered from London under three weeks. Advertisements were appearing in all the leading Argentine papers in regard to British products, and the British government had officially informed the different South American governments that all their industries were normally working again and that orders placed for any kind of products would be supplied without delay either as to manufacture or time of receipt.

In contrast to this our general manager stated that the last passenger steamer which left Buenos Aires for New

York, sailed in October, and the last direct mail service was by a steamer leaving Feb. 2. Since then not a single passenger or direct mail boat had left Buenos Aires for New York, though one had been announced as possibly to sail at the end of March.

Make sure that every shipment that leaves this country is up to full standard of quality—the second lot in every respect as good as the first.

Fulfill every obligation with scrupulous fidelity, even though a bad bargain was made, in the carrying out of which material financial loss is unavoidable.

Go to any reasonable length to satisfactorily adjust a bonafide complaint, for a disgruntled buyer is a ruinous asset.

Pack shipments at least equal to European practice. There has been much legitimate complaint as to the flimsy character of American packing, resulting in goods frequently arriving at destination in deplorable condition.

Study the weights, measures and currency of foreign countries, and do not hesitate to use them when submitting offers, so the buyer will know his costs at point of receipt.

Print advertising literature and pamphlets of instruction in the language of the country where use is to be made. Do not make the mistake of thinking that English is a universal language, or that foreign buyers, when unfamiliar with it, will take the trouble to have it translated into their own tongue.

Give careful thought as to how exports are to be paid for. It cannot be done in coin. Our own Government had to establish large credits to our Allies to finance war purchases made here, to be liquidated later by imports of commodities. If we deliberately close our national doors to the products of other nations, we will close foreign doors to ourselves at the same time, as payment must be made in commodities of some character. England as a nation has learned to take foreign stocks and bonds, and a sharing interest in local enterprises, in payment of her exports. We, too, as a nation must learn to do the same if we are to expand our exports.

Dynamometer for Testing Twist Drills

By R. Poliakoff
Asst. Prof. of Mechanical Technology, Technical Institute, Moscow, Russia, Pro tempo., New York

The dynamometer described in this article was designed and built by the author for the purpose of testing drills in a lathe, with the view to finding the torque and thrust exerted by different drills under varying conditions of speed, feed, material, diameter, etc.

Fig. 1 shows the dynamometer mounted on the toolrest of the lathe. Fig. 2 gives a larger view of the dynamometer itself showing its general construction and parts.

The blank *A*, Fig. 1, in which the hole is to be drilled is fixed in the chuck of the lathe, and is rotated during the process of drilling while the drill, which is set in the dynamometer, is fed toward it. The torque set up

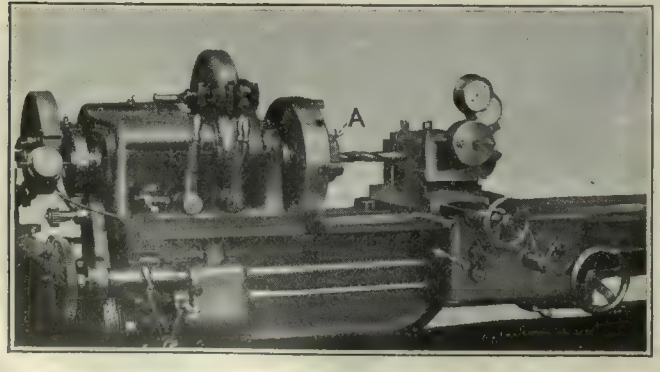


FIG. 1. TWIST-DRILL DYNAMOMETER MOUNTED ON THE LATHE

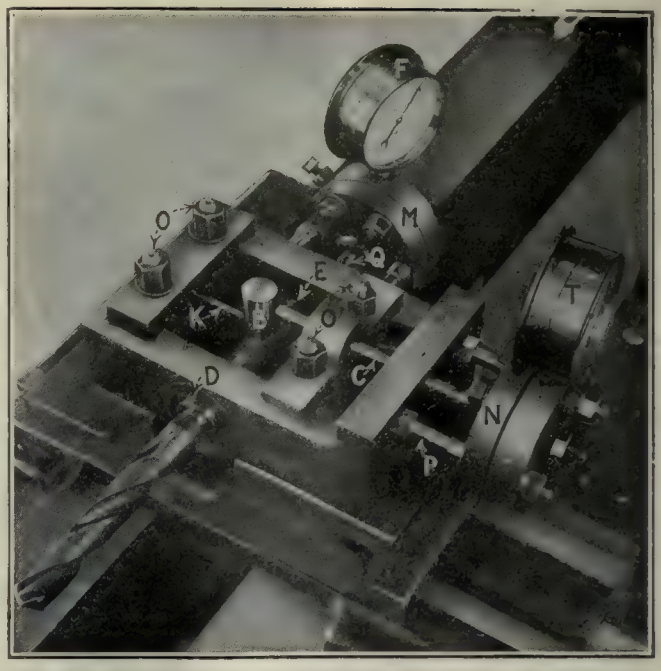


FIG. 2. CLOSE-UP VIEW OF THE TWIST-DRILL DYNAMOMETER

during the process of drilling is taken up by the crank *B*, Fig. 2, into the corresponding recess of which one of the tapered ends of the rod *C* is inserted. The other tapered end of the rod *C* enters a corresponding hole of the hydraulic support *N* connected with the pressure gage *T*. The support *N* has a brass plate or diaphragm inside against which the rod *C* presses. This pressure is transmitted through the brass plate to the fluid—which is distilled water or oil—in the support and through it to the gage *T*. The hand of the gage will therefore move in proportion to the pressure exerted on it by the rod *C* through the angular movement of the crank *B* rotating in its bearings *D* and *E* on account of the torque exerted by the drill.

The crankshaft is mounted in ball bearings at *D* and *E*. The rod *K* prevents the crank from falling back to the left and provides for adjustment of the crank in its central or zero position for which purpose it has a threaded end with two nuts on it. The bolts *O* are to attach the dynamometer to the toolrest of the lathe. The rods *P* serve to attach the hydraulic support *N* to the body of the dynamometer. The end of the crankshaft *B* has a tapered socket to take the shank of the drill.

This crankshaft moves longitudinally in its bearings on account of the thrust exerted on the drill as it is fed into the blank, and this thrust is transmitted through the rod *Q* into the hydraulic support *M* and through it to the pressure gage *F*, the hand of which moves in proportion to the thrust exerted.

The gages *T* and *F* can be ordinary gages as used for determining any fluid pressure and registering in pounds per square inch. If we know the area of the diaphragm we can easily calculate the total pressure in pounds. In the case of the gage *F*, this will give the amount of the thrust directly; in case of the gage *T* the thrust will have to be determined by the relation of the indicated pressure to the leverage of the crank in order to get the torque in inch-pounds. Naturally the gages have to be properly calibrated before the tests are made.

An Automatically Indexed Piercing and Shearing Tool

By L. L. DODDS

Sometimes the cost of an operation is more affected by what immediately follows than by the manner of performing the operation itself. Here is an illustrated description of an ingenious tool that was designed not so much to cut down the cost of that operation, though that was accomplished, as to straighten out and simplify subsequent handlings.

IN THE manufacture of safety Autolock switches the Krantz Manufacturing Co., Brooklyn, N. Y., has developed a laminated copper contact brush, which presents an interesting opportunity for tool development, as depicted in the illustrations. The brush, as shown in Fig. 1, is made up of 12 strips or leaves, punched from a copper ribbon ½ in. wide and 0.010 in., thick. These leaves are all of the same length, but

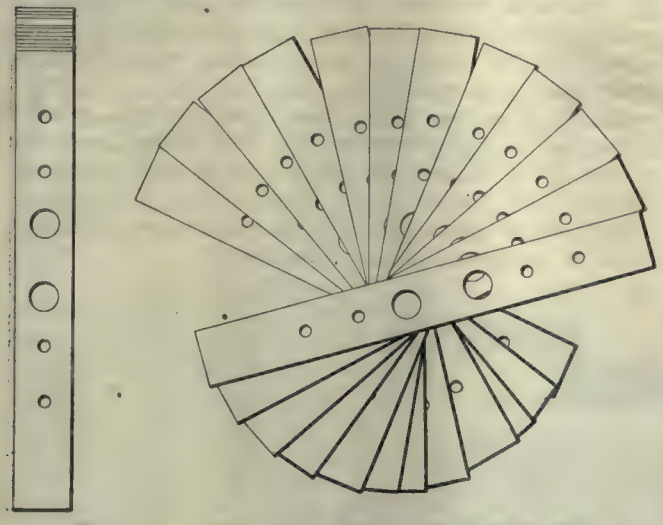


FIG. 1. A SET OF LEAVES OR BRUSHES FOR AUTOLOCK SWITCH

the location of the holes by which they are fastened together varies in steps of $\frac{1}{28}$ in., so that when riveted together each end of the completed brush presents a beveled appearance.

Before the development of the automatic indexing tool, which is the subject of this article, the method of producing the leaves with this variation was to cut from the copper ribbon a definite quantity of leaf No. 1 (the cutting and piercing being done at the same time), then adjust the relation of cutting blades to piercing punch and cut a similar quantity of leaf No. 2, continuing this until a sufficient number of all leaves were punched.

This rendered necessary the running through of comparatively large lots, and scrupulous care must be exercised to keep the different members from becoming mixed.

From the cutting tools the leaves passed to the sorting department, where they were stacked in racks, as shown in Fig. 2, from which they were taken by the assemblers in the first operation, which was known as bundling.

This was accomplished by placing one eacn of leaf No. 1 on each of the pins on the pin board shown before the operator in Fig. 2, following this with one each of No. 2, etc., until one of each leaf from Nos. 1 to 12 had been assembled. Each bundle was then removed from the pin board and wired together. From this point on the methods of handling have not been changed.

As the production of these brushes numbers many thousands in course of a year it was deemed advisable to devise better methods, and to this end I designed and built the tools here illustrated and described.

Fig. 3 gives a general view of the die in the press, while Fig. 4 shows a back view of the mechanism with the cover removed. Like letters refer to like parts in Figs. 3, 4 and 5. The end of the stock is fed through a guide *A*, Fig. 3, until it just clears the cut-off blade *B*, Figs. 3 and 4. The first stroke of the press squares the end of the ribbon and pierces the holes. The stock is then fed to stop *C* and held flat with the fingers of the left hand while the press is tripped. This completes leaf No. 1, which is then dropped over the two long rods, which are hung loosely upon the front of the bolster convenient to the left hand of the operator.

On each up stroke of the press the pull rod *D* which is attached to the gate raises the lever *E*, thereby causing a definite traverse movement of the piercing die,

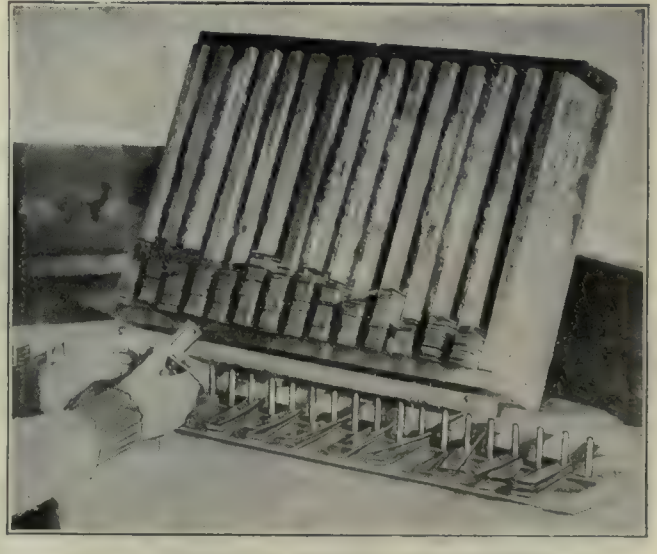


FIG. 2. PREVIOUS METHOD OF ASSEMBLING

which amounts to exactly $\frac{1}{28}$ in. This movement is transmitted to a train of gears *F* through a ratchet and pawl. On the shafts carrying the large gears are mounted heart-shaped cams *G*, Fig. 5, between which is the roller *H*.

The stud on which this roller turns is attached to the piercing tools, which with their punches form an independent unit arranged to slide freely but without shake in the dovetailed slide way *I*, Fig. 5.

The piercing tools are self-contained, being fitted with a stripper and with punch holder sliding on pillars, the punch holder resting on heavy coil springs so that it is not necessary to attach it to the press

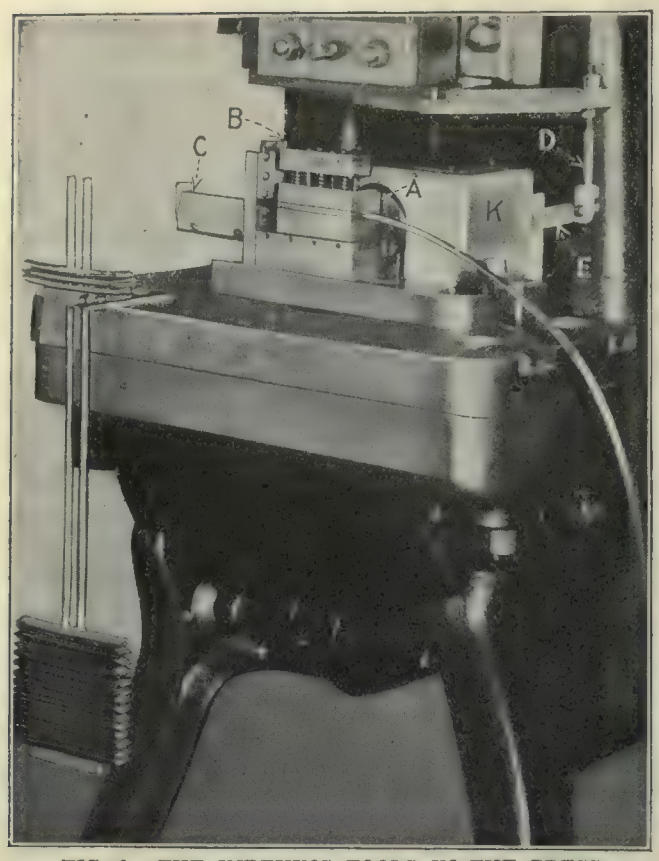


FIG. 3. THE INDEXING TOOLS IN THE PRESS

gate. The upper surface of the punch holder (which is of course hardened) is ground smooth, and a hardened-steel plate forms a part of the upper member, seen to the right in Fig. 5, which is attached to the gate. This construction leaves the tools free to be moved endwise by the cams as the punch holder, forced upward by its springs, follows the gate only just far enough for the punches to clear, when its upward movement is stopped by the shoulders of the pillars. The gate thus clears the punch holder before the ratchet comes into action and there is no resistance to the endwise movement of the tools so that the wear on the indexing mechanism is negligible. In order to eliminate side strain on the ratchet and pawl the lever *E* where it connects with the pull rod *D* is given a positive vertical motion; this is attained by slotting the lever where it bears on the fulcrum pin *J*, on which it slides. The action of the tool is as follows: Beginning by setting the tool to line in accordance with the instructions on the cover plate the operator proceeds to cut off the strips, or leaves, as he

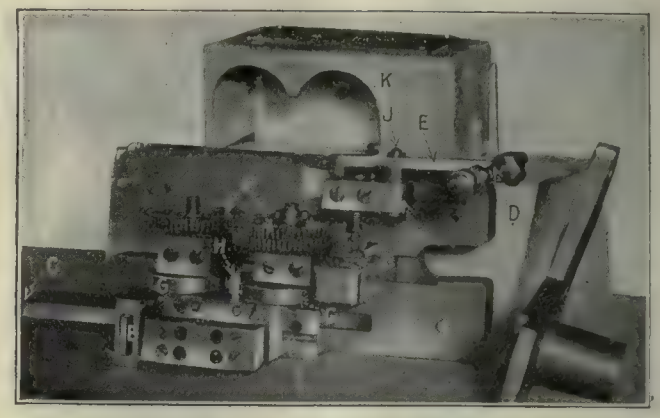


FIG. 5. TOP VIEW OF TOOLS

would with a stationary tool, the operation being as rapid and no more care being required.

With this device the piercing tools are moved forward by the ratchet and cams so that for 12 successive strokes of the press 12 leaves have been produced in which the holes have been moved progressively forward $\frac{1}{28}$ in., making one set.

On the next 12 strokes the movement is repeated in a reverse direction and another set of leaves is produced, the only difference being that this set is the other side up which is an advantage rather than a detriment in the assembling operation.

Should it be desired to make brushes with a greater or lesser number of leaves the only thing necessary would be to change the ratio of the first reduction gearing.

The entire operating mechanism is protected by a cover *K*, made from $\frac{1}{8}$-in. sheet steel.

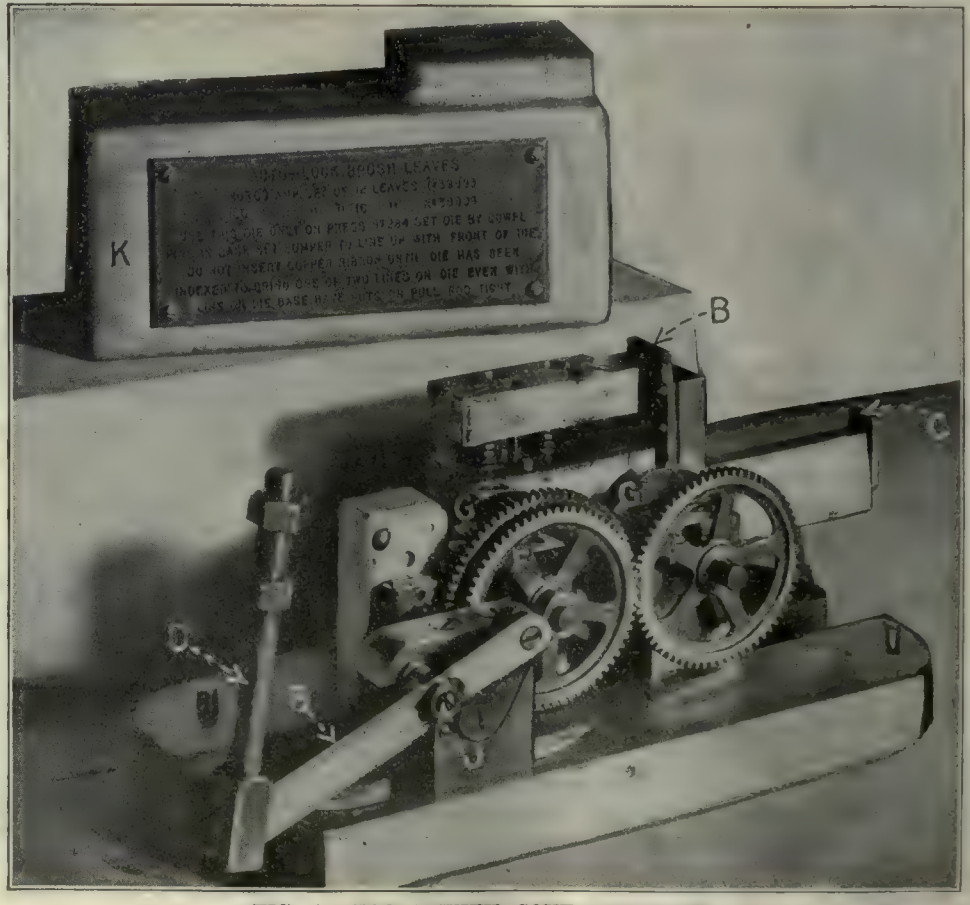


FIG. 4. TOOLS WITH COVER REMOVED

An engraved instruction plate is attached to the cover, setting forth plainly the manner in which the tool is to be used.

The method of handling the leaves after punching is interesting. The long rods on which the leaves are strung are held to the bolster plate of the press by a clamp, as shown in Fig. 3. When the accumulated leaves reach the top of the rods the operator grasps the rods in his left hand, loosens a wing nut with his right hand, permitting a hinged clamp to swing back, and allowing the leaves to drop to the bottom of the holder. When the holder is full, a small clamp (not shown) is slipped over the ends of the rods, pressed down and tightened. This serves as a convenient method of storing the leaves and presents them to the brush assembler in such shape that it is a simple matter to take off one set of leaves at a time and insert them directly into the riveting fixture.

American Machine Tools in Many Markets

By L. W. ALWYN-SCHMIDT

All eyes are turned toward Europe just now for various reasons, not the least of which is the market for machine tools which awaits development. Mighty England, devastated France, crippled Poland and Serbia, the northern and southern neutrals and even hated Germany offer possibilities worth investigation by the manufacturer and the selling corporation. Here is a brief survey of the field.

THE period between the declaration of the armistice and the signing of peace was bound to bring a slowing down of the foreign demand for American machine tools. The machine industry of the world needed time to study the situation. But it would not be surprising to see a recovery in the international machinery market after peace has actually arrived. This will be the most important time for our machinery exporters.

The American machine industry has vastly improved its export facilities during the last four years and has succeeded in winning a large part of the foreign trade which was handled by foreign interests. Several large American corporations representing a great number of machine plants are engaged in exporting American machinery and others are to be added in the near future according to rumors now current.

There is plenty of work just now for the American machinery industry all over the world and it will depend entirely upon the enterprise of our own manufacturers, how large our share will be of the new trade that is to be expected. The commercial agents of the U. S. Department of Commerce have given more than usual attention to this side of the American export problem, and justly, for after all a large percentage of all industrial production consists of machinery of some sort or another.

In the following article an attempt is made to give to the manufacturer, interested in the foreign demand for American machinery, as short and as clear an impression as possible of the character of the present demand and its likely development in the immediate future. The material for this study has been collected from a great number of reliable sources including the reports of the American consuls and commerce experts published in recent months. This information is supplemented by news items collected by the writer from foreign publications dealing with the subject.

A beginning may be made with the European market. With the end of the war the large demand for machinery from England, France and Italy naturally has come to an end. The English machinery industry is now busily engaged in reorganizing its business for the purpose of resuming a normal peace production, and this work is progressing rapidly notwithstanding the many difficulties met by the English manufacturers, including those of labor. The English machine-tool makers organized themselves several years ago into an association which contemplates not only a close coöperation between the individual manufacturers but intends to go a step farther by the introduction of a system of coördinating the manufacturing energy of each member. It is intended to make certain machine tools only in factories especially suitable for that purpose and to bring about in this way a better specialization in production similar to that already existing in the United States. It appears from recent reports that the machine industry is at present largely engaged in repairing and overhauling the present machine equipment of the English factories much of which demands renewal.

Incidentally there is expected an increasing demand for higher class machinery from factories which until now have used cheaper and less effective equipment. Practically all of the English machine-tool equipment is now of the most up-to-date design, having been installed during the war. The older types of tools which were pressed into service during the first months of the war when every unit of machine-tool equipment was urgently required have slowly been eliminated, either because they were worked out or because they proved a hindrance to rapid production when employed side by side with the modern English or American equipment. The English machinery industry, therefore, enters international competition under much more favorable conditions than those existing before the war. It is an interesting question, how the new situation will influence the later-day demand for the better-class American machine tools in England. England has received during the last four years American machine tools to the value of nearly $60,000,000. Many of these tools were bought for special work connected with the war and may prove useless for industrial production. It is, however, a fairly safe guess that several years of good service are left in at least three-quarters of the American machine tools imported into England during the war. These machines will now be taken over into the general industrial equipment of the English machine-building industry. It will depend upon our own abilities whether American tools will replace these when they have to be discarded or whether English ones will take their place. Taking the life of a machine tool at approximately eight years, would mean that

three years are left to our industry to install itself in the English market. Naturally the English machine-tool industry will always have the lion's share of the English and colonial trade. This, however, does not prevent the American machine tool from making itself so useful in English industrial production as to become practically indispensable. Only if we succeed in this respect can we expect to hold the English market or that part of it which our industry has gained during the war.

Impression of Technical Men Who Have Returned from England

The impression of technical men who have returned from England recently seems to be that for the next year too many orders should not be expected from England. Such business as will result from the present situation in that market would be rather of a supplementary nature, filling out gaps which cannot be successfully stopped by the present English production, and applying to machinery required for coördinating the existing American machine equipment. To handle the English business will require careful attention and a close coöperation between the English consumers and the American producers.

The future exports to France will be closely linked up with the progress made in that country with the general reconstruction work. American experts have visited recently the devastated parts of France and their report shows that while the destruction is practically complete in certain regions there are others where only repairs will be required and the latter seem to be in the larger number. The Germans have often not dismantled the whole machine but have confined themselves to taking all the copper and brass parts of the equipment. These parts will have to be repla ed and the machines put into proper repair. As a result there will be an enormous demand in France for general repair shops and it is not clear yet whether France will possess all the equipment required for this purpose.

France, like England, has imported great quantities of American machine tools which have been used to supplement the existing national equipment. Like the shipments to England, the tools have been in a large part special tools for the manufacture of armament and may have to be discarded. Most of the imported tools have been installed in newly erected factories in localities where in former years there was no machine industry of consequence. They may now be removed from their present quarters and transferred to northwestern France to be employed in repair work or installed in the factories which have been left reasonably intact by the war. A great number of special automatic repair machines will have to be imported in the interest of a speedy rehabilitation of the French industries, but this work cannot be hurried on account of financial difficulties and lack of labor. France will receive a war indemnity. This, however, can only repay her in part for the great losses she has suffered during the war and cannot be collected immediately. So French rehabilitation work will proceed at a slower pace than has been expected. This will distribute the French purchases for machinery over a longer period. The peace treaty with Germany will have a material effect on the French purchases of machinery, for if this treaty should prescribe the restoration of the actual machinery by Germany, it would mean that most of these machines will be made in German factories during the next two years. The German nation of course will have to pay for these machines.

This is an eventuality which must be taken into consideration by our own machine-tool manufacturers. It might in fact have a very peculiar and unexpected influence on the direction of our own machine-tool exports after the signing of peace. The German machine-building industry most likely has suffered more severely from the war than the French, because of the different economic position of the two countries. France has been able to buy foreign machine tools and in consequence has been able to replenish her equipment regularly. The German industry had to make all the tools itself. As a consequence much industrial energy which in France could be employed in the conduct of the war has in the case of Germany gone into the building of supplementary machine equipment. Now, when the war has come to an end, the German machine industry sees itself with a large equipment on hand built for the special purpose of the war and with hardly any other prospect for employment. This equipment will have to be modernized at first by more suitable machinery before the industries can work again at a normal basis. If France is to have her machinery replaced by Germany two possibilities are open. Either the machinery will be bought in other countries with German money or Germany will manufacture that machinery. As the German equipment will prove insufficient for the latter purpose, Germany will have to buy it from England or the United States. It is, therefore, not at all unlikely that Germany may be quite a heavy buyer of American machine tools during the next few years until her own factories are able to catch up with their production. The present difficulty in Germany no doubt lies in the enormous social changes which the country has undergone during the last few months. Only men intimately conversant with industrial conditions in the old Germany can understand fully what these changes mean. Whatever may be the outcome of the present turmoil, the German workman will not be again a subservient military-trained being. His outlook on life will be different in future years and the German industry will not be such an aggressive national unit as it has been in years gone by. Such a far-reaching change of the industrial organization of a country like Germany must have a very decisive effect on our own relations to that market. A free-trade Germany or a low-tariff Germany may well consider it good business to buy machines in the United States instead of manufacturing them, provided of course that we are willing to sell them.

Political Changes in Germany

But the political changes that have taken place in Germany are nothing compared to those of all the rest of eastern Europe. Unfortunately, few of our machine-tool makers and general machinery manufacturers are really capable of gaging correctly the importance of the present events in those parts of Europe for our future connection with these new countries. Out of the wreck of two empires arises a series of new nations, all of great national consciousness and desiring to take their place amongst the other nations of the world. It has been the fashion during recent years to call these nations "subject" nations. This, however, does not correctly describe their condition as it implies an industrial backwardness which was the case in only a few instances. The new Bohemia, for instance, has

done very well as an industrial nation in the past and it will start its new national independent life with an excellent industrial equipment which may need supplementing only in so far as the war may have destroyed part of it. The situation is somewhat different in Poland. The old Russian regime had no interest in giving Poland an independent industrial life. Her industries in fact were shaped to be rather supplementary to the great Russian industries further East. If Poland now sets out to prepare herself for the life of a national unit she will have to reconstruct her industries so to make them self-sustaining. This will make necessary the erection of a number of new factories and this cannot be done without the importation of quantities of machine equipment, for very little can be made in Poland. The new Poland has industrially all the making of a second Saxony or Bohemia. She will have her own iron and coal mines and a large and industrious population. Poland therefore will be an excellent market for American industrial equipment and the great possibilities which this country offers for the development of a small machine-building industry should give American machine-tool builders their opportunity.

Ukraine Will Have to Build New Industries

What applies to Poland applies equally to the Ukraine, provided order can be restored in that part of the former Russia. As in the case of Poland, Russia had no interest in allowing a separate industrial development in that part of her dominions and in consequence the Ukraine became an agricultural development only, with the exception of the oil districts. Now after the separation from the empire the Ukraine doubtless will have to build up a new industry of her own, entailing the purchase of quantities of industrial machinery including machine tools. Both countries will be very desirable markets, because they are essentially rich and will be richer in the future. To enable them to buy their equipment from us small loans may be necessary but these loans will soon be repaid. The recovery will be quick and this whole territory may be in complete working order by the end of 1920.

Conditions are somewhat different in Serbia and those parts of the former Austria-Hungary which will be united finally under the Serbian flag. No country has suffered more from Austrian domination than Serbia. Cut off from the sea and dependent for her principal commercial outlets upon Austria the latter had seen to it that no industrial life of any importance should grow. The new Serbia will unite a great part of the old Austria with the main body of the Serbs and will have a proper outlet to the sea. The possibilities of developing industrial enterprise in Serbia are good, but the country has suffered heavily by the war, both economically and in the number of its inhabitants, and extensive and well-placed financial assistance will have to be rendered before we can expect her to buy American machinery.

Turning to the neutrals in Europe the three Scandinavian countries have attracted much attention lately. The great industrial problem of the three markets, Sweden, Norway and Denmark, is today that of raw materials and industrial equipment. Taking it for granted that the necessity of repaying the war debts will force Germany to work largely in the interest of English and French buyers the Scandinavian countries can expect little of either materials or equipment from Germany. Their only source, therefore, can be England or the United States, and the latter possibility seems to find more favor with the Scandinavian buyers. All three markets have been good customers for American machine tools and the most recent statistics show that their interest continues.

Much attention has been shown by our machine-tool manufacturers to the Mediterranean markets, especially Spain and Italy. Spain was the first of the great neutral countries to develop during the war a large demand for American machine tools. She has continued to buy large quantities of American tools and the Spanish industry is now well equipped with many of our best automatic machines. Spain's manufacturing problems are those of a vastly increased demand for all sorts of commodities which must be met by an industrial organization slow in development. Under such circumstances the employment of high-class automatic machinery becomes more than a convenience; it is indispensable. This explains why American machine tools have been in such demand in Spain during the last three years and it also is the reason why no falling off in this demand need be expected in the near future.

Italy is in a similar situation. Having as her neighbors such powerful industrial producers as Germany and Austria the development of many manufacturing industries had been somewhat neglected. This state of affairs is now being corrected with the result that many new factories have been built during the last two years and a still greater number may be erected during the coming period. The Italian demand for machine tools may not be as extensive in peace as it has been during the last years of the war. It will, nevertheless, be very considerable. Part of it may flow to England and Germany. The United States, however, should secure a large percentage of the orders for industrial equipment.

Naturally the after-the-war sales of American machine tools and industrial machinery will not be as large as those made during the war. We can, however, expect confidently a considerable increase above the numbers and quantities of 1913.

Measurement of Plain Rings

By R. L. Rankin
Gage Section, Bureau of Standards

During the peak of war-time gage production, ring gages were submitted for inspection to the gage section of the Bureau of Standards in such quantities that it would have been a difficult problem to inspect them accurately and quickly had it not been for a ring-measuring tool devised previously by the chief of the gage section, in anticipation of just such a condition. This device is simple enough but the accuracy and



FIG. 1. RING-MEASURING FIXTURE

speed which it is possible to obtain by its use make it worthy of attention. The ring-measuring fixture consists of a carefully ground cylindrical head with a rod driven into it, giving the whole fixture the appearance of a hammer, as shown in Fig. 1. One end of the head is fastened in a clamp set up on a stand. This leaves the other end of the cylindrical head projecting, and it is upon this longer, projecting end that the rings are placed. The under side of this end of the head is cut on a taper as shown in Fig. 2, when the device is to be used for measuring small rings. An indicator is attached to the rod so that the indicator arm has contact with the ring under its point of support. The whole device then acts as a gage for measuring the diameters of plain rings and the amount that they are out of round.

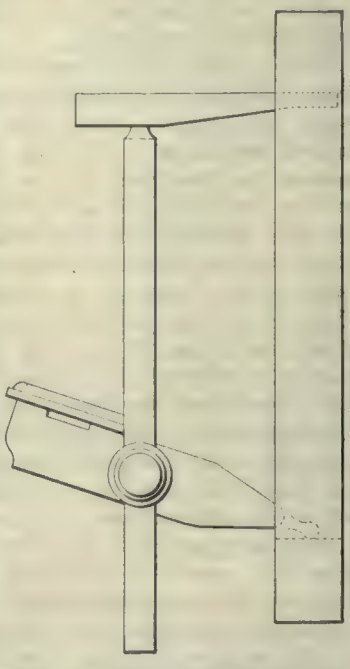


FIG. 2. DETAIL DRAWING OF INDICATOR HOLDER

A zero reading must first be taken from the top of the cylinder across the indicator arm. This is done by means of a micrometer caliper or by means of precision blocks set for the nominal diameter of the rings, Fig. 3. After the zero reading has been taken, the measurement of the diameter of a ring consists simply in setting the gage on the device as shown in Figs. 3 and 4, and noting the difference between the reading of the indicator and the reading observed for the nominal diameter. Variations in the diameter are determined by revolving the ring and noting the changes in the indicator reading.

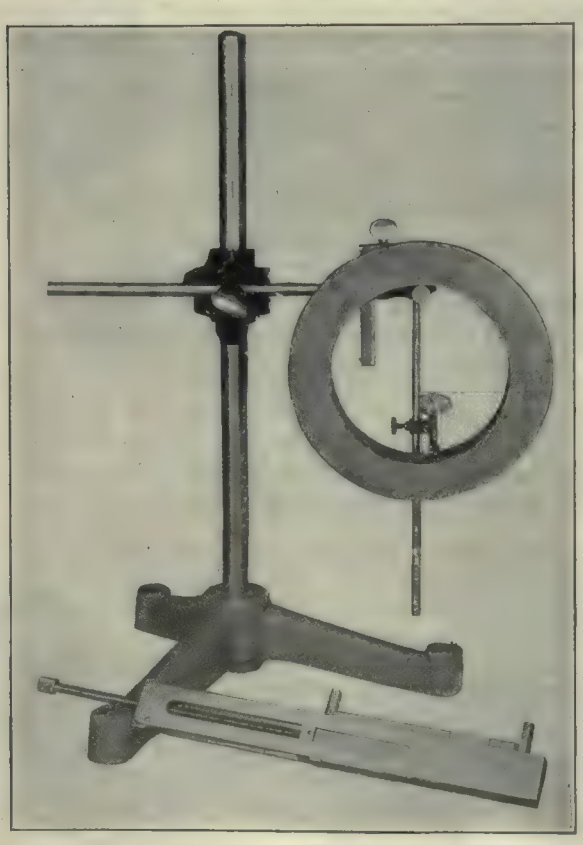


FIG. 3. SET-UP SHOWING PRECISION BLOCKS

No particular care is necessary to get the indicator arm directly underneath the cylindrical support of the ring, although it is true, of course, that if the ring is allowed to hang free and the indicator arm is not in such a position, the full diameter reading will not be obtained. This difficulty is overcome, however, by rocking the ring gently from side to side and taking the maximum reading on the indicator. Thus, in Fig. 3, the ring must be swung to the right to obtain the diameter reading.

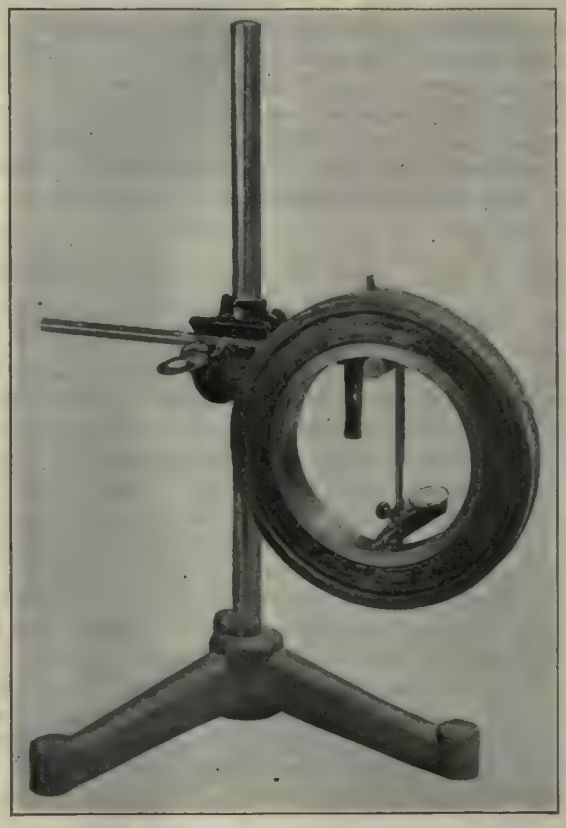


FIG. 4. SET-UP OF APPARATUS

When large quantities of rings of the same nominal diameter are submitted for test, this device is a great time saver and it is accurate within 0.0001 in. In order to obtain this accuracy, care should be taken to see that the supporting rod for the indicator is secured firmly in the cylindrical head. This method is used by the gage section in the inspection of all plain ring gages over $\frac{1}{2}$ in. in diameter and it is of particular value in the determination of the uniformity of the diameters across different points of the ring. Experiments made with the rings in a horizontal position indicate that the elongation of the rings (produced by their own weight when in a vertical position) is negligible.

Any one who is further interested in this device will be given any details not mentioned herein, upon request to the Bureau of Standards. Visitors are welcome at the bureau to inspect this or other work in which they are interested.

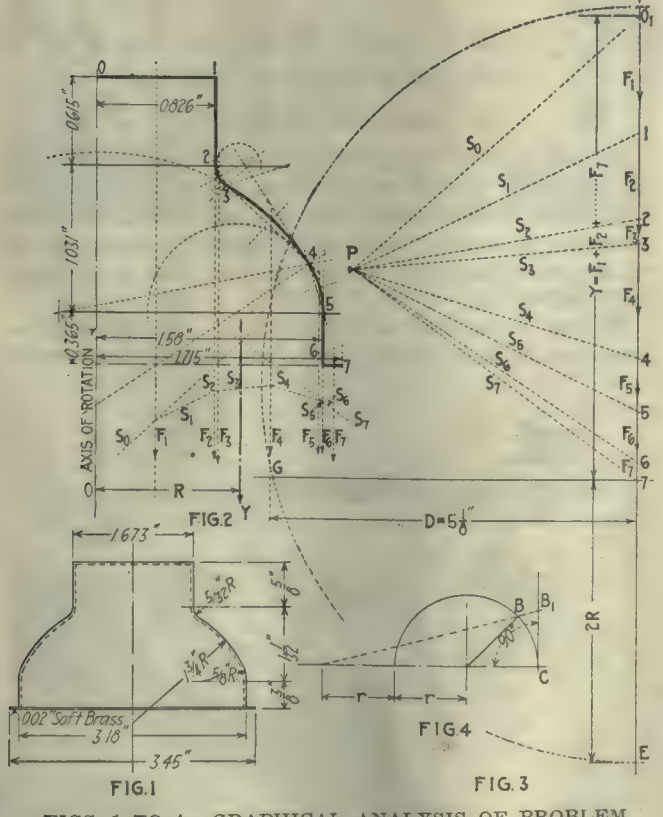


Blank Diameter by Graphical Method

By Walter Hinman

The American Ever Ready Works of the National Carbon Co., Long Island City, use for their Daylos a number of parts, the outlines of which consist of combinations of circles and straight lines. To find the blank diameter in the usual way necessitates complicated figuring. The following graphical method proves a quick, reliable way and gives entirely satisfactory results by substituting a number of mechanical operations for tedious figuring. It is based on the theorem of Pappus, uses the funicular polygon to find the center of gravity and assumes that the neutral surface of the blank and the finished work are the same.

The theorem of Pappus for surfaces is: Assume that a plane curve, length L, revolves about an axis in its plane but not cutting it; and let S be the length of circular arc traced by its center of gravity. Then area of surface generated by L is $A = LS$. If $S =$ a complete revolution, $A = 2\pi RL$, where $R =$ distance from axis to center of gravity of L.



FIGS. 1 TO 4. GRAPHICAL ANALYSIS OF PROBLEM
Fig. 1—Part to be drawn. Fig. 2—Funicular polygon. Fig. 3—Force polygon. Fig. 4—Rectification of arc CB

The length of the neutral line is easily figured or scaled and the funicular polygon used to find R.

To make the process clear we will determine the blank for the reflector shell of a searchlight Daylo, shown in Fig. 1. In order to get the length of the plane curve L we draw one-half of the finished piece to double scale, Fig. 2. We next rectify the arcs as shown in Fig. 4 and locate the center of gravity of each by assuming that it is on the perpendicular to the chord two-thirds of the distance from chord to arc above the chord. This is close enough for all purposes.

We next assume that a force represented by a vertical line equal in length to the respective portion of the curve acts at each center of gravity. The lines of action of these forces are the dotted lines, F_1, F_2, F_3, etc., Fig. 2, which are projected downward to keep the funicular polygon clear of the figure. We then lay off the forces to scale on the line $0 - 7$, Fig. 3, and choose any convenient point P for the pole of our force polygon. P is then connected to the points $0, 1, 2, 3 \ldots\ldots 7$, by the lines $S_0, S_1, S_2 \ldots\ldots S_7$ and the funicular polygon drawn by making $S_0, S_1, S_2, S_3 \ldots\ldots S_7$ in Fig. 2 parallel to $S_0, S_1, S_2 \ldots\ldots S_7$ in Fig. 3. Through the intersection of S_0 and S_7 we draw the resultant of the forces Y, which will be at a distance R from the center line of the finished piece and be equal in length to the sum of the forces in the force polygon or $0 - 7$.

From the theorem of Pappus, stated above, we can say that the area of the finished piece is

$$A = 2\pi RY \qquad (1)$$

As this should equal the area of the blank which is a circular disk of diameter D,

$$A = 2\pi RY = \frac{\pi D^2}{4} \text{ and } 2RY = \frac{D^2}{4} \qquad (2)$$

D may be found graphically as shown in Fig. 3. This method applies the geometrical proposition which states that if one of two intersecting perpendicular chords of a circle is a diameter, one-half the shorter chord is the mean proportional between the segments of the diametrical chord.

In formula (2) $\frac{D}{2}$ is the mean proportional between $2R$ and Y, for the equation may be reduced to the form of a proportion—$2R : \frac{D}{2} = \frac{D}{2} : Y$. Add $2R$ to Y in Fig. 3, giving the distance $0 - 7 - E$; describe a semicircle on OE as a diameter and erect a perpendicular at 7 which intersects the arc at G and gives $G - 7$ as the length of $\frac{D}{2}$ desired. As this figure is to double scale the value $\frac{D}{2}$ found is actually the diameter of the blank.

A Radius Turning Tool

By E. T. Grimes

The sketch shows a simple tool for turning small radii, such, for example, as the concave face of wormwheels. It is made by forging a boss on a piece of 1 x ½-in. steel, drilling this boss and facing it both top and bottom for the swivelling toolpost. The shoulder of the post where it passes through the boss should be gaged very accurately as to length so that when the nut is tightened the post will turn easily without being loose. The hole for the tool may be round, and the tool may be a piece of drill rod or it may be broached square to accommodate the commercial toolbit of high-speed steel. The toolbit is held by a small setscrew passing through the side of the toolpost.



RADIUS TURNING FIXTURE

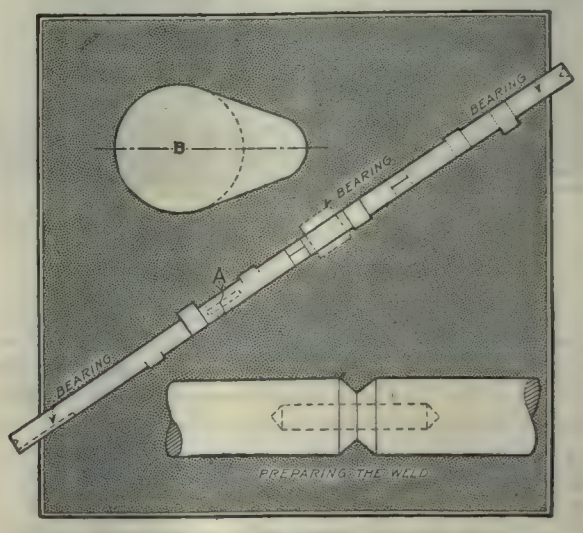
In attaching the handle care should be taken to have it at a right angle to the hole for the toolbit, otherwise it will probably interfere with the regular toolpost in which the shank of this tool is held. Instead of a permanently attached handle the top of the swivelling post may be squared and an ordinary S wrench used for turning it. The radius to be turned is determined by the adjustment of the toolbit.

Welding a Broken Camshaft

By O. F. Kuhlman

The camshaft of a gas engine was broken as shown at *A* in the sketch and it was decided to repair it by welding. The broken ends were first annealed, care being taken not to anneal the cams. Each piece of shaft was then swung up in a lathe and ⅜-in. holes were bored 1½ in. deep in the broken ends. The ends of the break were now beveled to about 45 deg. for the welder, the bevel extending about half-way down to the center.

A pin was driven into the larger piece of shaft first, then the smaller piece was forced onto the protruding end of the pin. The shaft was then put on a surface plate in V-blocks, and with the aid of a surface gage and a pipe wrench the cams were lined up in the following manner: A line was scribed on



WELDING A BROKEN CAMSHAFT

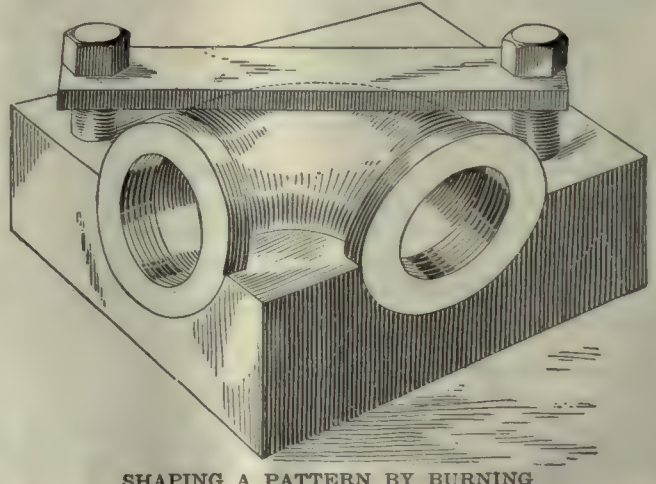
the intake cam of cylinder No. 1, as shown at *B*, and a similar line was scribed on the intake cam of cylinder No. 4. By using the pipe wrench the smaller piece was turned around until the intake cam of No. 1 was directly opposite the intake cam of No. 4 and in this position the pieces were welded together. After it had cooled sufficiently to handle, the shaft was put between the centers of the lathe and straightened. Upon being put into the engine it worked very satisfactorily.

A Quickly Made Holding Jig For Irregular-Shaped Pieces

By Frederick J. Spangler

Having a lot of irregular elbows to thread, it became necessary to provide some means of holding them in the lathe. The number did not seem large enough, however, to warrant any very expensive tools and so we sought a means of doing it cheaply and at the same time effectively.

Taking a block of wood of suitable size the depression was cut out roughly and then finished by heating



SHAPING A PATTERN BY BURNING

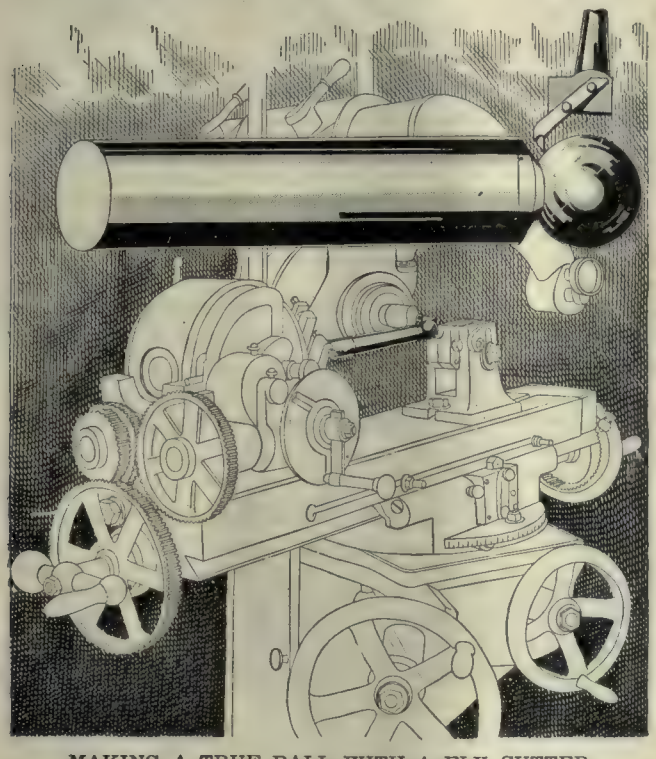
an elbow red-hot and burning the wood with it. With a little care this was done very nicely and the resulting casting required no machining except to drill and tap necessary holes for holding it to the faceplate of the lathe and for fastening the work in position.

Forming an Accurate Ball on the End of a Rod

By Bernie Soule

Many times it is desirable to form an accurate ball on the end of a rod, as for instance in the making of what is known as a ball pitman used on many power presses.

The usual way of accomplishing this is to rough it out in the lathe, operating the traverse and crossfeeds by hand, squinting at the job with one eye shut, until



MAKING A TRUE BALL WITH A FLY CUTTER

the piece assumes a shape that is something between a goose-egg and a door-knob, and then with hand tools, files and templets used in connection with plenty of perseverance, profanity and Prussian-blue, reducing it to a ball that is not *much* bigger in some places than it is in others.

Now it is quite easy to make a tool that will turn a sphere and nothing else—that is, a tool that cannot under any circumstances produce a spheroid—and it does not require any close calculation either. It is based upon the fact that any plane cutting any sphere is bounded by a true circle.

The work (after roughing out in the lathe as described above in order to save time) is mounted in the chuck or on the centers of a dividing head, according to its size. The tool may be a hollow-mill or a fly cutter as shown in the cut. The dividing head and work is placed on the table of a universal milling machine, which is swiveled to an angle dependent upon the manner in which the work is supported and the size of the neck which joins the ball to the rod. If the neck is proportionately small and the work is held on centers, the table need not be swiveled at all, as there must of course be a small tit remaining around the tail center to support the work, which is afterward removed in the polishing operation. Again, if the neck is larger and no tit is required, as may be the case if it is possible to support the work without a tail center, the table may be turned as much as 15 degrees.

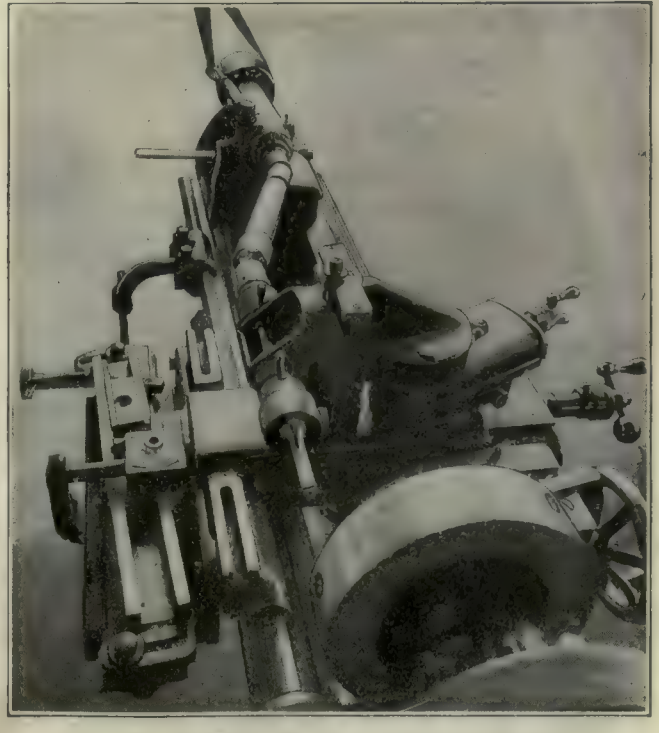
The diameter of the circle swept by the fly cutter may be anything less than the diameter of the desired ball; how much less will depend upon the diameter of the required neck and the angle at which the milling-machine table stands? Whatever this circle may be (below the maximum) it determines only the proportion that the machined surface bears to a complete ball—the sphericity of the portion covered is not affected, whatever its diameter. Thus, it is practicable to reduce the diameter of the ball by feeding in with the crossfeed screw of the milling machine exactly as one reduces the diameter of a shoulder by feeding in the cross-slide of a lathe, and to determine its diameter as accurately by measuring it with a micrometer, with the assurance that whatever the reading shown by the latter it will be the same at whatever angle the measurement is taken, as the ball will always be perfectly round.

By careful attention to the cutting quality of the tool it is possible to make a ball that requires little more to finish it than polishing with emery cloth.

An Internal Thread-Milling Attachment

By W. C. Loring

The internal thread-milling fixture shown in the accompanying picture has been designed as an attachment to a 16-in. Le Blond lathe, which is also equipped with taper, and relieving attachments. The point of view, looking down from above the lathe head, was necessitated by lack of room in which to set the camera and still obtain a comprehensive picture. The device



ATTACHMENT FOR MILLING THREADS

was designed and built by the A. F. Way Co., Inc., of Hartford, Conn., for the purpose of milling the threads in gun-mount nuts, ranging in diameter from 1 in. to 2¼ in. with U. S. Standard threads.

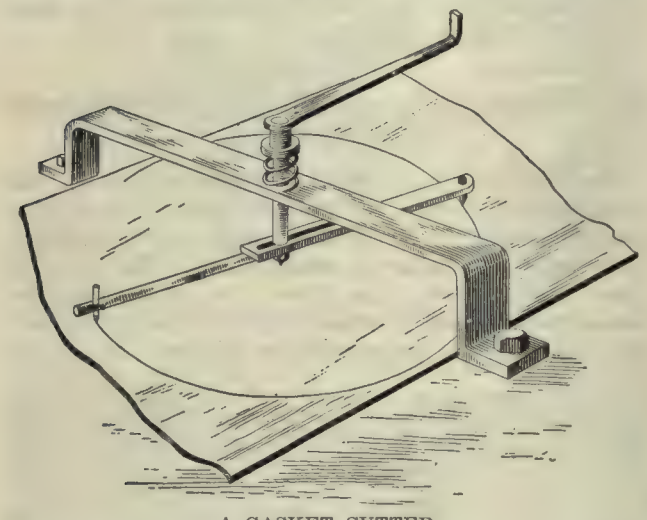
The housing is attached to the compound rest of the lathe and thus can be adjusted to any convenient angle. A swivel, which is part of the housing, allows the cutter spindle to swing in a vertical plane, making the attachment practically universal. The speed of the regular lathe countershaft is reduced to give a suitable rate of feed. The cutter is driven from a small special countershaft and through the medium of a universal joint, the first member of which runs in a long sleeve placed in the position usually occupied by the tail spindle. With this equipment, work of thread-gage accuracy and with beautifully finished surfaces is turned out.

A Simple Gasket Cutter

By M. H. Potter

The device shown in the illustration is easily and cheaply made and will save a good deal of time where there are many gaskets to be made as it will cut both the outer and inner diameters at the same time.

The center pin is made of drill rod and is driven into the larger rod and then ground to a sharp point. The



A GASKET CUTTER

cutter is also made of drill rod ground to a cutting edge and held in the beam by a headless setscrew. The beam should be of sufficient length to cover any job that is likely to be encountered. Adjustment for diameters is by means of a nut on the central arbor.

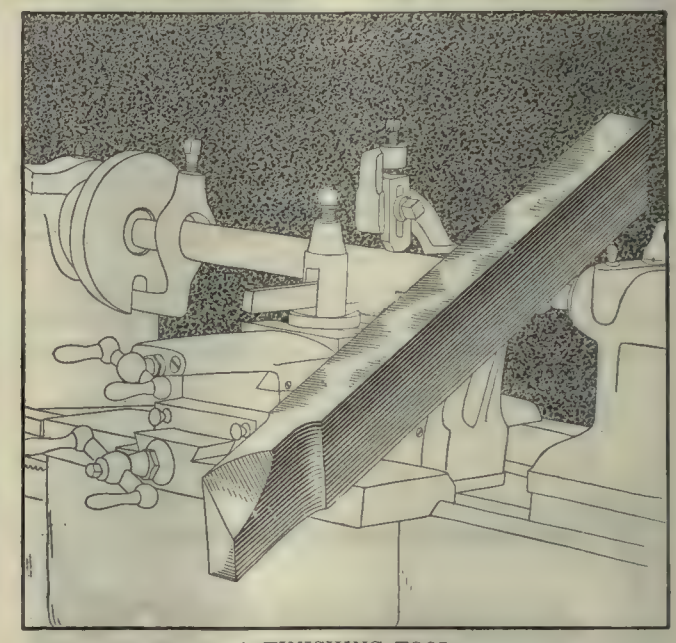
A Finishing Tool for Smooth Surfaces

By C. E. Liebensberg

The sketch shows a cutting tool which at first may seem irrational to the average mechanic, but having used it myself for several years with success I recommend it for good results.

It is purely a finishing tool for the lathe, shaping, or planing machine and has the rake ground on the cutting side while it travels against the rake instead of from it. It has a shearing effect, delivering a coarse-pitch, tube-like shaving.

It holds the edge longer than the ordinary or conventional type as it needs no "lip." The cutting edge is ground approximately 45 deg. from the vertical. The front is ground slightly convex for flat surfaces; more so for boring, and flat, for turning or cutting circular work externally. It gives a finish approaching that of, if not as good as, a spring tool, with the



A FINISHING TOOL

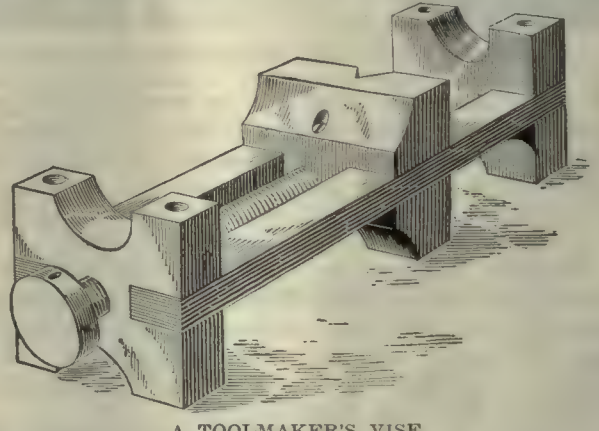
advantage over the latter that it makes no depressions in the work. Another advantage is that it cuts a perfect shaving of less than 0.001 in.

[The principle of this tool is the same as that of the "twist-lip" tool, familiar to the older mechanics.—Editor.]

Small Vise for Toolmakers' Use

By Charles Sehl

The sketch shows a tool that is a cross between a vise and a clamp which I built for my own use and I have found it very handy for many purposes for which the regular toolmaker's vise is unsuitable. With the



A TOOLMAKER'S VISE

exception of the screw it is all made of cast iron, though that is, of course, not essential. It has the advantage of not requiring a special casting or forging as it is made of small pieces held together by dowel pins. The end pieces are cut away, as shown, so that the tool has a four-point bearing either side up. Care should be taken to make it square in every direction so that it may be used in any position.

Standardization and Interchangeability; Factors Which Help or Hinder According to the Work in Hand

By FRED H. COLVIN
Principal Associate Editor, *American Machinist*

The desire for standardization and interchangeability, commendable in itself, sometimes leads us to extremes which are not only unprofitable but which defeat the object to be attained. This article shows some of the pitfalls to be avoided and indicates the opportunities for increasing production and decreasing costs by a careful consideration of all sides of the problems.

ALL agree that economical production is the great need of the country to enable it to recuperate from its extraordinary expenditures and to enable it to supply its own needs and the needs of others less fortunately situated. This means that we must carefully consider all the factors which enter into production and abandon practices which have proved too costly for the results obtained. It means that we must take advantage of all the experience gained in our war activities and profit by it.

Perhaps the most important point for consideration is that of interchangeability, as this question has been prominent from the beginning of the introduction of modern shop methods, and is the most talked-of and the least understood factor in manufacturing. At the risk of being elementary we may say that parts are interchangeable when they will go together satisfactorily without fitting. But here the word "satisfactorily" leaves room for arguments of many kinds. Agricultural machinery is very largely a foundry product and it can be and is made satisfactorily interchangeable with very little machining of the various parts. Even after considerable wear has taken place a new part can be used, as the extra "play" or looseness of fit is not objectionable for this class of work.



Rifles and other arms and ammunition present a very different problem. The parts must fit each other quite accurately to obtain proper functioning. The exact tolerance which can be allowed and still secure this functioning is naturally a matter of dispute in many cases. With agricultural implements on one hand and airplane motors on the other we cover about all the field of machine building.

Before going further, however, it is well to consider carefully just how far interchangeability is either necessary or desirable and also just what quality of interchangeability is needed for the particular work in hand. For we have wasted thousands of dollars during the past two years in unnecessary refinements, not to mention the precious weeks and months which slipped away while we were chasing the interchangeability fetich to its illogical conclusion.

From the standpoint of assembly alone there can be no question about the advantage of complete interchangeability. If this can be secured with wide tolerances, as in the case of agricultural farm machinery already referred to, it would be foolish to consider anything else. But when this fetich demands such accuracy as to cause the rejection of from 25 to 50 per cent. of the parts machined there are other factors which must be considered. Ease of assembling alone can hardly justify the scrapping of thousands of dollars' worth of parts which might easily be used if absolute duplication were not insisted upon. The importance of this exact duplication must be carefully weighed not only by the theorist alone but by the practical engineer who can consider proper functioning, first cost and repairs and balance these factors as they should be.

Those who demand absolute interchangeability think only of two things—the assembling and the replacing of broken parts. These were the considerations which made the original demand for complete interchangeability in the airplane motor. These demands overlooked the fact that in the case of the rifle practically no repairing is ever done away from a base shop, and that with the motor enough wear has always taken place to make fitting of bearings, etc., a necessary part of the work. In other words, they fail to realize that unless absolute interchangeability of parts is a help in manufacture and in repair it can be (and is) a serious and expensive hindrance.



Selective Assembly

Becoming elementary once more it is evident that as tolerances are necessary some pieces will fit more loosely than others. If for example we get a minimum pin in a maximum hole, the fit is decidedly looser than as though a maximum pin was put in a minimum hole. If we can tolerate a play of say 0.002 in. in a fit we would, if we desired, make our total tolerance 0.003 to 0.004 in. and never exceed the 0.002 in. by using the large pins in the large holes and the small pins in the small holes. In other words, we can use selective assembly, as is done in many places.

This does not mean that the assembler wastes time by picking up and measuring pieces to get those which fit together best. He has no such bother or delay. The inspection room sorts the parts as they go through for final inspection and puts them in boxes with identifying marks which show the assembler just what parts to use. One of the best-known builders of high-grade automobiles assembles cylinders and pistons in this way and their quality of workmanship is never questioned. Its engineers know full well that long before the motor

ever needs repairing the wear will make oversized pistons necessary.

Selective assembly would have reduced the cost and increased the output of rifles and many other munitions without in the least interfering with their proper functioning. A large maker of high-grade guns told me that if he could confine absolute changeability to the few parts which were necessary to the proper functioning of the arms, his factory could increase its output at least 40 per cent. In another factory I have seen a rifle which was made up entirely of parts rejected by Government inspectors, yet which not only functioned perfectly but also made a very high target score on the firing range.



A similar condition existed in the building of Liberty motors and unnecessarily delayed production as well as increased the cost. Thousands of dollars' worth of perfectly good parts were sent to the scrap pile in the earlier days of the work, at the time when we needed motors the most. The fetich of interchangeability was too strongly intrenched in the minds of the engineers who set the tolerances to allow them to see the need of rational dimensions and to discriminate between the vital parts and those in which wide tolerances were perfectly permissible. The inability of any factory building these motors (all of them accustomed to accurate work) to obtain satisfactory production, led to much more liberal tolerances in many cases. These were camouflaged under the head of "deviations" from the specifications and many variations which caused vital parts to be scrapped early in the game were allowed to pass when it was found that they gave satisfactory service and that the tolerances demanded were neither necessary nor practical.

Consider Your Own Product

Instead of being swept along by the tide and demanding absolute interchangeability of all parts, every manufacturer should consider his own product and its needs. If it must interchange with other parts in other machines, as in the case of spark plugs, oil cups, motor drives, etc., the accepted standards should be adhered to on the parts which fit the other machines. The rest of the product should be considered from the various angles of manufacture, of parts, assembly used and of replacements. The question of use or proper functioning should properly come first, as this affects all the rest.



If, as in the case of such munitions as time fuses, shrapnel, etc., the part is used but once and is then destroyed, proper functioning is the first question which must be considered. Wear and replacement or repair do not enter into the problem. Manufacture of parts and assembling so as to function properly are all that need be considered. Perfect screw threads, such as required to resist wear, are unnecessary so long as they hold sufficiently well to keep the parts together until the grand finale—the explosion and destruction of the piece. Except from the assembling point of view interchangeability of the components is unnecessary, as there are no replacements. Selective assembly with fairly wide limits would in most cases give all that is required.

The building of airplane motors and other machinery presents entirely different problems. Certain parts are subjected to wear from the time the motor goes into service. The cylinder and bearings wear large while the pistons, shafts and pins wear small. Other parts, such as the valve rocker-arm housing on the motor, while subjected to wear in the bearings, have no other vital dimensions. The exact height from the cylinder is not vital because the play between the valve stems and tappets could be taken up with shims, or distance washers, or in other ways.



Repairs Require Fitting

Here then is a piece in which considerable variation in height could be allowed, and on account of the nature of the work and the general springiness of the aluminum casting it is a good policy to be liberal in tolerances. In replacements, fitting and adjusting must be done in any case. Cylinders, pistons, rods and crankshafts can never be replaced without fitting if the motor has run for any length of time. The parts should be interchangeable to the point of being easily fitted, but beyond that it is impossible to go where accurate work and close-fitting bearings are necessary.

There are many parts in automobiles not subject to much wear which can be replaced without fitting. Brake rods, speedometers, gears and cables, spring leaves and shackles and similar parts can be replaced by a novice because there is little wear on the portions which fit and close tolerances are not necessary. Replacing a broken ball in a ball bearing, however, becomes a serious problem if the bearing is subjected to a heavy load. A new ball, even very slightly larger than the rest, might take the whole load and either crack, crush or score (or all three) the races, in a short time. The only safe way is to measure all the balls with extreme care and select a new ball of the same size.



In making machine tools all builders endeavor to make the parts interchangeable to a degree which gives ease of assembling. They make such units as gear boxes interchangeable, as units, so they can be placed on any machine without fitting. But if there is a gear in one part which must mesh accurately with a gear on another they wisely put in some sort of an adjustment so that the shafts can be moved into the exact engagement they desire for quiet running. This strictly speaking is not interchangeability, but it is far more sensible and practical than the other method. And in case of replacement after use it would be necessary to do fitting just the same.

We make headstocks, tailstocks and carriages in special fixtures so as to have the lathes go together easily in the assembling room, but we would never think of ordering a new headstock or new carriage and expect to use either without being sure that it lined up just right, and we would be very much surprised if no fitting or scraping was required to put

the parts in line with the old bed and tailstock. In the case of the carriage we should find the bed worn more at some portions of its travel than at others, more on the front way (or shear or V) than on the back, and would expect to scrape the ways until it lined up well enough at all points for our particular work.

If we have had experience we will not try to locate one part accurately on another by means of screws, but will locate with nicely fitting dowels and use cap-screws or bolts, which do not pretend to be very close fitting in the hole of the piece being attached. It seems to be one of the next-to-impossible things to get bolts with the body and threaded part exactly concentric or to tap a hole exactly concentric with the drill. This is particularly noticeable in aluminum or bronze, but holds reasonably true in all metals. For this reason screws or bolts which position parts that must be held accurately should not depend on the tapped hole to do so. All positioning should be done by a dowel pin or by the body of the bolt, and the threaded position should be loose enough not to bind the body of the bolt.

The quality of work as well as the material to be used should conform to the requirements of the part being considered. There are places where a cast-iron bearing or a cast-iron gear answers every purpose as well or better than if made of alloy steel and heat-treated. Every part should be made plenty good enough for its purpose with a fair margin to be on the safe side. But to use a drop-forging with many operations, when a piece of steel rod formed in a wire-bending machine will answer every purpose, is a foolish waste of time, money and material.



The cost of material, machining and assembly, the use of the piece and the wear it will receive, the likelihood of its being replaced and whether or not this can be done without some fitting are all questions which the manufacturer who desires really economical production must study most carefully.

Standardization and interchangeability can be and have been overdone in many instances. We have demanded much greater accuracy than was necessary in too many cases. When a machine is made of material possessing all the necessary qualifications for the work it must perform, when the work is sufficiently accurate to function satisfactorily, when it can be assembled and repaired economically, it is a good commercial product. Better material or greater accuracy would be an economic waste.

It may happen that the increased cost of assembly due to wide tolerances and selection may pay for much close work in the machining operations. Generally speaking the waste due to scrap is increased with the narrowing of working tolerances, although there are shop managers who have had the opposite experience. But in any case the costs in each department must be balanced against the others, including the cost of making replacements and repairs.

No matter what the tolerance the use of limit gages is to be carefully considered, and there are few cases where they are not to be recommended, especially for inspection. As working gages they are apt to be more costly than many anticipate, owing to wear when used on running work or rough surfaces, as is sometimes done. Here again the costs must be balanced against results in each case.

But no matter what sort of measuring instruments are used always keep the shop, or working, tolerances smaller than those allowed the inspectors. In this way the amount of scrap is materially reduced. The practice of selecting gages with the least variation for the inspectors has been the cause of a vast amount of spoiled work. This has been emphasized by the war work of the past two years, most of it in shops where gages, and particularly limit gages, were almost unknown.

Another factor which affects production and which is misunderstood in many ways is that of accuracy or conforming to close dimensions. Unnecessary accuracy is as uneconomic as it is foolish. Unnecessary accuracy on a mowing machine would be as foolish as cabinet work on a chicken coop. Hand finish or exact dimensions on a rifle stock (except of course where the barrel rests) is as unnecessary as on a broomstick.



Close-fitting bearings are a real detriment to some classes of machinery and absolutely necessary in others. Locomotive-rod bearings must be left loose or they will bind and heat. Automobile-motor bearings are usually fitted very tight and allowed to wear in by easy running for the first 500 miles. Airplane-motor bearings are fitted closely, but not so tight as those for automobile motors, as there is no slow-running period in airplane work. They also require more careful fitting than for those in automobile motors. Each should be fitted as best suits its needs, but unnecessary refinement should be avoided.

Much discussion has been published in these columns on doing the best work possible in all cases as against making it sufficiently good for the purpose and avoiding the waste of time due to making it better than necessary. The latter contention is very evidently the more sensible in every way. The absurdity of making a pattern for one casting as thoroughly as though it were to be used indefinitely should be apparent to all.

Quality of work, standardization and interchangeability are all questions to be carefully considered by every manufacturer who is looking to the future. And each manufacturer must consider them from the standpoint of his own method of manufacturing. There are great opportunities for wasting money in all of these directions and handicapping him in the coming race for markets.



Never before was there such a need of competent judgment in the planning and carrying out of machine shop work, and this entirely aside from the question of labor or personnel, which is far more important now than even before. Never was there such a need of competent engineers with more experience and common sense than was ever required in the days gone by. Practical common sense, not theory, is needed at this time. Scientific managers or efficiency engineers of the old sort will not fill the bill. The first thing is to know what to build and what engineering features are

needed rather than the exact routine by which the work is carried out or followed up. That is mere routine; the other requires real judgment.

The experience of the past two years has developed many good engineers who will be found of great value along the lines indicated. They should be frequently consulted if not kept on the job permanently. No business which hopes to succeed in the days to come can afford to ignore the engineer to assist the business manager to meet all the emergencies which will arise. There is work enough for both, and only by the closest coöperation can the best results be obtained. We must not be handicapped by the traditions or fetiches of the past, but must each choose what is best for his particular line of manufacture.

Automatic Drilling Machine Feed

By E. Ferber

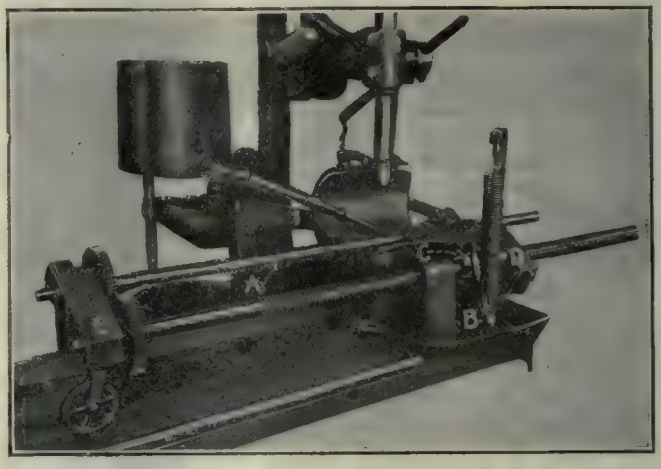
The illustration with this article shows how a manufacturing job, which was a somewhat tedious manual operation, was, by the exercise of a little native ingenuity and the use of a few odd parts taken from old machines in the discard, converted to machine production with practically no outlay for material and little cost for time. The work to be done was the drilling of the small holes in the pipe shown at *A* in the cut. Accurate spacing of the holes was not essential and the drilling had been done for some time by boys, who would hold the pipe in a V-block on the table of a sensitive drilling machine, spacing the holes according to the judgment of the boy so that they would look about right.

As there were a lot of the pipes to be drilled, the job got to be very monotonous; the boys would lose interest in the work, fail to pay proper attention to the matter of spacing the holes and holding the pipe, with consequent loss due to drill breakage. Boys would get so tired of doing such tedious work that they would "jump their job" and it became a problem to get boys sufficiently intelligent to do the work well and yet so lacking in ambition as to be willing to do it. It was really for this reason that the master mechanic devised the scheme here described, but aside from getting out the work, the new device practically eliminated drill breakage, reduced operating cost to almost nothing and greatly improved the quality of the work.

The work is done now, as it was previously, on a multiple-spindle sensitive drilling machine, but only one spindle is used. The casting *B* was a part of a special machine that had been discarded, and the fitting of the bracket thereon with the ratchet, lever, and pawl, which is partly disclosed at *C*, was practically the only special work put upon the device aside from the assembling. The hole in the bracket is not threaded nor is the one in the smaller bracket to be seen just beyond the spring, these two holes serving only to guide the feed screw. This screw is a part of the lead screw of an old lathe. As may easily be seen from the picture its days of usefulness as a lead screw are long since past, but it fits into this scheme perfectly. The sleeve of the ratchet has a key fitting the spline in the screw which serves to transmit the rotary movement.

The nut *D*, another relic, is made in two parts and hinged together so that it is necessary only to move the latch and open the nut to remove it or transfer it from one part of the screw to another. A projecting screw-head resting against the bracket prevents the nut from turning with the screw, and as the movement is always in one direction, this is all the fastening that is required. To reset the machine for a new piece of pipe, the nut is opened and transferred to the end of the screw. The movable part *E* rolls along the table of the machine upon sheave wheels that once carried a weighted cord for some purpose or other, and is guided solely by the screw passing through the two brackets on *B*. The gears connecting the screw and the work spindle are change gears from a lathe. They are of the same size, but this only happened so, as they were chosen to conform to the center distance already established by the piece of scrap material which constitutes the carriage.

A piece of pipe to be drilled is set in the machine by slipping the end over the stud that carries the driven gear and putting in the pin *F* which passes through a previously drilled hole in the pipe and a corresponding hole in the stud. The outer end of the pipe rests in a V-block under the drill. The drive for the whole device is a worm and wormwheel located on the back of the part *B* just out of sight in the picture.

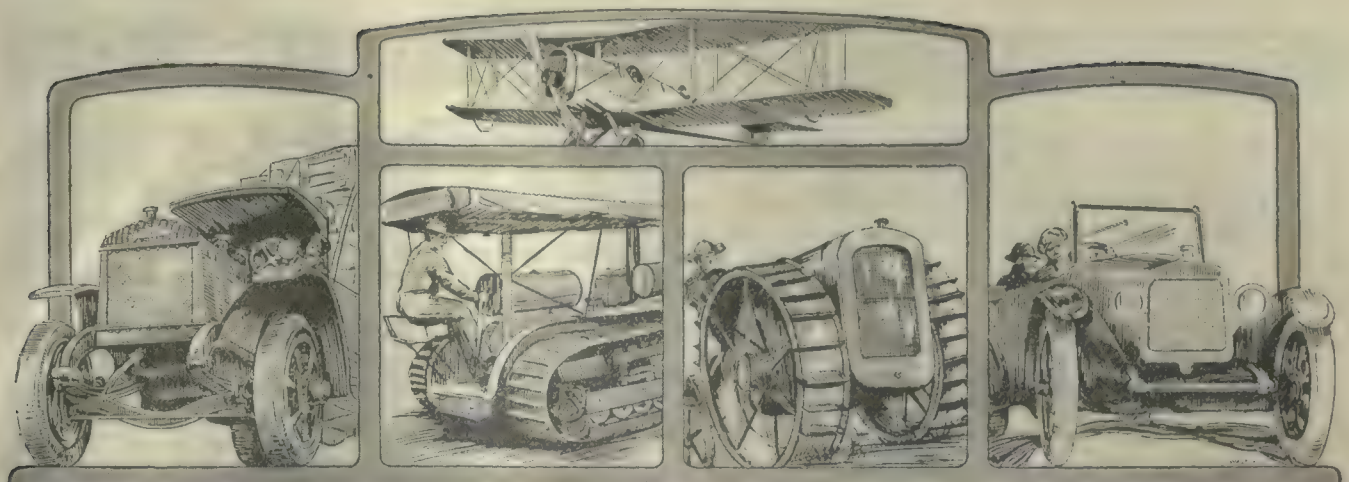


IMPROVISED AUTOMATIC DRILLING DEVICE

The wormwheel operates, through connecting-rods, the drilling lever and also the ratchet lever that feeds the work forward.

The cycle of operation is obvious. With the carriage run to the left as far as it will go a piece of pipe is pinned to the stud and the machine is started. The drill advances quickly to the work but slows up as the crankpin which operates it nears the center so that when the drill breaks through into the orifice of the pipe the movement is very deliberate and little trouble is experienced from drill breakage. As the drill rises from the work, the ratchet is stepped forward, giving the screw a partial rotation, and through the medium of the gears a partial rotation is also given the pipe. Again, because of the nut *D* which is clamped about the screw, the pipe and screw are drawn forward an amount equal to the lead of the screw for the distance turned. Thus the resulting line of holes in the pipe is a continuous helix the exact counterpart of the thread of the screw except that the direction of lead is reversed.

Though the action is considerably slower than could be accomplished by hand, it is continuous and not subject to the drawbacks due to manual operation. All that is necessary for the operator to do is to put in a piece of pipe and start the machine, after which he is free to continue his other work.



AUTOMOTIVE CONSTRUCTION

Making an Automobile Wrench in Two Operations

By HUGO F. PUSEP

The automobile wrench, described in the following article, was formerly made in three operations, but when it became necessary to make a second set of tools it was found practical to reduce this number to two. A valuable feature in follow dies of this nature is the system of sliding stops for the guidance of stock until the regular latch stop comes into action.

THE double-ended wrench shown at *A*, Fig. 1, comprises a part of the regular equipment of tools furnished with a popular-priced automobile, the hexagon end being for the hub caps of the wheels. Formerly this wrench in a modified form was a steel casting, but owing to its weight and the necessity of machining the openings to size, the design of the wrench was slightly changed and now it is made of No. 9 gage (0.156-in.) sheet steel on the punch press at one-fifth the cost of the cast-steel wrench. A reinforcing flange is formed around the wrench openings, at each end as at *B*, Fig. 1, while the bead *C* serves to stiffen the middle part or handle. The blank is shown at *D*. This wrench is made complete in two operations.

Fig. 2 shows the first operation die, which is of the progressive piercing and blanking type. The cast-iron die shoe *E* has four guide posts which are a sliding fit in the corresponding holes of the punch holder. As may be seen from the sketch, the die proper is built up of sections let into suitable openings milled in the die shoe, the sections coming flush with the top of the cast iron and being held in place by screws and dowels.

In order to save stock the strip of material is passed through the die twice, the dotted lines showing the position of the holes punched in the stock on the first pass as they appear when the strip is reversed and passed through the second time. In operating this die the stock, which comes in strips 11 in. wide, is fed under the stripper (not shown) to the first sliding stop *F*, shown in dotted lines. These stops are made of flat steel and slide in grooves milled on the underside of the stripper.

On descending, the punches pierce the holes *G* and *H*, after which the stop *F* is pulled back and the stock is pushed forward till it comes into contact with the second stop *I*. This stop locates the two holes already punched approximately over the blanking die opening *J* where the pilots enter the holes when the punch comes down and lines them up to the outline of the die opening. At the completion of this stroke a wrench blank is punched out and drops through the die into a tote-box. The stop *I* is then pulled back and the stock advanced till it is stopped by a regular latch stop *K* which works in a slot cut into the stripper plate and is pivoted on a pin. After this stop is reached, the operator simply pushes the strip against the latch at each stroke of the press, till the entire strip is fed through the die. The strip is now turned over and passed through the die a second time, the sliding stops *L* and *M* locating the strip correctly, as already explained in the case of the first pass, till the latch stop *K* drops into the punched hole and thereafter locates the material for each stroke of the pass. As can be seen from the sketch, the latch stop is set somewhat to one side of the center line of the die, and it is also of such form that it slides over the narrower part of the hole that was punched on the first pass of the stock but drops into the opening that was punched on the second pass, thus locating each alternate hole in the stock.

Pilots in the blanking punch are cylindrical, as indicated by the dotted lines at *N* and *O*. The hole *G* in the die is about $\frac{1}{8}$ in. longer than in the punched wrench blank, this being necessary to produce clean sharp corners at *P* in the blank. This construction is used in all dies where the punched hole runs beyond the outline of the blank.

Second-operation dies are shown in Fig. 3. Both the punch holder and the die shoe are made of cast steel of heavy cross-section, in order to withstand the stresses incident to forming. The position of the punches and dies is reversed, the former being attached to the lower member. Forming punches *A* and *B* are machined from

AUTOMOTIVE CONSTRUCTION

tool steel of cylindrical form, leaving round heels which fit into flat-bottomed holes on the shoe and are held in place by screws and dowels. The stripper plate *C* is made of hardened tool steel with the holes a free sliding fit over the punches. As can clearly be seen from the cross-section view this stripper is very thick for the

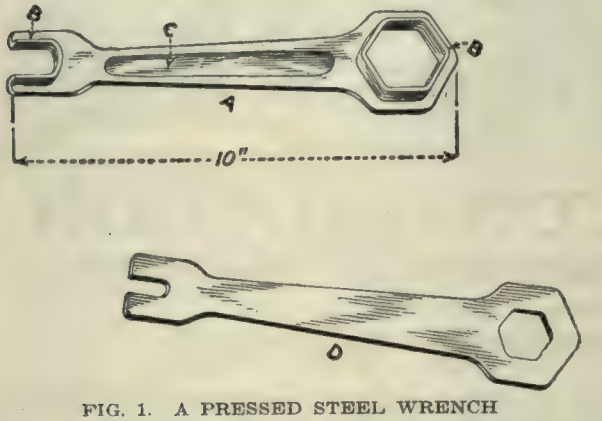


FIG. 1. A PRESSED STEEL WRENCH

reason that it serves also as a flattener for the wrench blank and a die for forming the bead on the handle of the wrench. Several stiff springs of rectangular-section wire are provided under the stripper plate. One of these is shown at *D* which also shows the form of the special shoulder screw which limits the movement of the stripper plate.

The upper member of the die is made in three sections *E*, *F* and *G*, all of tool steel, hardened and ground. They are held in place by fillister head screws and dowels. The dies are counterbored from the back to

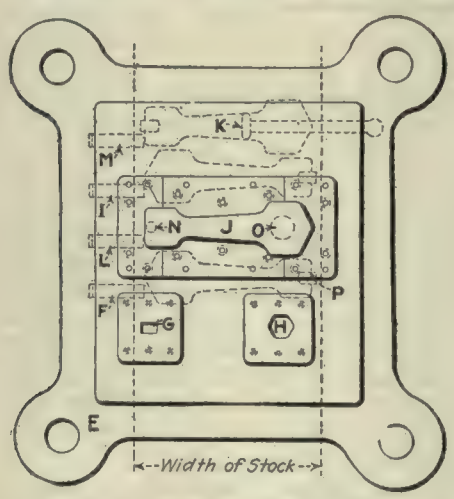


FIG. 2. THE BLANKING DIES

accommodate shoulders on the knock-outs *H* and *I*, the faces of the latter coming flush with the faces of the dies. The knock-outs are a slip fit in the die openings of similar shape and are backed by extra heavy springs. The bead-forming punch *J* is set into a corresponding slot through the center of the die, and this punch has a heel which is backed by a hardened and ground tool-steel plate *K*.

Only two guide posts are provided and as they serve merely to keep the punch and die in alignment during the setting up and clamping of the tools in the press they are made of small diameter. Two hardened-steel nest plates *L* are set one at each side of the open end of the wrench blank and held by flat-headed screws and dowels. These plates are of a thickness slightly less than the wrench blank and their function is to prevent the open end of the wrench blank from spreading under the forming operation.

In operation, this forming die works as follows: The blank from the first-operation dies is placed on the stripper plate of the forming die, the bevelled corners *M* of the punches entering and locating the holes in the

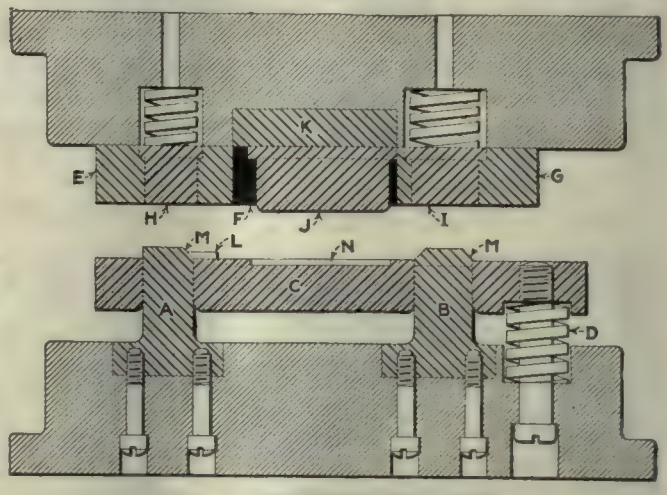


FIG. 3. THE FORMING DIES

wrench blank correctly. In this position the wrench blank nearly touches the stripper plate. When the press is tripped, the upper half of the die descends and carries the wrench blank down over the punches *A* and *B*, together with the stripper plate, till the latter comes in contact with the upper face of the shoe.

This operation completes the wrench by forming the flange around each of the wrench openings, the bead being formed at the same time by the beading punch *J* forcing the metal into the depression *N* of the stripper plate. The press is set so that at its lowest point it comes down hard enough to iron out any wrinkles in the formed blank. On the upstroke of the press, the finished wrench is stripped from the forming punches by the stripper plate, the knock-outs stripping it from the forming dies.

THE FORMING TOOLS

The forming tools are built first and a trial blank is then filed out by hand. A record of this blank and of all subsequent trial blanks must be kept, so when the right form of blank has been obtained, the piercing and blanking die can be laid out from this blank. The easiest way of keeping this record is to file out two identical blanks at each try, one to be formed up and the other to keep for reference and final lay-out blank. The bevelled corners of the forming punches are ground off to suit the developed blank.

A Bliss press of 5-ton capacity was used for the first operation, and a 50-ton double-crank, back-geared press for the second. The completed wrenches as they come from the forming dies need only a polishing operation to remove the burs and are then ready for plating.

CALDWELL BILL

Reintroduced

MOST of you remember the Caldwell Bill, H. R. 15,625, which was introduced in the last session of Congress and which proposed to loan machine tools to educational institutions. This bill, like many others, met its fate in the Sixty-fifth Congress in failing to come up for consideration in the Senate during the last few days of congested legislation.

This bill was reintroduced on May 26 by Mr. Caldwell under the number H. R. 3143. An addition has been made to its terms insomuch that in the present bill it is proposed to include "scientific instruments" as well as machine tools. This is a very commendable addition and will enable colleges of civil and electrical engineering and the like to get instruments and apparatus that they could not obtain in any other way. This bill, like the original bill, proposes to *loan* these tools and this scientific equipment to schools at the discretion of the Secretary of War. There was some comment with regard to this arrangement in the original bill, that it would be more advisable to give these tools to the schools or to sell them outright at a nominal price.

It would seem inopportune at the present time to have any division of opinion regarding the details of this bill when such division might tend to defeat its passage. Whether these tools are given away, loaned or sold at a nominal sum will make little difference in carrying out the spirit of the bill, which is to put these tools where they will do the public the most good. Those who oppose the loan of these tools on the ground that they will have an insecure possession of them need have little fear that the title to them will be transitory. The sole possibility of their being called back (aside from flagrantly improper use) is in the emergency of war. If we have another war, trade schools and technical schools will be commandeered anyway and the tools along with them, whether the title is held by the Government or by the school. But anticipation of trouble on this account is rather far-fetched.

We urge everyone who is interested in the promotion of technical education, and thereby the development of the immense natural resources of America, to get back of the Caldwell Bill, H. R. 3143. Write your Senators and Congressmen, and particularly Chairman Julius Kahn of the House Military Affairs Committee, Washington, D. C., that you are in favor of this bill.

66th Congress
1st Session

H. R. 3143

In the House of Representatives, May 26, 1919.

Mr. CALDWELL introduced the following bill, which was referred to the Committee on Military Affairs and ordered to be printed:

A BILL

To provide for further educational facilities by requiring the War Department to loan certain machine tools and scientific instruments not in use for Government purposes to trade and technical schools and universities, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War shall lend to trade and technical schools and universities and other recognized educational institutions which in the discretion of the Secretary of War should have such equipment the machine tools and scientific instruments suitable for their use which are owned by the United States of America, which are under the control of the War Department, and which are not being used for the Government purposes: *Provided, however,* That each institution so equipped shall be responsible to the United States of America, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

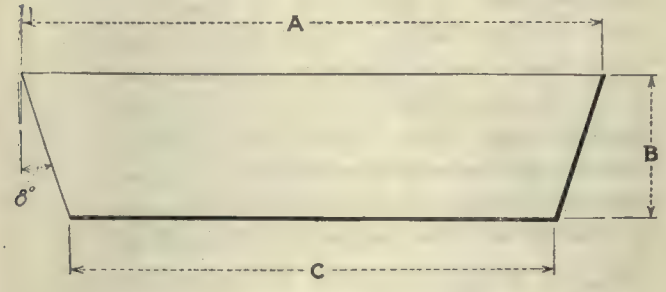
Dies and Plugs for Drawing Brass Tubing

By ROBERT SCHAFER

This article gives the details of manufacture of dies and plugs for drawing brass tubing. Differences in the methods used for the various sizes are discussed and the limits to the reworking of worn dies are defined. Some dangers in the hardening process are mentioned and the average production for each operation is given.

THE manufacture of dies and plugs for drawing brass rod and tubing requires first of all the right steel properly treated. It must be able to withstand without injury the internal stresses and strains caused by a large number of shrinkings. Steel containing about 1.1 per cent. carbon has been found most suitable for this work.

The hardening process, given later, will close in the opening of a die from 0.005 in. to 0.008 in., depending



	A	B	C	
2½"	2 25/32"	2 9/16"	7/8"	
4"	4 3/8"	4"	1½"	
6"	6 3/8"	5 7/8"	2"	
12"	Straight			

FIG. 1. FORGED SHAPE OF DIES

on the size of the hole. This is what is known to the trade as shrinking.

A satisfactory standard for sizes is as follows:

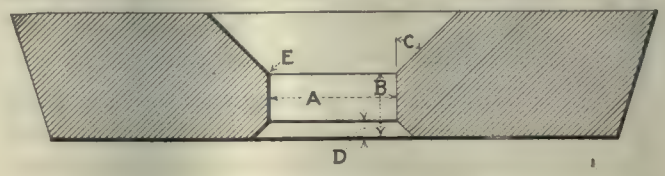
Out side Diameter of Die	Finish Size of Hole	Disk Size Before Forging
2½ in.	0 in. to ¾ in.	2¾ in. x ⅞ in.
4 in.	¾ to 2 13/16 in.	4 in. x 1½ in.
6 in.	2 13/16 in. to 4½ in.	6 in. x 2 in.
12 in.	4⅝ in. up to maximum	10 in. x 3 in.

The 2½-in. disks are cut from bar stock and taken direct to a forging press; the 4-in. ones are drilled with a ¾-in. hole in the center before forging; the 6-in. size are drilled with a 2-in. hole in the center and then forged; and the 12-in. disks are forged with a 3-in. hole under a steam hammer. The drilling of the 4-in. and 6-in. blanks is done on a heavy-duty drill, one man drilling 120 of the 4-in. size or 50 of the 6-in. size in 10 hours. After drilling the disks are taken to a forging press and forged to the shape shown in Fig. 1.

Preparatory to forging, the blank disks are heated to 1600 deg. F. in an underfired muffle using oil as fuel. A muffle having an area of 24 x 36 in., or 6 sq.ft., will hold a charge of 200 two-and-a-half-inch dies, 125 four-inch dies or 100 six-inch dies, and will take approximately two hours to bring a charge up to heat. With a vertical-type press, giving an average final pressure of 425 tons, two men will forge 600 dies in 10 hours. After they are forged in this press, the dies are allowed to get cold before being treated further.

When the dies have become cold they are again placed in the furnace and brought up to a temperature of 1400 deg. F. and again allowed to cool in air. This operation is known as the refining process and restores the grain of the steel. The operation is quite necessary, on account of the high forging heat.

After being cooled in the air the dies are again placed in the furnace and brought up to 1400 deg. F.



A	B	C	D	E	F	G
0-¾"	1/4"-1/8"	21°	1/16"	¾"	2 25/32"	7/8"
¾"-1 5/8"	⅜"-3/16"	21°	1/16"	¾"	4 3/8"	1½"
1 5/8"-2 3/8"	13/32"-7/32"	21°	1/16"	¾"	4 3/8"	1½"
2 3/8"-3"	7/16"-¼"	21°	3/32"	¾"	6 3/8"	2"

FIG. 2. MACHINING DETAILS OF DIES

and allowed to cool in the furnace. This is called the annealing operation. Annealing requires about 15 hours and about 50 per cent. more dies can be charged into the furnace than was recommended for the forging operation. The furnace is usually started at 4 p.m. and is brought up to heat by 7 p.m. The dies will be cool enough to be removed by 6:30 a.m. the following morning.

The pyrometers used in determining the furnace temperatures must be of proved value as accuracy is essential and must be checked daily against a standard instrument.

The dies in the annealed state are now taken to the soft department where they are machined to the required sizes after which they are ready to be hardened and ground or scraped and lapped as the case may be. In the case of the 2½-in. and 4-in. dies the hole sizes up to 1½ in. are scraped to size and lapped to finish after hardening.

The operations on dies up to the 1½-in. hole size are as follows: First, drill to within 0.01 in. to 0.015 in. of the size; second, rough-ream the mouth; third, finish-ream the bearing; fourth, finish-ream the mouth.

These operations are done on a turret lathe and the average output is 50 dies in 10 hours.

The finish at this stage should be the best possible. If it is well done the scraping operation is almost

eliminated. The dies are now taken to the scraping heads, scraped smooth and polished to a high finish. Gages are used for sizing this operation. They are provided with two diameters, one to go and one not to go. The tolerance is 0.002 in. Scraping heads are just plain heads having two bearings holding the spindle. A clutch for holding the dies is attached to one end. Each head has two speeds, a scraping speed of 150 r.p.m. and a lapping speed of 1000 r.p.m. An

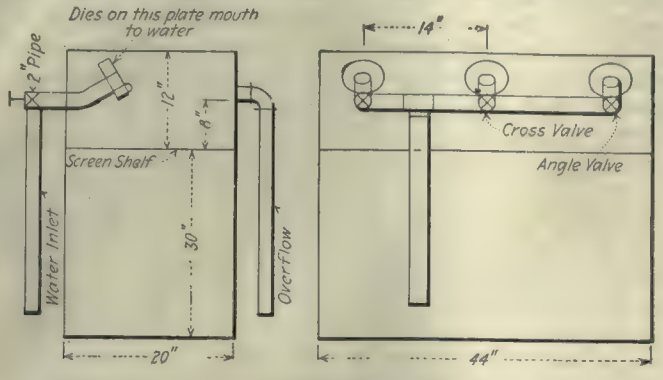


FIG. 3. TANK AND FITTINGS FOR QUENCHING

average workman will lap or scrape about 100 dies per 10-hour day.

Dies having a hole from 1½ in. upward are ground to size, and the following operations are performed in the soft state:

First—Drill to within $\frac{1}{16}$ in. of the size. An average workman will drill 120 dies in 10 hours.

Second—Finish-bore to contour an dhole size in a vertical chucking machine.

Third—Rough-ream to shape.

Fourth—Finish-ream to shape and within 0.005 in. of finished hole diameter.

The latter operation must be carefully done as a good finish here will greatly reduce the grinding time. An average workman will finish 90 four-inch dies or 60 six-inch dies in 10 hours. The 6-in. size is done in the same manner, except that a turret lathe has been found more satisfactory than a vertical chucking machine.

Following these operations the dies are taken to a drilling machine and the back of the hole is chamfered. One man will do the work on 500 dies in 10 hours. The dies are now ready to be hardened and are machined as shown in Fig. 2.

The dies now go to the hardening room where they are heated to a temperature of 1375 deg. F. in a lead pot. After this they are quenched on a spout of water which is so arranged that only the hole is hardened. When the die has become nearly black all over it is thrown into the quenching tank and left until cold. Dies treated in this manner, if of the proper steel, will indicate on the scleroscope from 90 to 100 on the wearing surface, and if fractured will show a carbon penetration of from $\frac{1}{8}$ to $\frac{5}{32}$ in. on the inner surface. The outside of the die remains soft and acts as a retaining ring for the inside.

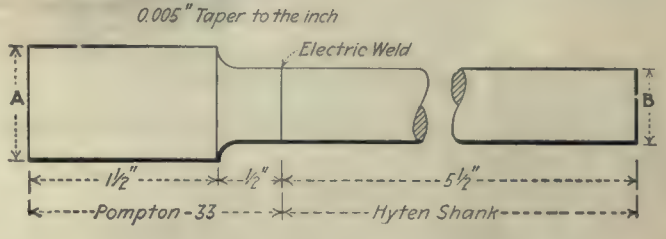
The hardening strains are now relieved by drawing the dies in an oil or electric furnace at 300 deg. F. for two hours. This operation relieves the hardening strains but does not affect the hardness.

The dies are now ready to be ground to finished size. Fig. 3 shows the general arrangement of the tank and fittings for the quenching operation which is called shrinking, for while it hardens the die it also shrinks it so that the size of the hole will decrease about 0.005 in. to 0.008 in. in size.

The above operations apply only to dies that are new. Used dies that have worn badly are treated to the shrinking operation only, after which they are ground out again to the original size. In treating old dies great care must be used to see that no brass sticks to the die before the hardening operation is begun as wherever brass adheres to the die a soft spot will appear and the die will commence to scratch immediately upon drawing tubes through it.

Used dies should not be shrunk and reground more than four times because by that time the outside of the die will have decreased to such an extent that it is below standard and will no longer fit the bench head. At this stage the dies must be reforged, an operation which increases the outside diameter to standard but reduces the thickness. Dies, after being reforged, are treated the same as new dies. They can be reforged until the minimum thickness is reached at which time they are rebored until the wall is too thin to hold, when they are junked.

Grinding or lapping is the next operation in order. This work is done on a grinding machine having a magnetic chuck, a work speed of 100 ft. per minute and a spindle speed of 10,000 r.p.m. This machine should be equipped with grinding wheels whose outside



Under 7/16" use Stub's steel

Size	A	B	
1"	1"	7/8"	
7/8"	7/8"	3/4"	
3/4"	3/4"	5/8"	
1/2"	1/2"	7/16"	
7/16"	7/16"	3/8"	

FIG. 4. DIMENSIONS OF SOLID PLUGS

diameters are 4 in., 3 in., 2½ in., 2 in., 1¾ in., 1½ in. and ⅜ in. thick, of grade M to O and No. 50 grain with a ⅜-in. hole. These wheels have a life of about 8 dies. Such a machine, with one good operator, will turn out 60 four-inch outside diameter dies in 10 hours; 35 five-inch dies in 10 hours, or 8 twelve-inch dies in 10 hours. The amount to be ground out of the dies will vary from 0.008 in. to 0.015 in., due to the variations in the shrinking. Rough-finishing will demand the most grinding. Dies under 1½-in. hole diameter are lapped to size on the lapping heads previously described.

After the dies are lapped or ground they are cleaned in hot caustic soda and rinsed in hot water. From here they are taken to the inspection room where they are inspected for size, finish, shape and hardness.

The length of bearing on a tube die is a very important feature. The following table gives the limits

of length as determined by many tests and experiments on different sizes:

Hole Diameter	Minimum Length	Maximum Length
0 in. to ¾ in.	1⅛ in.	¾ in.
¾ in. to 1⅛ in.	⅞ in.	1 in.
1⅛ in. to 2¾ in.	1⅛ in.	1⅛ in.
2¾ in. to 3 in.	1½ in.	1½ in.

When the bearing becomes shorter than this the tubes are very apt to crack in annealing. If it is longer than the maximum, the extra wearing surface will cause a greater pull and tube points will pull off or the tubes will pull apart. A high finish to the die hole is essential, as it causes the least resistance to drawing. Hardness should not be less than 90, as shown by a scleroscope,

Diam	1" 1 5/16"	1 21/64" 1 9/16"	1 37/64" 2 1/4"	2 17/64" 3 1/2"	3 33/64"-4 1/2"	4 33/64"
Length	1½"	1½"	1½"	2"	2½"	3"
Hole D	5/8"	¾"	⅞"	1 1/8"	1 1/4"	1½"
Drill	35/64"	43/64"	25/32"	1"	1 5/32"	1 9/32"
Tap	0635"	0760"	0890"	1138"	1265"	15"
Threads	11	10	10	8	8	6
Radius R	3/16"	3/16"	3/16"	¼"	¼"	¼"

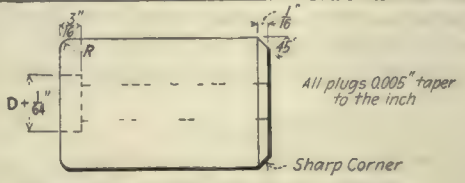


FIG. 5. DIMENSIONS OF TAPPED PLUGS

and a die should draw at least 3000 ft., of tube each time it is ground.

The weight of die blanks is as follows:

Size	Weight
2½ in.	1.4 lb.
4 in.	5.3 lb.
6 in.	16.0 lb.
12 in.	78.0 lb.

The minimum thickness of a 4-in. blank is ⅞ in. and of a 6-in., 1½ in. In no case should they be used, after they have been bored with the largest diameter hole, if of less thickness than specified.

Plugs are made of the same grade of steel specified for dies and up to 1 in. diameter are made solid. Sizes 1 in. and upward are made with a tapped hole in them by which they are screwed onto a rod that holds the plug in position. Up to 1 in. diameter, plugs are made on an automatic screw machine which has an output of from 700 to 1000 in 10 hours, depending on the size. The operations are as follows: First, stop to length; second, center and turn shank; third, cut off.

After they leave the automatic they are taken to an electric welding machine where a machine-steel shank is welded on. The sizes of the complete plugs are shown in Fig. 4.

Lapped plugs are made from 1 in. upward in size and up to 2¾ in. outside diameter are turned out on an automatic screw machine (with the exception of tapping) having an average output of 250 plugs in 10 hours. The operations are as follows: First, spot drill and counterbore; second, drill and turn within 0.020 in. of the finished size; third, partly cut off, make radius, chamfer; fourth, cut off. Following these operations the plugs are tapped in a tapping head which has an output of 600 plugs per 10 hours with one operator. Fig. 5 shows the various sizes and dimensions.

Plugs 2¾ in. and upward are cut off to length from bars on a hacksaw, averaging 250 plugs in a 10-hour day. They are then taken to a turret lathe and drilled, counterbored and tapped, one man averaging 150 in 10 hours, solid plugs 2¾ in. and upward are finish-turned in a plain engine lathe to within 0.020 in. of the finished diameter. One man will finish from 50 to 300 in 10 hours, depending on the size.

All plugs are now in their finished state as far as the soft stage is concerned and are now ready to be heat treated. The solid plugs are heated to 1450 deg. F. in a lead pot, quenched in water at 80 deg. and then drawn to 400 deg. for one hour. The tapped plugs from 1 in. to 1⅜ in. diameter are heated in an oil-fired muffle to 1450 deg. F., quenched in water for 10 seconds and finish quenched in oil, then drawn to 400 deg. F. for one hour. From 1⅜ in. up to 2¾ in. they are heated to 1450 deg. F. in a muffle, quenched in water at 80 deg. F. for 15 seconds and then finish quenched in oil, after which they are drawn to 400 deg. F. for one hour. Plugs 2¾ in. and upward are heated to 1475 deg. F., quenched in water at 80 deg. F. for 30 seconds, finish quenched in oil and then drawn to 400 deg. F. for one hour and a half. Lead pots are not used on screw plugs on account of the lead depositing in the threads. Tapped plugs, if finish quenched in water, will invariably develop water cracks from the sharp point at the bottom of the thread. It is therefore essential to finish quench them in oil.

After the plugs are hardened they are ground to size on a plain grinding machine. The operator will grind from 75 to 400 plugs in 10 hours, according to the size. The wheel speed should be 2400 r.p.m., the work speed, 100 ft. per minute, and the wheel used should be 10 in. outside diameter, ¾ in. thick and be made of No. 60 grain corundum of L to O grade. The life of such a wheel is about 1500 plugs.

Used plugs, after being worn, are returned to the toolroom, annealed by being heated to 1450 deg. F. and turned down to the next size smaller, and then rehardened and ground. The following premium rates and operations were used by the writer:

Die Grinding

Hole Size	Number per Man per 10 Hours
1⅛ in. to 2 in.	40
2 in. to 3 in.	30
3 in. to 4 in.	25
4 in. to 5 in.	15
5 in. to 6 in.	8

Scraping and Lapping

Size	Number per Ten Man Hours
0–¾ in.	100
¾ in. to 1 in.	80
1 in. to 1⅛ in.	60

Plug Grinding

Size	Number per Ten Man Hours
0 to ¼	200
¼ to 1	175
1⅛ to 2	150
2 to 3	100
3 to 4	50

Plug Turning

Size	Number per Ten Man Hours
0 to ¼ in.	350
¼ in. to 1 in.	250
1 in. to 1⅛ in.	250
1⅛ in. to 2 in.	200
2 in. to 3 in.	80
3 in. to 4 in.	50

Tapping Plugs up to ¾ In. 35 per man hour

The treatment given here was developed for Pompton steel, temper No. 33, made by the Ludlum Steel Company, Watervliet, N. Y., and containing 1.1 per cent. carbon.

The Influence of Size on Heat-Treating

By E. J. JANITZKY*

THE influence of size on the physical properties obtained in heat-treating steel has been a topic of much discussion among metallurgists. Elaborate tests have been conducted by various investigators who have attacked the problem rather from a standpoint of experimentation and results obtained than from a theoretical conception based upon the simple mathematical factors involved.

With an increase in the mass of steel there is a corresponding decrease in both the minimum surface hardness and depth hardness when quenched from the same temperature under identical conditions of the quenching medium. In other words, the physical properties obtained are a function of the surface of the metal quenched for a given mass of steel. Keeping this primary assumption in mind it is possible to predict what physical properties may be developed in heat-treating by calculating the surface per unit mass for different shapes and sizes. It may be pointed out that the figures and chart that follow are not results of actual tests, but are derived by calculation. They indicate the mathematical relation, based on the fact that the physical properties of steel are determined not alone by the rate which heat is lost per unit of surface, but by the rate which heat is lost per unit of weight in relation to the surface exposed for that unit. The unit of weight has for the different-shaped bodies and their sizes a certain surface which determines the physical properties.

For example, the surface corresponding to 1 lb. of steel has been computed for spheres, rounds and flats.

TABLE I—SPHERE

Diameter of Sphere X	Surface per Pound of Steel Y
8 in.	2.648 sq.in.
6 in.	3.531 sq.in.
4 in.	5.294 sq.in.
3 in.	7.062 sq.in.
2 in.	10.61 sq.in.

X Y = 21.185

TABLE II—ROUND

Diameter of Round X	Surface per Pound of Steel Y
8 in.	1.765 sq.in.
6 in.	2.354 sq.in.
5 in.	2.829 sq.in.
4 in.	3.531 sq.in.
3 in.	4.708 sq.in.
2 in.	7.062 sq.in.
1 in.	14.125 sq.in.
0.5 in.	28.25 sq.in.
0.25 in.	56.5 sq.in.

X Y = 14.124.

For the sphere with a unit weight of 1 lb. the portion is a cone with the apex at the center of the sphere and the base the curved surface of the sphere (surface exposed to quenching). For rounds, a unit weight of 1 lb. may be taken as a disk or cylinder; the base and top surfaces naturally do not enter into calculation. For a flat, a prismatic or cylindrical volume may be taken to represent the unit weight. The surfaces that are considered in this instance are the top and base of the section, as these surfaces are the ones exposed to cooling.

The results of the calculations are as shown in tables I, II and III.

Having once determined the physical qualities of a certain specimen and found its position on the curve we have the means to predict the decrease of physical qualities on larger specimens which receive the same heat-treatment.

When the surfaces of the unit weight as outlined in the foregoing tables are plotted as ordinates and the corresponding diameters as abscissas the resulting curve is a hyperbola and follows the law XY = C. In making these calculations the radii or one-half of the thickness need only to be taken into consideration as the heat is conducted from the center of the body to the surface, following the shortest path.

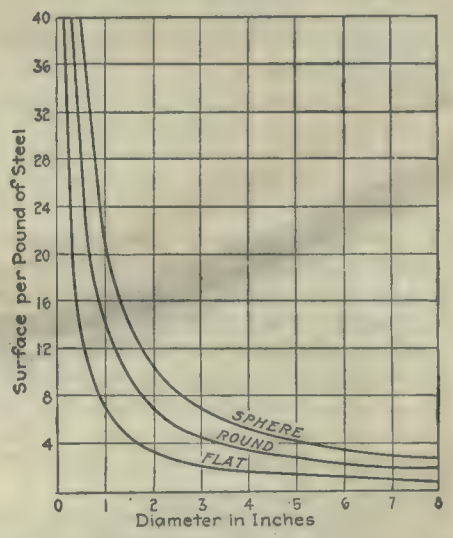


CHART SHOWING THE INFLUENCE OF SIZE AND SHAPE

The equations for the different shapes are as follows:

For flats..... XY = 7.062
For rounds..... XY = 14.124
For spheres..... XY = 21.185

It will be noted that the constants increase in a ratio of 1, 2 and 3, and the three bodies in question will increase in hardness on being quenched in the same ratio, it being understood that the diameter of the sphere and round and thickness of the flat are equal.

TABLE III—FLAT

Thickness of Flat X	Surface per Pound of Steel Y
8 in.	0.8828 sq.in.
6 in.	1.177 sq.in.
5 in.	1.412 sq.in.
4 in.	1.765 sq.in.
3 in.	2.345 sq.in.
2 in.	3.531 sq.in.
1 in.	7.062 sq.in.
0.5 in.	14.124 sq.in.
0.25 in.	28.248 sq.in.

X Y = 7.062.

Relative to shape it is interesting to note that rounds, squares, octagons and other three-axial bodies, with two

*Metallurgical Engineer, Illinois Steel Co., in the Journal of American Steel Treaters' Society.

of their axes equal, have the same surface for the unit weight. For example:

Size	Length	Surface	Weight	Surface for 1 Lb.
2 in. sq.	12 in.	96 sq.in.	13.6 lb.	7.06 sq.in.
2 in. round	12 in.	75.4 sq.in.	10.68 lb.	7.06 sq.in.

Although this discussion is at present based upon mathematical analysis it is hoped that it will open up a new field of investigation in which but little work has been done, and may assist in settling the as yet unsolved question of the effect of size and shape in the heat-treatment of steel.

Turning Versus Grinding

By J. H. Hollinger

In his letter entitled, "Turning Versus Grinding" on page 648 of *American Machinist*, E. H. Fish leaves one at a loss to know exactly what his sentiments are. He says, "Why not stick to the lathe? There are some jobs on which accuracy cannot well be attained except by grinding, but the greater number of lathe jobs can be finished on a lathe within the limits prescribed." He then turns around and gives very good reasons why the grinding machine has taken a permanent place in the machine shop.

The reason for the success of this machine in the shop is its ability to produce work, smooth, round and true to a greater degree than is possible in the lathe and with a production from 50 to 100 per cent. higher.

Put the same refinements the grinding machine has on the lathe and set the automatic feed to take off the final 0.008 in. as he recommends and see what happens; the surface will be rough, full of holes, out-of-round, torn up and probably somewhere near size. The lathe today is a roughing machine and always will be.

Mr. Fish states that the grinding machine has some well-known limitations. Now it would have been more interesting if he had stated just what these limitations are. It is not expected to grind a thread or do anything ridiculous. The grinding machine today is successfully grinding the general run of work in the machine shop, also a varied line of formed work, external work and internal, and the grinding machine operator is rated higher than the lathe man for no other reason than that the lathe is a roughing tool and the grinding machine an error-correcting one.

The cylindrical grinding machine has helped to reduce the price of automobiles and other machines. Crankshafts are being ground upon it direct from the forging without assistance from the lathe. The same is true with cams. Every part of an automobile that is possible to grind is finished in this way and for no other reason than lowering the cost of production.

Grinding wheels ordinarily used are grades L and M, the average operator preferring a wheel on the hard side. I agree with Mr. Fish that soft wheels are more economical than hard ones, but they should not be so soft as to wear down too rapidly. A soft wheel requires less power to drive it, less expense in diamonds for dressing, and the wheel being more porous and free cutting tends to give a higher rate of production.

The man who understands how to arrange wheel and work speeds to suit the grade of the wheel to the material being ground, is not usually a machine operator, consequently the cause of faulty grinding remains many times a mystery. It requires a specialist, one who has studied the conditions attendant upon the operation of grinding, to secure the best results.

One common fault with operators is dressing the wheel too smooth with the diamond. This error may be pointed out and demonstrated to them, but they drift back to the old way.

Work is sometimes run at an abnormally high speed; yet results are good. This is particularly so when a piece of work is finished in one operation. It is necessary then to run the work a little above normal speed to produce the finish required, but to get a good clean finish it is better to make two operations; the work speed can then be slower.

It is unnecessary to rotate the work fast to secure a high production. Many people have the idea that the work must run fast or the production will be low. If the right wheel is used and the work speeded to suit it the machine will be working under ideal conditions and best results as well as greatest production obtained. A few minutes after a wheel is put into service a good operator will be able to determine whether it is too hard, too soft or just right for the work in hand.

Grinding a Large Die Without Equipment

By James H. Follen

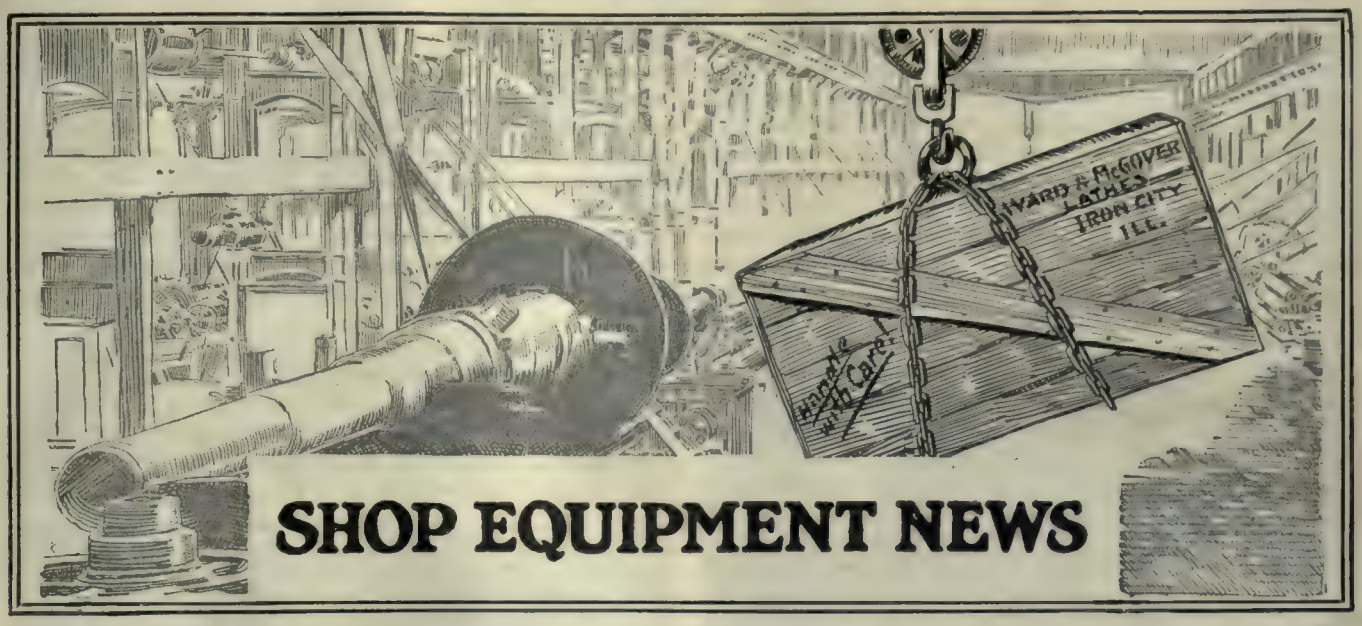
Reading Chordal's letters about the way the men of the old-time shops had to use their heads to do some of the jobs that came along reminded me of a grinding job we had to get out in a small shop of which I had charge about 15 years ago.

This shop made high-pressure tanks for the then popular gasoline-lighting systems and we decided to make a set of combination dies for the bottom and top of the tank and stamp them in one operation, using the same tool for both except changing the center block and knock-out on account of the difference in shape. These dies were a simple lathe job, and as we had no grinding equipment at all except an emery-wheel stand, we had hoped to avoid the grinding as a few burrs on the blanks would not matter. We found, however, that the blanking ring had gone out-of-round about $\frac{1}{32}$ in. in tempering and it would have to be ground inside. The die was about 24 in. outside diameter and we had to have the lathe work done by outside parties as the largest lathe we had in the shop was 18-in. swing.

After a lot of thought we hit on the idea of grinding it in the drilling machine which was an ordinary upright with a round table having the usual round shank set into a bearing on the knee. We turned up a taper arbor to fit the hole in the spindle, threaded it for a nut, made a couple of collars, and mounted an ordinary 8 x 1-in. grinding wheel on it. We then put a larger pulley on the shaft to run the wheel about the proper speed.

The die ring was clamped to the table, using the same threaded holes that held it into the shoe, and after setting the knee and clamping it firmly, the table was revolved by hand by the machinist and a boy, the wheel being fed up and down by hand also. The entire job was finished in one afternoon and made a very clean, accurate blank, from which we made many thousand stampings satisfactorily.

Of course this seems crude nowadays when every shop has several tool-post grinding wheels, but it sure pulled us out of a hole that time.



Newton Radius-Link Grinding Machine

The illustrations show the radius-link grinding machine manufactured by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn., and intended for railroad-shop use. A number of changes have recently been made in this machine, chief among which is that the vertical spindle revolves in an eccentric sleeve which allows for a ½-in. movement front and back. This eliminates the necessity of moving the heavy table and allows for finishing a link without changing the position of the table. Thus, after the machine is set up with a fixed radius center, the adjustment made possible by the front and back movement of the spindle in the eccentric sleeve eliminates the necessity of changing the position of this center when a deeper cut is desired.

The machine has a capacity for grinding radius links with 24- to 100-in. radii, and with thicknesses up to 5 in.; the present design also being arranged to permit the grinding of straight links, or crosshead guides for which the table is arranged with a maximum straight travel of 40 in.

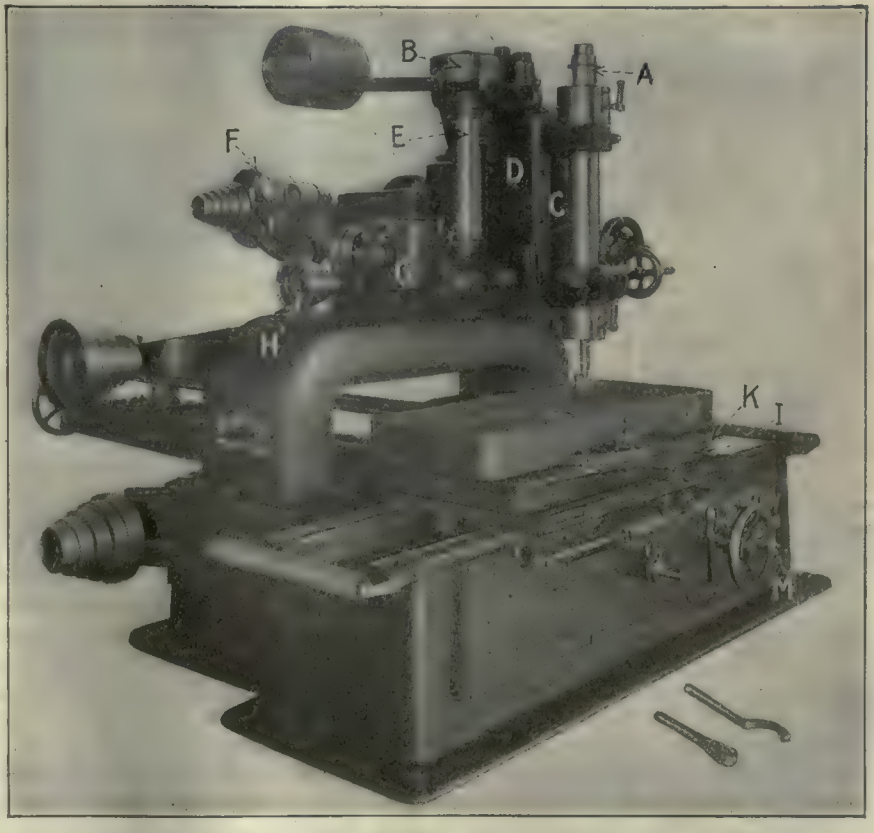


FIG. 1. THE NEWTON RADIUS-LINK GRINDING MACHINE

Capacity of grinding, radii from 24 to 100 in. with thicknesses of the work up to 5 in.; can also be used for straight links with a maximum travel of 40 in.; adjustment of spindle, front and back, ½ in.; vertical oscillating motion of spindle, ⅝ in.

The spindle of the machine is equipped with roller-thrust bearings at the top and bottom, and revolves in an eccentric sleeve, which allows for a ½-in. movement each way front and back. This is controlled by a worm and one-half wormwheel, which is so arranged as to give the full ½-in. adjustment front and back. This permits finishing a link without changing the position of the table. The spindle is driven by a belt connecting pulleys *A* and *B*, and the drive is further carried through the drum *E* and the pulley *F* on the main driving shaft.

The spindle saddle *C*, in which the spindle is mounted, has a vertical oscillating motion of about ⅝ in., which insures parallel wear on the wheel. This oscillating motion is for use on the new design links which have sufficient clearance to permit the use of grinding wheels 2½ to 3 in. in diameter, and of slightly greater lengths than the face of the link.

The saddle *C* is mounted in turn in the saddle *D*, which has power feed vertically in both directions, and is utilized on the older-style links which have only a limited amount of clearance, about an inch or so. This limits the diameter of wheel that

can be used and, consequently, the diameter of the mandrel on which the wheel is supported. The reason for the feed is that the small-diameter mandrels compel the use of narrow-faced wheels as the mandrels would not be strong enough to rigidly support wheels to cover the full face of the link, as is desired wherever practical.

On the bottom of the drum shaft *E* a clutched worm and wormwheel are located to control the oscillating motion of the saddle *C*, while the motion for the reversing feed is taken through the gear box *G* and the cone *H*. There is a scale mounted on top of the radius

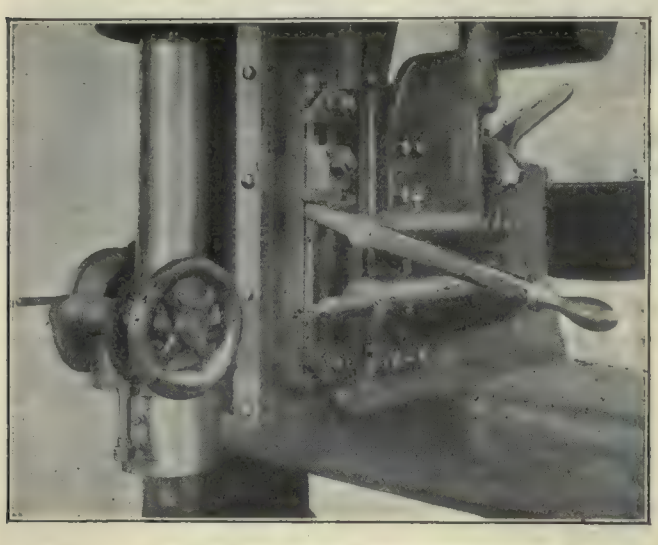


FIG. 2. A CLOSE-UP VIEW OF THE SPINDLE AND ECCENTRIC SLEEVE CONTROL

bar which gives direct readings for radii from the center of the table.

The saddle *I* has reversing cross-traverse on the base, and the table *J* has a pivoted fit to the slide *K* which moves back and forth with the radius control. The pins *L* are to insure the central location of the table while setting the links. The handwheel *M* controls the screw which adjusts the table *J* for depth of cut and from side to side of the links.

The table has automatic reversing motion, and the design is such that the rate of travel to the table may be varied in relation to the spindle rotations. The power vertical feed for the saddle *D* is variable in rate and at most would probably not exceed ½ in. of vertical movement in the complete stroke. Dogs are provided for reversing the motor after the narrow-faced wheel has traversed from the top of the link to the bottom, or vice versa.

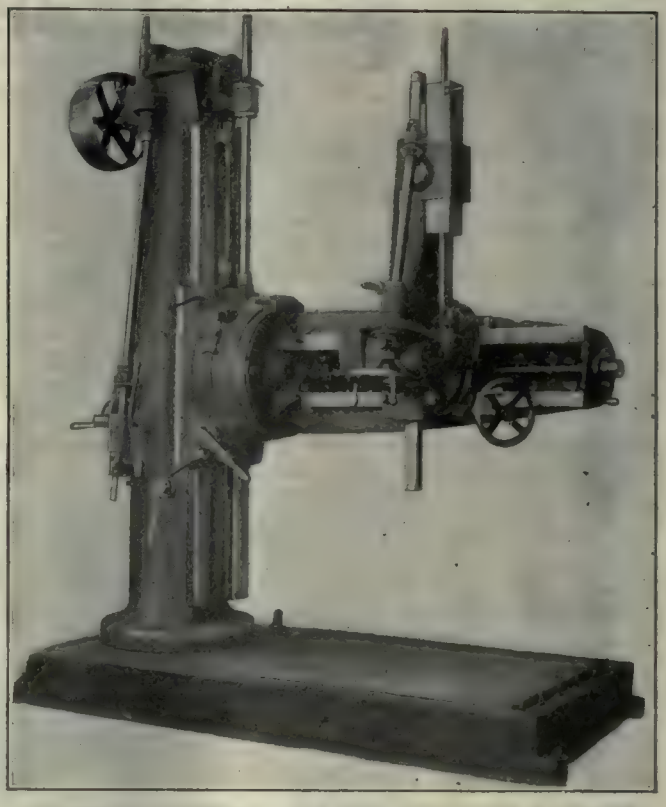
Western Universal Radial Drilling Machine

The illustration shows one of a new line of full universal radial drilling machines that have just been placed on the market by the Western Machine Tool Works, Holland, Mich. It is stated that these machines are powerful and rigid and that the low-hung drive on the lower end of the spindle is superior to the type of drive customarily used.

The bed of the machine has a large working surface with T-slots and is internally ribbed to relieve any tendency to spring, these ribs being of I-section. The bottom of the bed is planed and the bolt holes in the corners are drilled. A channel is cast around the outer edge for collecting the drilling compound, which drains into a reservoir cast in the rear end of the base.

The column is of box section and turns on an inner column that is bolted to the base. The outer column bears on the inner column at three points, top, middle and bottom; the clamping being done about midway of the height of the middle column. The bearing at the top is of the roller type with ¾-in. rollers, while that at the bottom is an annular-ball type with ¾-in. balls.

The gear box is located at the top of the column and gives eight changes of speed through a sliding cone and tumbler gear. Only nine gears are used in all, and none are in mesh except those transmitting the power. The gears and bearings on the inside of this box are submerged in oil to insure proper lubri-



WESTERN UNIVERSAL RADIAL DRILLING MACHINE

Made in three sizes, 4, 5 and 6 ft. Specifications for 5-ft. machine: Maximum distance from face of column to center of spindle, 61 in.; minimum distance from face of column to center of spindle, 26 in.; maximum distance from end of spindle to bed, 66 in.; minimum distance from end of spindle to bed, 0 in.; size of working surface of base, 64 x 44 in.; number of drill speeds, sixteen, 16 to 230 r.p.m.; ratio from pulley to spindle, 1 to 20; speed of driving pulley, 300 r.p.m.; size of driving pulley, 16 x 4 in.; number of drill speeds, four, 0.006 to 0.018 in. per spindle revolution; diameter of driving part of spindle, 2½ in.; Morse taper in spindle, No. 5; traverse of spindle, 20 in.; net weight, 11,000 lb.; box table, 20 x 20 in.; horsepower of motor recommended, 7½; speed of constant-speed motor recommended, 1200 r.p.m.; variable-speed motor recommended, 400 to 1200 r.p.m.

cation. Bearing bushings are bronze and all the shafts are steel ground to size. The changes are made through hand levers at the front of the column, a hollow cylinder with guide slots and plunger holes in its surface serving to locate the eight different positions of the tumbler-gear yoke. Sixteen speeds are possible, eight through the gear box, and eight through the back gears, and these are arranged in geometrical progression to cover a wide range of work.

The saddle is held on the column with adjustable gibs, the bearing being long, to overcome the tendency of the arm to lift under the pressure of a heavy cut.

Clamps are furnished to secure the saddle at any desired position on the column. The elevating mechanism is located in the saddle and is controlled by a lever at the front. Motion for raising and lowering the arm is transmitted through a pair of adjustable friction clutches. The arm is of C-section, ribbed on the inside. The inner end of the arm is graduated in degrees and may be swivelled through a complete circle, the movement being accomplished by a worm and worm gear, the worm-gear teeth being cut integral on the largest diameter. The inner end is recessed into the saddle, four T-bolts being provided for securing it against movement. A dowel serves to locate it in its zero position.

A tapping attachment is regularly furnished, power being obtained through a pair of bevel friction gears on the vertical drive shaft in the saddle. Internal expanding-ring frictions with adjustments for wear control the forward and backward motion, these being mounted on the highest speed shaft, in order to work a maximum efficiency. The head has been made so that the center of the spindle is nearly in line with the center of the column, and all main bearings are provided with bronze bushings. It may be swiveled 45 deg. each side of the perpendicular by means of a segment gear and pinion, or through a full circle when operating by hand beyond 45 deg. Means are provided for locking it in place, and a dowel locates it at the zero or vertical position. The swiveling of the head is entirely independent of the saddle-moving mechanism. The head cannot sag while being adjusted as it is recessed into the saddle. The head saddle is provided with taper gibs for adjustment, and is moved along the arm by means of a handwheel, binder clamps being provided.

The low-hung drive for the spindle is one of the distinctive features, the spindle being driven by a pair of reduction gears at its lower end close to the drill or cutter being used. The large bevel gear is slideably connected to the spindle at its largest diameter by means of two keys. The drive gearing is of steel, the back gears being located at the inner end of the arm, and operated by a lever within reach of the operator.

Four changes of feed are provided, these being obtained through eight steel gears. The present drive makes it possible to use ball-thrust races containing large balls under the feed quill, which is a valuable feature when heavy cuts are being carried. A friction feed release is used which allows the worm to remain constantly in mesh. The feed is provided with an automatic depth gage, the feed also being tripped, when the spindle reaches its limit of travel in either direction. Hand feed is also provided.

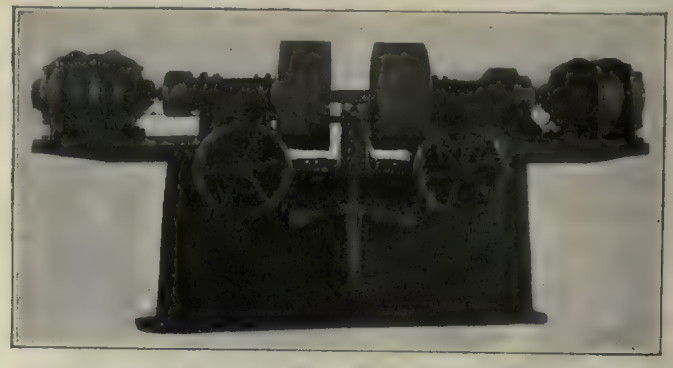
The spindle is counterweighted, this mechanism operating through the rack pinion, which serves to balance the spindle regardless of its angle of inclination.

The drive is from either the lineshaft or a motor as desired, the motors being either of the constant- or variable-speed type. When a motor is used it is placed on a suitable plate bolted to the rear of the column, or if desired it can be mounted on top of the column and geared directly to the vertical drive shaft of the drilling machine.

Box and universal tables can also be furnished if desired. The box tables are planed to size and shape and have T-slots on both the top and sides for securing work or fixture.

Hawes End-Surface Grinding Machine

A grinding machine for finishing the end surfaces of various parts is a recent product of C. L. Hawes, 12 Adams St., Ashtabula, Ohio. The machine will grind the end surfaces of parts from 3 to 12 in. in length, stops being supplied to set to any desired length. The two grinding wheels are driven by direct-connected electric motors. The emery wheels are the cup type, 18-



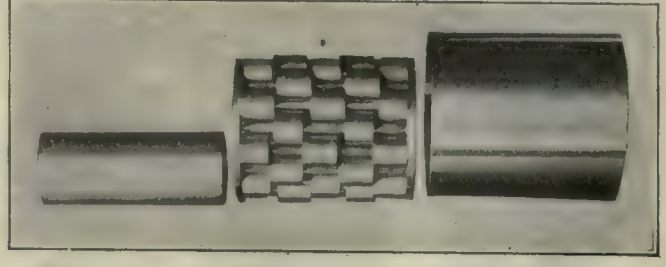
HAWES END-SURFACE GRINDING MACHINE

Capacity, work from 3 to 12 in. in length; wheels used, cup type with 6-in. face, 18 in. in diameter with 3-in. face on cup side of wheel; electric motors, 5 hp., 1000 r.p.m., 60-cycle, a.c.; length of machine, 9 ft.; weight, 2750 lb.

in. in diameter, with 6-in. face, and a 3-in. face on the cup side of the wheel. The bearings are of the Timken roller type. In operation the wheels are moved apart by a foot pedal, the work being placed in a jig between the wheels. When the operator releases the pedal, the wheels close automatically, the jig in the center being moved mechanically across the face of the wheels so that they will wear true and the ends of the work will be ground square. The machine is so arranged that either wheel can be adjusted independently of the other to any desired distance from the center, this adjustment being made by means of the handwheels shown at the front of the machine. The couplings connecting the grinding spindles with the motors are of the flexible type.

Hart Roller Bearings

The Hart Roller Bearing Co., 512 Main St., East Orange, N. J., is now marketing a line of roller bearings that are said to have a number of features that make them desirable. The rollers instead of being made as long as the bearings, are made short and are mounted on alignment shafts supported at their ends by the retainer rings, the rollers revolving freely on these alignment shafts. The rollers are made short and of different lengths and are staggered as can be noted in the illustration. The advantages claimed for this construction are that the bearing angle or the included

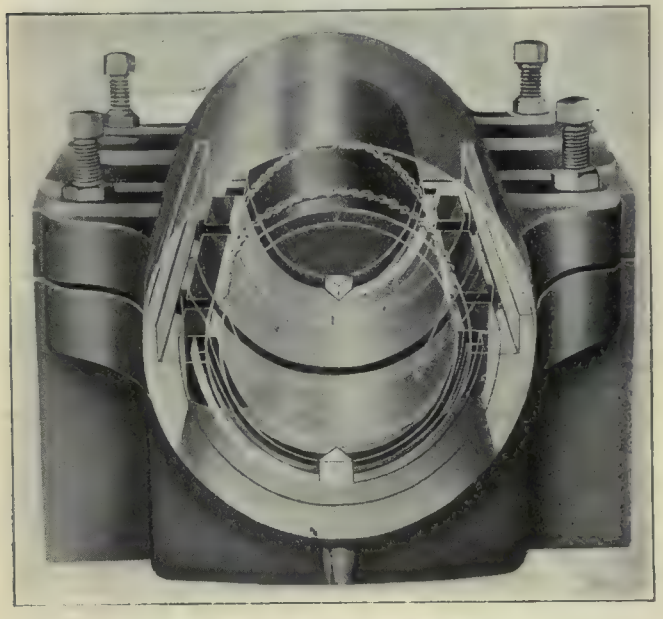


HART ROLLER BEARING WITH STAGGERED ROLLERS

angle between radial lines drawn from the axis of the bearing through the centers of the adjacent rollers is considerably reduced, that the staggered arrangement provides more space for the circulation of oil or grease, that frictional resistance between the cage and the rollers is reduced and that when one end of the bearing is loaded heavier than the other the staggered arrangement gives a greater load capacity than other arrangements. The rollers are made of a special analysis chrome-vanadium steel, heat-treated and ground to size.

Industrial Oil Wipers for Bearings

The Industrial Products Co., 1024 Penobscot Building, Detroit, Mich., has placed on the market an oil wiper for bearings. It consists of a tempered-steel spring with a triangular-shaped piece of babbitt metal

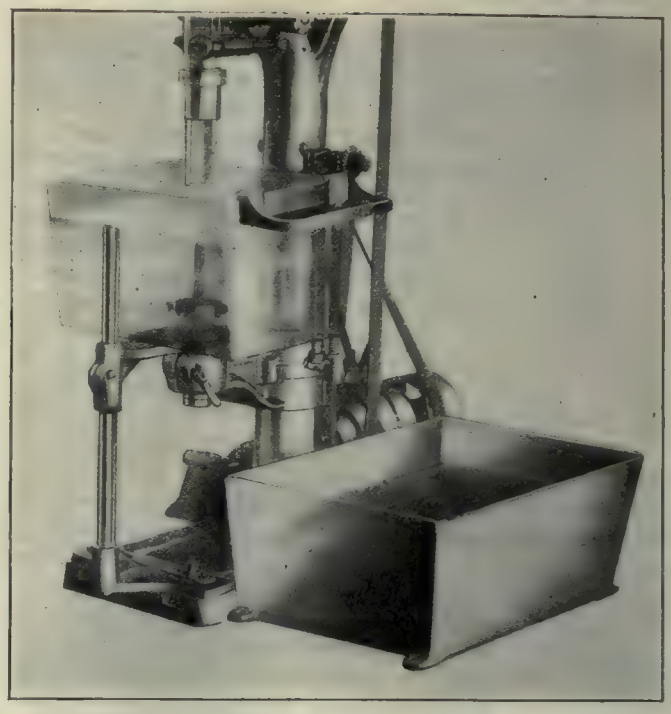


INDUSTRIAL BEARING WIPERS

mounted on one end. This piece of babbit metal is shaped to the shaft, and is said to wipe it clean, returning the oil to the reservoir of the bearing. The spring is fastened to a convenient point in the groove at the end of the bearing or to the housing, there being a wiper at each end of the bearing. The wipers may be applied to plain, roller or ball bearings. It is said that they will hug the shaft under all conditions, and that they will last as long as the bearing itself. The shaft may be run in either direction, as desired.

Hjorth Submerged Drilling Attachment

The Hjorth Lathe and Tool Co., 27 School St., Boston, Mass., is now marketing the submerged drilling attachment shown in the illustration. The upper tank is attached to the drill table socket, and two centering holders, the lower of which is attached to the lower drill table, and the other to the bottom of the tank, allow it to be raised, lowered and kept in alignment. The drill is held in the holder which is fastened to the bottom of the tank, the point being covered by the cutting compound. The drill is self-centering in the socket holder. The tank is provided with an outlet, so that the lubricant can be quickly drained to the lower tank, for removing or changing drills. The drill holder accommo-



HJORTH SUBMERGED DRILLING ATTACHMENT

dates drills from ¼ to 1½ in. in diameter. The work is held in a chuck attached to the drilling spindle, the drill remaining stationary. The advantages claimed are that the work is prevented from heating; that the drill is constantly lubricated, and hence of longer life and that the chips and shavings are kept from sticking.

American Pneumatic Chucks

The illustrtions show two special pneumatic chucks that have recently been manufactured by the American Pneumatic Chuck Co. and sold by the Neidow & Payson Co., 9 South Clinton St., Chicago, Ill. The 12-jaw chuck shown in Fig. 1 will take work 28 to 36 in. in diameter, the jaws having a movement of something over 4 in. each. The chuck is only 3½ in. wide on the outside diameter, and the large number of jaws are used in order to prevent springing the work out of round. In Fig. 1 the chuck is shown with the faceplate both on and off, the latter view giving some idea of the construction. The sliding jaws are moved from the air piston through a rack-and-pinion mechanism. The chuck is operated by a 12-in. standard

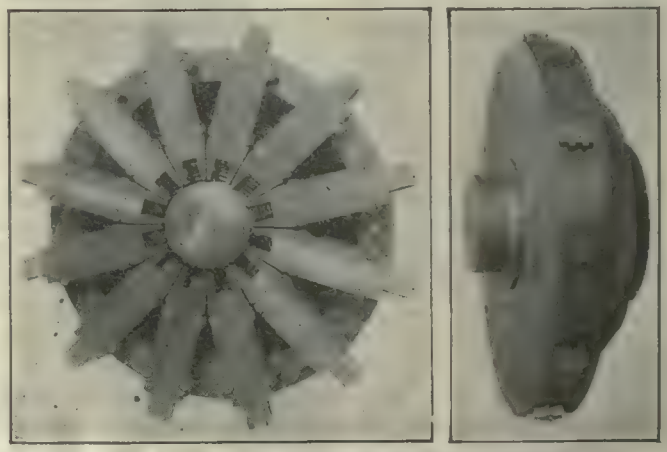


FIG. 1. THE 12-JAW PNEUMATIC CHUCK

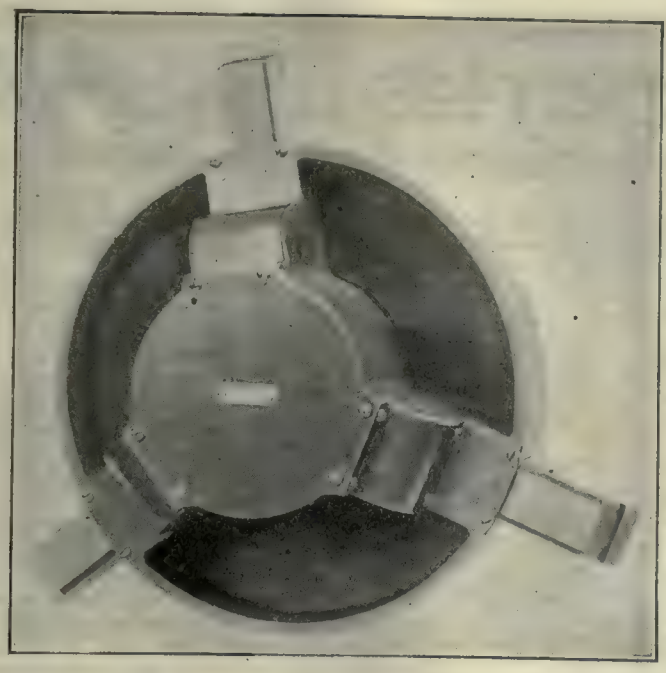


FIG. 2. A 3-JAW PNEUMATIC CHUCK

double-acting cylinder and can also be made for external gripping by using false jaws. It is believed that this is the largest air-operated chuck ever built.

Fig. 2 shows a 3-jaw chuck that is built with somewhat similar construction. This chuck has a range from 17 to 24 in. and is operated by a standard 10-in. double-acting cylinder.

Criticism of Modern Shop Systems

By H. M. Fitz

I am much interested in the article by J. B. Gray on page 777 entitled, "A Mechanic's Criticism of Modern Shop Systems." If everybody agreed with every one else, please tell me how mistakes and errors would be corrected. The instance he cites, of the confusion caused at first by substituting symbols for the names of tools, is not unusual—in fact, it is to be expected that there will be difficulty in the first change over. The main reason for this is that, heretofore, and it is still the custom in many shops, the mechanic has had to depend almost entirely upon himself for the selection of the proper tools for whatever job he is engaged upon. The idea of substituting symbols for names is to standardize and simplify the handling of tools, by figuring out the proper tools for a certain operation or job, making it a definite instead of a makeshift proposition. This probably would not assist the all-round mechanic as much as the machine operator or machine specialist, but would be especially helpful if he happens to be changed from one job or machine to another.

The instruction card would tell him immediately what tools to use on the job, and just as long as these drawings, tools, jigs, etc., are delivered to him, and everything else required to do the work, what difference does it make to him whether symbols or foreign language are used to designate the tools? In addition to this, many of the shop men operating machines today may know the proper tool to use, but do not know the correct name for it; many do not even know the proper tool to use, and, again, some tools are called by different names in different shops. This is all confusing to tool-crib tenders and shop messengers, resulting in loss of time and often in the selection of the wrong tool. To illustrate this, let me cite two instances that have come to my attention: In one plant, where they were setting up small steam cylinders for mine-sweepers on a planing machine to have front and back planed, a new man was put on the job with no instructions except job and drawing number, nor did he have the assistance of shop-messenger service. He had to find his own drawings and select the proper supplies at the machine, around the shop and in the toolroom. The clamps he found were either too long or too short; some of the bolt heads had to be ground to get them into the slots, while on others the threads were stripped; the nut supply was too low altogether, and the washers were of a dozen different sizes; even the shims and drivers were not right. With this collection of the best to be found, he set up the job, and after getting the things in order and grinding up two roughing tools he was ready to begin work, having used up 3 hr. 20 min. in getting started.

Another Man on the Same Job

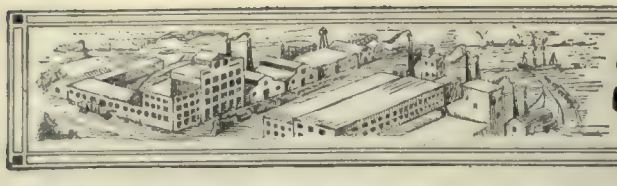
On the other hand, another man on the same job, who was previously supplied with an instruction card and given shop-messenger service, was put to work. Drawings, clamps of the correct sizes and number, bolts, nuts, washers, etc., were delivered to him in good condition, and he was supplied with cutting tools of correct shape and proper grinding. It took this man but 56 min. to make the set-up required, as against the 3 hr. 20 min. for the man without proper instructions.

This same thing would be true if one were going to dig a trench. If tools and equipment were ordered according to symbol, one need not know whether a pick or a shovel, or even a ditch-digging machine is to be supplied. But one thing is certain—the best and most efficient equipment for that particular job will be provided.

In some plants the symbolizing of tools and other scientific methods may not be to the best advantage. When Mr. Emerson installed the bonus system on the Santa Fe, he did not make the mistake of changing the names of tools (if they can be considered as such). The fact that one is raised on goat's milk does not necessarily mean that he is going to stick to that drink all his life. This same thing applies to systems. They may not always fit the conditions and a little change here and there may be necessary for successful working.

We have in mind one plant that was operating four different systems; namely, bonus, premium, piece work and day work. This sounds confusing, but on investigation it would be seen that each had its own advantages, peculiar to the conditions and nature of the work in that particular division. It also showed that whoever installed the systems was not the staunch advocate of any particular cut-and-dried system. We do not say that the conditions could not have been changed to suit any one of the systems, but the advantage would probably not have been the same. The principles of efficiency enter into each of these systems, but are applied in different ways, in order to attain quality and quantity and secure the most accurate record at the best cost.

Criticisms are good, and always have a beneficial and educational effect on some one, and sometimes the critic will see the other point of view after it is explained to him. If, on the other hand, his contention is correct, then the other fellow should profit by the criticism.



Sparks from the

Greater Shipping Service to Latin-America

Chairman Hurley of the United States Shipping Board Announces Plans at the Second Pan-American Commercial Conference

Edward N. Hurley, Chairman of the United States Shipping Board, brought forth the applause of the second Pan-American Commercial Conference when he announced the plans of the Board for extending shipping service between the United States and Latin-America. The great interest shown in Mr. Hurley's speech was evidenced by the large number of questions which were asked him by representatives of the different countries and by business men from different parts of the United States as to these plans.

"Not a Single Country to Be Neglected"

The speaker asserted that "not a single country was going to be neglected" in the greatly enlarged shipping facilities to be provided. He said that every principal port in the United States, on the Altantic, the Pacific, and the Gulf, would be taken care of and they would receive their proper allocation of the shipping.

As to competition he declared that the United States intended to compete in the markets of the world fairly and squarely with other countries and that he had no fear as to the results; but he announced that the vessels flying the American flag would carry only a certain percentage, not more than 50 per cent., of the products, and that this would give all the Latin-American countries full opportunity to make use of their own ships.

Planning a Special Sailing

Mr. Hurley announced that the Board was planning for a special initial sailing from New York about Nov. 1, of the Kronprincessin Cecelie, a former German vessel, now the Mt. Vernon, and that they hoped to make this a record trip to at least three of the South American ports, including Buenos Aires and Rio de Janeiro and that he hoped the members of the governing board of the Pan-American Union, as well as officials of this Government and a large delegation of American business men would avail themselves of the opportunity to take this trip.

Martin Behrman, mayor of New Orleans, one of the speakers at the morning session; declared that "New Orleans is talking big figures and doing big things," and he spoke of the developing friendly relations among all the nations of the Western Hemisphere.

Augustus Post, secretary of the Aëro Club of America, speaking of aviation as an aid to Pan-American commerce declared that "within ten years aircraft will be the most powerful single factor in developing the Latin-American republics economically, socially and commercially."

* * *

Summer Course in Industrial Management

The fourth summer session in factory organization, cost accounting, employment and scientific management will be held at the Pennsylvania State College, Aug. 11 to 23, 1919.

The morning lectures and discussions will be conducted by Maj. Hugo Diemer, formerly professor of industrial engineering at the Pennsylvania State College, but at present superintendent of personnel at the Winchester Repeating Arms Co. Major Diemer's practical experience includes that of superintendent of the National Motor Vehicle Co., Indianapolis; organization manager for the Goodman Manufacturing Co., Chicago, Ill, and consulting industrial engineer for many manufacturing corporations, including the Cincinnati Milling Machine Co., Fairbanks-Morse Manufacturing Co., International Harvesting Machine Co., and as Major of Ordnance in charge of important munitions work at the U. S. Cartridge Co., Lowell, Mass., and the Bethlehem Steel Company.

The afternoon practice work will be in charge of Lieut. J. O. Keller, who has done time-study work at the Aluminum Castings Co., and shop lay-out work with the Austin Co., and served as Lieutenant of Ordnance. Lieutenant Keller is Major Diemer's first assistant in industrial engineering branches at the Pennsylvania State College.

* * *

Italy's Needs in Machine Tools for Expanding Industries

The provision of machine tools for expanding industries after the war is exercising the minds of prominent Italians. One-tenth of these imports before the war was supplied by England, three-tenths by America, and six-tenths by Germany. The last-named country will, however, cease to count among Italy's suppliers, and her requirements will have to be met elsewhere. To this end, says *Engineering*, a company was recently formed at Milan which, pending the time when Italy is able to provide for her own wants, will control the business of machine-tool imports, among which agricultural motors and machinery take a leading place.

Home Institutions Selected for Training Disabled Men

Generally speaking, the Federal Board for Vocational Education is training men in four lines of work; namely, agriculture, industry, commerce and the professions. The belief of the Board, which it endeavors to live up to, is that disabled men should go back to their own states for their training, if possible. The Board is using private commercial colleges for the commercial education of disabled men, because they are accustomed to dealing with individual students, with differing degrees of education, who enter the course at irregular intervals. Land grant colleges are being used for agricultural training, and whenever practical for engineering courses as well. Industrial trade schools and shops and plants of all kinds in many places are being used for the industrial work. The idea of the Board is to keep the men contented during their period of training, and, as a rule this is best accomplished by placing the men near their own people, and among familiar surroundings.

* * *

A Co-partnership Formed in Binghamton, N. Y.

A new co-partnership has been formed in Binghamton, N. Y., to act as manufacturers' representatives and engineers, under the name of the Universal Equipment Co., with offices in the Security Mutual Building.

The firm is composed of T. M. Hutchins, former Binghamton publicity agent for the U. S. Treasury Department; H. L. Ellis, a salesman, and Alvin R. Gilmore, a local engineer.

This new concern will carry on a general business in iron and steel specialties and builders' supplies, lighting, power, waterworks, sewerage-disposal and grading equipment.

* * *

New Incorporations for April

New Incorporations during April had total authorized capital of 516 million dollars compared with 371 million dollars for similar organizations in March and 256 million dollars for the new incorporations of April, 1918. This is a new high record for total capital of new incorporations during any one month since 1900 and probably indicates only a beginning of the growth and development which is to take place during the next year or two. With the bulk of Government financing out of the way capital will be offered more freely for industrial development and the financing of public-service and transportation companies.

World's Industrial Forge

By E.C.Porter, News Editor

Convention of the National Gas Engine Association

The twelfth annual meeting of the National Gas Engine Association was held at the Hotel Sherman, Chicago, Ill., on June 2 and 3, 1919. The presiding officers for the convention were: President, O. H. Fischer, Oakland, Calif.; treasurer, O. M. Knoblock, Chicago, Ill., and secretary, H. R. Brate, Lakemont, N. Y.

The sessions of the meeting were largely devoted to discussions of trade and sales problems. Few papers were presented which had been prepared in advance of the meeting.

The annual election of officers on the last day of the meeting resulted in the following selections: President, L. M. Ward, Cushman Motor Co., Lincoln, Neb.; first vice president, Theodore C. Menges, Associated Manufacturers Co.; Waterloo, Iowa; second vice president, Henry Kennedy, Lalley Electric Lighting Corp., Detroit, Mich.; treasurer, O. M. Knoblock, Chicago, Ill.; secretary, H R. Brate, Lakemont, N. Y. The new members of the executive committee are; Richard De Forest, Alamo Farm Lighting Co., Chicago, Ill., to serve one year; F. E. McKee, Manning, Maxwell and Moore, Inc., New York, to serve two years, and Geo. Cormack, H. C. Doman Co., Oshkosh, Wis., to serve three years.

* * *

A Solution to the Housing Problem

In order to provide proper housing for the employees of its Buchanan, Michigan plant, the Clark Equipment Co., manufacturers of steel-disk wheels and "Celfor" drills, recently purchased a tract of land, plotted it into subdivisions and erected 45 houses and bungalows.

The common practice of the employees paying for their homes on the rental basis has, as a rule, proved unsatisfactory. In the Clark plan the purchasing employee pays on terms to suit his purse, on an amortization plan, so that at the end of a period of years the property is free.

To head off speculators and keep profiteers from grabbing the unearned increment, the company, in fixing the prices, adds 100 per cent. to the actual cost of the lot and 5 per cent. on the cost of the house.

After five years of payments the purchaser has an equity sufficient to guarantee his good faith in carrying the deal through to the end, and the 100 per cent. on the lot and the 5 per cent. on the house are remitted and applied on the account, so the buyer gets his home at actual cost price.

That this plan appealed to the employees is shown by the fact that larger and better houses than are found in the usual run of corporation houses, were desired.

There is also a combined stock sale and profit-sharing plan which is very popular with the employees. The employees are allowed to subscribe for stocks in "lots," which consist of one share each of preferred and common stock, in amounts up to 10 per cent. of their salary. With each lot the purchaser is given an employee's participating certificate which entitles the holder to a minimum dividend of six per cent.

In addition to this there is a distribution dependent upon profit. The combined dividends to participating employees have gone as high as 65 to 70 per cent. on their investment.

* * *

Money in Circulation

Money in circulation on the first day of May totaled 5863 million dollars compared with 5847 million dollars a month ago and 5319 million dollars a year ago. The population of the United States is estimated at 107,311 thousand compared with 105,581 thousand a year ago, making the circulation per capita $54.64 compared with $54.56 a month ago and $50.30 a year ago. The general stock of money in the United States is estimated at 7615 million dollars compared with 7587 million dollars a month ago and 6541 million dollars a year ago.

* * *

Power Required to Make Ferroalloys

The power required to make a number of ferroalloys was recently tabulated in *La Houille blanche* by Director Flusin of the laboratory of electrochemistry and electrometallurgy of the University of Grenoble. His figures give the power, generated in water-power plants, in kilowatts per 24 hr. required per ton of product made, and also the number of tons of principal raw materials per ton of resultant product. Some of the figures are as follows:

	Kw.-day per Ton	Tons of Materials to Ton of Product
Ferrosilicons:		
10 to 12 per cent. Si	109	1.55
25 to 30 per cent. Si	172	1.9
45 to 50 per cent. Si	333	2.9
70 to 80 per cent. Si	714	4.3
90 to 95 per cent. Si	1000	6.4
Ferromanganese:		
18 to 12 per cent. Mn	67	1.8
70 to 75 per cent. Mn	167	3.15
Ferrochrome:		
10 per cent. Cr	286	2.9
1 per cent. Cr	555	4.05
Ferrotungstens	400 to 286	2.7

Trade Currents From Western Cities

Reports from Chicago State that May was the Best Month for the Machine-Tool Trade—Cleveland Reports Less Shopping and More Buying

Chicago Letter

Recent optimistic reports in regard to the condition of the Chicago machine-tool trade are fully justified by inquiry into the actual business done by various dealers during the month just closed. The unanimous expression is that May was the best month since the end of the war, both in sales and collections, and one large dealer states that it ranks second in his entire history in point of sales and first in point of collections.

The large volume of business done, approximating 25 per cent. over that of April, is in sales of from one to a few prices scattered throughout a wide range. The outstanding feature is that the great corporations who have been making inquiries are still deferring their buying, but the smaller concerns are purchasing freely. Trade in machine-tool attachments and small tools has been very lively. There seems to be a particular demand for sheet-metal-working machinery, new and second hand, many dealers reporting inability to fill orders.

Prices are less a matter of speculation than a few weeks ago. The impression is gaining ground that it is a wise buyer who places his order at the prevailing list, as the tendency to stiffen up prices is very noticeable all along the line. It has been strengthened by the announcement by one of the large machinery and small-tools manufacturers that their guarantee to buyers against a decline is withdrawn. Their explanation is that they made a guarantee against decline, upon the signing of the armistice, to protect both dealers and buyers during the period of transition from war to peace; that in their opinion business in the machine-tool industry is now on a firm peace basis, and that such protection is no longer necessary.

Inquiries continue to be received by dealers in such volume as to insure a continuance of excellent business throughout the coming month.

Cleveland Letter

Less shopping and more real buying is the keynote to the opening of June in the machinery and machine-tool field in the Cleveland and northern Ohio district. Anticipation for improvement in the whole equipment situation is being realized because of the contrast in the

early business of this month with that of May at this time. The outstanding feature for the month, in the opinion of leading dealers, will be the inability of producers to make prompt deliveries. In many plants, it is explained, production has been cut, which, under these conditions, brings the present demand to above normal, although it would be sub-normal with a 100 per cent. production. To a certain extent this will mean a shortage of equipment, and distributors consequently are urging their clients to place their orders now if they expect anything like reasonable deliveries.

LARGE TENTATIVE ORDERS COMING FROM COMMISSION HOUSES

Another development of the last week, expected to bear good fruit during the balance of the month, is the larger number of tentative orders coming into the machinery field in this district from commission houses in the East representing foreign firms. It is believed here this is the beginning of the long-anticipated demand from European consumers and tends to offset the predictions that foreign countries would not enter American markets for their equipment needs.

Principal domestic business now being placed is for automatic screw machines, which are being taken largely by automobile, piano and talking-machine interests in other parts of the country. Shaping machines, drilling machines and gear-cutting machines make up the balance of the bulk of business and the remaining orders are scattered over a miscellaneous assortment of equipment. In all quarters most of the inquiries now being received are for equipment that each firm can handle, leaving fewer items unfilled than for several months past.

* * *

Business Failures in April

Business failures during April numbered 503, the smallest number of failures ever reported in any month, which compares with 558 failures in March and 867 failures in April of last year. Liabilities of the concerns failing in April were 11 million dollars compared with 14 million dollars for those failing in March and 13 million dollars for concerns failing in April of last year. No better indication of the solidity of underlying business could be presented. Six months have passed since the end of hostilities and, during that six months of change and readjustment, business failures have been the smallest ever known for a half-year period.

* * *

Opens Employees' Restaurant

The Cleveland Milling Machine Co., Cleveland, Ohio, has opened an employees' restaurant, and will sell food at cost price. This restaurant was designed with the view of accommodating 300 people and has up-to-date kitchen facilities to prepare regular as well as short-order meals.

Business Items

The Cleveland Milling Machine Co., Cleveland, Ohio, has announced the appointment of H. I. Miner as sales manager.

The National Tool and Manufacture Co., St. Louis, Mo., has changed its name to the Bluebird Manufacturing Co., effective June 1.

Barber-Colman Co., Rockford, Ill., has opened a branch office at 451 Ellicott Square Building, Buffalo, N. Y. C. G. Kaelin is the manager.

The Union Drawn Steel Co., Beaver Falls, Penn., has opened a branch sales office in Cleveland, Ohio. Fred. C. Young is the district sales manager.

The Kauffman Metal Products Co., Bellefontaine, Ohio, has taken over the H. Murphy Bronze and Aluminum Co., and has increased its capital from $50,000 to $125,000.

The Peninsular Tool Salvage Co., Inc., Detroit, Mich., has dropped the word "Peninsular" from its name and in the future the name of the company will be Tool Salvage Co.

The R. E. Ellis Engineering Co., Chicago, Ill., will handle the agency for Horstmann indicating calipers which were recently described in the New Tool Section of the *American Machinist*.

Leeds & Northrup Co., Philadelphia, Penn., has recently opened a sales and service department at 1304 Monadnock Building, Chicago, Ill. Henry Brewer will be in charge of the new branch office.

Peter A. Frasse & Co., 417 Canal St., has recently been chosen as the exclusive agency in New York City and vicinity for the Walcott Lathe Co., and the Jackson Shaper Co., both of Jackson, Mich.

The Heine Safety Boiler Co., manufacturers of Heine water-tube boilers, with plants at St. Louis, Mo., and Phoenixville, Penn., has secured the services of Chas. H. Stoddard as its consulting marine engineer.

The Niles-Bement-Pond Co. has opened a new office and store at 116 South Ave., Rochester, N. Y., and will carry a stock of Pratt & Whitney machinist's small tools. Another office has also been opened at 454 East Third St., Los Angeles, Calif.

The Schiotz Tool, Gear and Machine Works, Inc., Waterloo, Iowa, has recently opened a plant with O. W. Schiotz as president and manager. Mr. Schiotz during the war was connected with the Grey Machine Tool Co., Buffalo, N. Y., holding the position of factory superintendent.

On Apr. 29, a charter was granted by the State of Pennsylvania, to the Roberts Co., with offices at 1049 Drexel Building, Philadelphia, to conduct a consulting and contracting engineering business. This company will engage itself in covering the rolling mill, steel plant and special machinery fields. A L. Roberts, has been elected president, and V. F. Signorelli, secretary and treasurer of the new company.

Whitman & Barnes twist drills are to be on exhibition at the convention of master mechanics, to be held at Atlantic City, June 23 to 25. R. A. Ammon, New York office; J. C. Scanlon, Chicago office; Kennith Grant, salesman; A. A. Williams, salesman; Ralph Templeton, salesman; Karl Kendig, advertising manager of the "W & B" company, and J. K. Booth, master mechanic of the Bessemer & Lake Erie Railroad are to form a party to attend the convention.

The Joseph Dixon Crucible Co. of Jersey City, N. J., has announced the removal of its Philadelphia sales office from 1020 Arch St. to Rooms 801 and 802 of the Finance Building, South Penn Sq., Philadelphia, Penn. The Philadelphia sales district comprises Pennsylvania, southern New Jersey, Delaware, Maryland, District of Columbia, Virginia and West Virginia. The Dixon sales organization in Philadelphia is under the management of W. G. Stringer.

The Railroad and Power Equipment Co., Woolworth Building, N. Y., has received many inquiries for machinery and equipment from England, Belgium, France, Spain, Italy, Bulgaria, Greece, China, Japan, India, Panama, Chile and Argentine. This company was recently incorporated under a Delaware charter with $5,000,000 authorized capital stock, to take over the business conducted during the past 20 years by Charles F. Johnson, in New York, Buffalo, Cleveland, Philadelphia, Chicago and Toronto.

The firm of Young, Corley and Dolan, Inc., engineers and contractors and manufacturers' representatives, formerly 115 Broadway, New York, has moved into the five-story building which it purchased at 28-30 West Broadway, where its executive offices, showrooms and warehouse will be combined. This company recently opened offices in various parts of Europe with the principal office in Paris, France. It also has an office in Japan. The officers of the firm are R. A. Corley, president; L. R. Williams, vice president, and D. J. Dolan, secretary and treasurer.

The Tacony Steel Co., Philadelphia, Penn., announces the results of its recent election: J. B. Warren, secretary and general manager, was elected president and general manager; George Satterthwaite was chosen vice president and treasurer, and Henry T. Stetson was made secretary. Messrs. Warren, Satterthwaite and Stetson, with O. W. Bird, Jr., W. C. Witherbee and W. H. Turner compose the present directorate. The company also announces the opening of a New York district sales office at 2 Rector St., and several other district offices throughout the country will be organized

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Milling Machine, Continuous Manufacturing

Beaman & Smith Co., Providence, R. I.

"American Machinist," May 22, 1919



Intended for heavy manufacturing work where large numbers of parts of the same type have to be milled. The machine consists essentially of a substantial bed to which uprights are attached, these uprights supporting the horizontal spindle heads and the crossrail, which in turn carries the vertical spindle heads. Each pair of uprights with its bank of spindles is one milling unit. As many spindles can be mounted on this unit as necessary and as many units may be attached to the bed as are required to do the work in hand. The feed-driving mechanism is carried on one unit only and the removable tables that carry the work are fed along the bed, taking a fast motion when the cutters are idle and a slow motion when the cutters are working. Gearing is used to secure four changes of feed, which vary from approximately 3 to 8 ft. per minute with a fast motion of about 12 ft. per minute when the cutters are idle.

Engine Lathe, 54-In. Geared Head

Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass.

"American Machinist," May 29, 1919

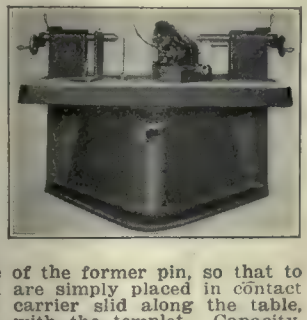


Width of bed on top, 53 in.; depth of bed, 24¼ in.; actual swing over ways, 56⅝ in.; actual swing over compound rest, 38¾ in.; actual swing over taper attachment, 35 in.; distance between centers with 22-ft. bed, tail flush, 9 ft. 11 in.; front spindle bearing, 8½ in. in diameter, 16 in. long; rear spindle bearing, 7 in. in diameter, 13 in. long; centers, Morse taper No. 7; spindle speeds, 18 with two sets of back gears, 2.715 to 154.05 r.p.m.; number of changes through quick-change gear box for screw cutting and feed, 40; range for screw cutting, ¼ to 14 threads per in.; longitudinal feeds, 0.016 to 0.444 in. per spindle revolution; crossfeeds, 0.019 to 0.543 in. per spindle revolution; capacity of center rest, 5 to 27 in.; weight with 22-ft. bed, 68,300 lb.; floor space with taper attachment, 25 ft. 9 in. by 12 ft. 6 in.

Grinding Machine, Cutter No. 2040

Wm. O. Barnes, Leominster, Mass.

"American Machinist," May 29, 1919



Provides a means for the grinding of any milling cutter within its range, whether a single cutter of simple shape or a large complicated gang with either straight or curved contours. The cutter on its arbor is placed on centers carried by the two columns, and a flat templet having the desired contour is laid on the ledge that may be seen at the back of the table. The grinding wheel is mounted on a carrier equipped with a former pin and a tooth rest. Means are provided for so truing the wheel that its periphery at the top of the rest is in exact vertical alignment with the surface of the former pin, so that to grind the cutter the different teeth are simply placed in contact with the top of the rest and the carrier slid along the table, keeping the former pin in contact with the templet. Capacity, cutters up to 20 in. in diameter and 40 in. between columns; floor space, 100 x 31 in. over-all; weight, 2250 lb.

Shaping Machine, Crank

Simmons Machine Co., Inc., Albany, N. Y.

"American Machinist," May 29, 1919

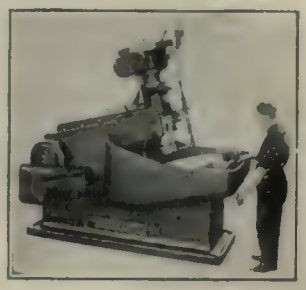


Stroke, 17 in.; table, 10 x 13 in.; head graduated; keyseating capacity, up to 3 in. in diameter; swivel vise graduated; elevating screw, double, knee support being also provided; cone pulleys, four step for 2½-in. belt; automatic horizontal feed, 13 in.; weight, 1700 lb.

Milling Machine, Tilted Rotary "Ohio"

Oesterlein Machine Co., Cincinnati, Ohio

"American Machinist," May 22, 1919

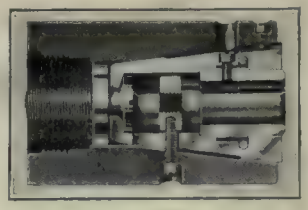


May be used either as a station machine or for continuous milling. The chief features claimed are the great rigidity, the elimination of considerable idle time between cuts and the construction that enables a generous supply of lubricant to be supplied to the cutter. Inclination of table, 15 deg.; diameter of table, 30 in.; worm for table drive, 4 in. in diameter, 1½ pitch; taper in spindle, No. 16 B. & S.; capacity of lubricant pump, 35 gal. per minute; capacity of reservoir in base, 60 gal.; indexing mechanism for table, 2 to 72 divisions; width of belt, 4 in.; spindle speeds, 30 with 15 pairs of change gears; diameter of lower spindle bearing, 4½ in.; weight of flywheel on spindle, 250 lb.; area of table bearing, 475 sq.in.; area of ram bearing, 1000 sq.in.

Chuck, Air-Operated Compensating-Collet "Logan"

Logan Machine Co., Logansport, Ind., Manufacturers,
Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., Agents

"American Machinist," May 29, 1919

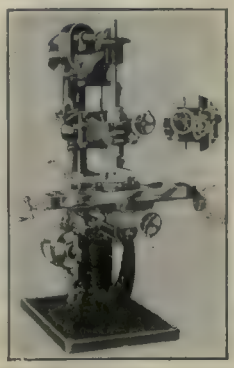


The chuck housing or body is of hardened steel, ground, the taper seat for the collet jaw being a part of the housing, giving the advantage of one-piece construction to the body. The jaws are not fastened together, but are simply set loosely into the body and held in position at the drawrod end by the taper on the connecting screw and held expanded at the front end by means of a spring. This floating type of jaw construction allows the jaws to adapt themselves for work of different diameters and allows an equal and positive grip the entire length of the work. Regularly supplied in the two- and three-jaw type, with master collet jaws to which false jaw blocks for holding various sizes can be fitted, and in 1½-, 2½-, 4- and 6-in. sizes.

Drilling and Milling Machine, No. 3

W. B. Knight Machinery Co., St Louis, Mo.

"American Machinist," May 29, 1919

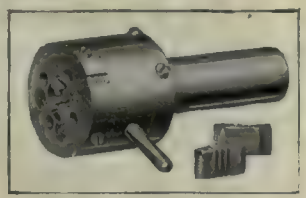


Floor space, 72 x 62 in.; height, 85 in.; weight, 2700 lb.; diameter of countershaft pulley, 14 in.; belt face, 3 in.; speed of countershaft pulley, 300 r.p.m.; distance from center of spindle to column, 10 in.; maximum distance from spindle to table, 18 in.; vertical feed of spindle, 6 in.; working surface of table, 8½ x 33 in.; T-slots in table, three, ⅝-in.; tilt of table, 70 deg.; longitudinal table feed, 24 in.; table crossfeed, 10½ in.; speed changes, eight, 25 to 300 r.p.m.; feed changes, eight, 0.008 to 0.060 in. per spindle revolution.

Die Heads, Automatic

Shehan Tool Co., 321 Frankfort Ave., Cleveland, Ohio

"American Machinist," May 29, 1919



The particular feature of this line of die heads is the use of double-ended chasers having cutting edges on both ends. These chasers can be supplied with duplicate threads on both ends or with different diameters and pitches on the two ends as desired. All parts except the shank are hardened and ground and the parts are interchangeable. The heads are made on the round construction principle throughout making possible the elimination of cams and other such parts. The outside diameters are less than those of any other type head on the market. The four operating shafts that oscillate the chasers have teeth that engage the chasers their full cutting length, giving a perfectly distributed bearing that is said to add much to the accuracy and life of the cutting points, and make it impossible for the chasers to tip, or cut tapers. The head can be cleaned by simply removing the faceplate with a screwdriver.

Patented Aug. 20, 1918

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An official of the government of Siberia wishes to purchase for the ministry supplies, machinery, electrical supplies and implements, measuring devices, tools and accessories, machinery supplies, etc., a complete list of which together with further information may be had on application to the Bureau of its District Offices. No. 29,454.

Hydraulic machinery, electrolytic copper bars, resistance wire, covered wire and cables, motors, and general electrical material and machinery for developing electric power are required by a firm in Spain. Quotations should be given f.o.b. New York. Terms, payment in New York. Correspondence may be in English. References. No. 29,453.

A man in Italy wishes to purchase sliderules for calculation in lots of 50 to 100 at a time; drawing instrument cases, 500 to 1000 at a time; about 100 rolls per shipment of tracing cloth; parallel braced drafting machines; protractors, 360 to 400 deg.; metric scales, 20 to 50 cm.; and tape measures and tracing paper in large quantities with each order. Descriptive catalogs and samples are requested. Correspondence should be in Italian or French. References. No. 29,439.

M. Weismann, proprietor, Marco Weissmann, of Galatz (Roumania), a Roumanian import and export firm, desiring to import American machinery and other products, asks for quotations of agricultural machines, sewing machines, meat-cutting mills, files and rasps and other tools, general hardware, iron and steel goods, tin in bars, sulphate of copper, caustic soda, general chemicals, leather, leather beltings, and other articles.

Trade Catalogs

High-Speed Steel. Edgar T. Ward's Sons Co., Boston, Mass. Catalog, No. 1. It gives tables of weights, sizes and complete instructions for cutting, forging, hardening and grinding of Ward's high-speed steel.

Carpenter Alloy Steel. Carpenter Steel Co., Reading, Penn. Catalog, No. 8; describing the strength and stability or necessity to economize in weight and space of alloy steel and several diagrams showing its physical properties in relation to drawing temperature. A general catalog will be sent on application.

Personals

E. H. ANTHONY, formerly with the Bilton Machine Tool Co., Bridgeport, Conn., is now associated with the Gale-Sawyer Co., Boston, Mass.

B. W. STONE, formerly with E. W. Bliss Co., Brooklyn, N. Y. has been appointed Eastern manager at New York, of Kearney & Trecker Co.

G. A. DAVIES of the Davies-Morard Machinery Co., Detroit, has returned to Wickes Bros., Saginaw, Mich., as general manager.

R. A. CORLEY, president of the firm of Young, Corley and Dolan, Inc., engineers and contractors and manufacturers' representatives, with offices at 28-30 West Broadway, New York, has gone to Europe in the interest of the company and will make his headquarters at the company's head office in Europe.

GOTTFRID JANSON of Stockholm, Sweden, is visiting this country and is making his headquarters at the office of F. W. Jaeger, exporter, 95 Liberty St., New York.

PRESTON BELVIN has been appointed district sales engineer of the International Oxygen Co. in charge of the Pittsburgh district with headquarters at the office of the company at 1310 First National Bank Building, Pittsburgh, Penn.

F. W. MARSHNER has been appointed manager of the Detroit branch of the New Departure Manufacturing Co., succeeding the late Samuel B. Dusinberre. Mr. Marshner has been with the company at its Detroit office for about seven years.

Obituary

FREDERICK PEARCE, president of the Frederick Pearce Co., died on Wednesday, May 7, 1919.

JOHN LLEWELLYN, vice president of the Llewellyn Iron Works, Los Angeles, Calif., died in New York City, on Apr. 23, 1919.

FRANCIS A. DUNCAN, president Duncan Forge Co., Toledo, Ohio, died Apr. 29 after a four days illness, aged 46 years.

J. E. T. ALLEN, head of the firm of Taylor, Garnett, Evans & Co., Ltd., of Stockport, Manchester, Eng., printers of the European section of the *American Machinist*, died on May 5. Mr. Allen was one of the directors of the Hill Publishing Co., Ltd., London, and had been connected with the European edition since its inception in March, 1900.

COL. CLARENCE E. BURKE, born in Cleveland 69 years ago, died in New York, May 9. He was for years secretary of the Lake Shore Foundry, Cleveland, and an organizer of the United States Cast Iron Pipe and Foundry Co. He was a colonel of Ohio troops in the Spanish-American War and was chief engineer of the State under the administration of Governor Asa S. Bushnell.

FIRST LIEUT. JOHN R. MARCHANT was killed in action in France, Oct. 11, 1918. The announcement has been made by the George F. Marchant Co., Chicago, by means of a card stamped with a gold star, and reading as follows:

Sept. 22, 1894 Oct. 11, 1918

First Lieutenant John R. Marchant, 131st Inf., A. E. F., a valued member of this organization and son of the president and founder, was killed in action near Gercourt, France.

GEORGE F. MARCHANT, Chicago.

Forthcoming Meetings

The thirty-first annual convention of the American Boiler Manufacturers' Association will be held at Lafayette Hotel, Buffalo, N. Y., on Monday and Tuesday, June 23 and 24.

American Drop Forge Association will hold its sixth annual convention jointly with the Drop Forge Supply Association, June 12, 13 and 14, at Pittsburgh, Penn. The convention headquarters will be the William Penn Hotel. A. W. Peterson, of the American Drop Forge, Pittsburgh, is the secretary of the first-named association, and A. L. Wurster of the Sizer Forge Co., Bourse Building, Philadelphia, is the secretary of the latter.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 W. 5th St., Peru, Ind.

The American Society of Marine Draftsmen will hold its eight annual convention at the Hotel Brunswick, Boston, Mass., on June 20 and 21. B. G. Barnes, 1596 North Ave., Bridgeport, Conn., is the secretary.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 W. 39th St., N. Y.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On June 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

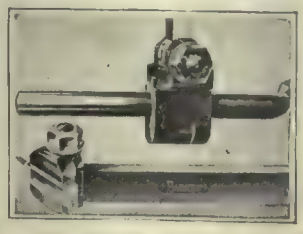
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Toolholder, Universal

Parker Machine Co., Boston, Mass.

"American Machinist," May 29, 1919

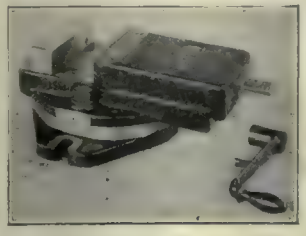


The holder is universal and reversible with a positive locking device for each one of the five positions obtainable, it being possible to use any type of bar-stock cutters, either flat, square, or round, and also special shaped cutters. It is claimed that more work can be produced with this holder than with a complete set of single-purpose holders and that the breakage of high-speed-steel tools bits and setscrews is eliminated. The illustration shows the toolholder with a rough-turning cutter in place and also with an internal boring tool ready for work. The holder is supplied with 15 cutters and forms a complete outfit in itself.

Vise, Swivel Machine

Bilton Machine Tool Co., Bridgeport, Conn.

"American Machinist," May 29, 1919



Designed for heavy work, the sliding jaw being pulled up against the work. This jaw is gibbed to the base in order to prevent it from rising when pressure is applied, the design also tending to hold the jaw on the base. The stationary jaw is of box-form construction, is keyed to the base and wholly incloses the operating screw, the end of which bears just back of the face of the jaw. The removable face of the stationary jaw is held in place by two screws, the heads of which are made long and project through to the back in order that the face may be conveniently removed. It will be noticed that the screw and operating mechanism of the vise are wholly inclosed in the box-type stationary jaw, so that dirt and chips are absolutely excluded.

Countershaft, Reversible, "Abitz"

Rockford Metal Specialty Co., 720 South Main St., Rockford, Ill.

"American Machinist," May 29, 1919

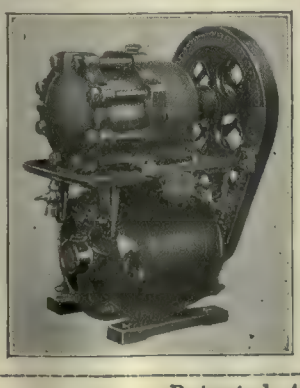


Arranged to give forward, neutral and reverse speeds, and makes use of a planetary-gear mechanism. A clutch at the right fixed to the shaft engages the pulley, while a stationary clutch at the left loosely mounted on the shaft engages the idling drum, and acts as a brake. Two spools fixed to one shifter arm are provided to expand the clutches. If the shifter arm is thrown to the left, the right clutch is expanded, engaging the pulley and driving the shaft in the same direction, the whole mechanism revolving as one unit; while if the shifter is thrown to the right, expanding the left clutch the idling drum will remain stationary, forcing the pinion to drive the gear fixed to the shaft in the opposite direction or reverse.

Pump, Pressure and Vacuum

Utility Compressor Co., Detroit, Mich.

"American Machinist," May 29, 1919

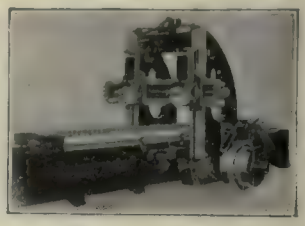


The rotary motion of the pump shaft is converted into a reciprocating motion of the eight pistons by a connecting-rod rocker pivoted on a universal joint. The circular or wavelike motion of the rocker delivers the power in turn to each of the pistons, there being ¼-in. lead between them. The connecting-rods are 2 7/16 in. long and have a §-in. hardened-steel ball at each end. Number of cylinders, 8; bore cylinders, 1 in.; stroke, 1 5/16 in.; speed, 420 r.p.m.; capacity, 2.1 cu.ft. of free air per minute; lubrication, splash system; height over-all, 17 in.; width, 15 in.; depth, 9½ in.; pressure pumped, up to 300 lb. per sq.in.; vacuums pumped, as high as 28½ in. of mercury.

Planing Machines, Heavy-Duty "Stamco"

Streine Tool and Manufacturing Co., New Bremen, Ohio

"American Machinist," May 29, 1919

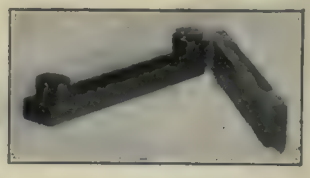


Made in 5 sizes: 36 x 36 in., 42 x 36 in., 42 x 42 in., 48 x 42 in., 48 x 48 in. Specifications for 42 x 42-in. machine: Width of work planed, 43 in. height of work planed, 43 in.; width of platen, 39 in.; thickness of platen, 7 in.; distance between V's, 24 in.; depth of bed, 25 in.; face of housing, 9 in.; face of crossrail, 16 in.; length of saddle bearing on rail, 17½ in.; length of rail-head down feed, 15 in.; face of bull wheel, 7¾ in.; diametral pitch of bull wheel, 2½ in.; width of cutting belt, 3¾ in.; diameter of cutting pulley, 30 in.; diameter of return pulley, 24 in.; width of countershaft belt, 6 in.; diameter of countershaft pulley, 18 in; height, 105 in.; width, 92 in.; countershaft speed, 350 r.p.m.; horsepower required for 50-ft. cutting speed of platen, 25.

Sine Bar

Simplex Tool Co., Woonsocket, R. I.

"American Machinist," May 29, 1919



This is a 5-in. bar, is mounted on a base and can be set either by measuring over the bottom of the base with the button with a micrometer, or between the top of the base and the button with blocks. With the swinging construction used it is only necessary to set one end of the bar. The device may be used against an angle plate or laid flat upon its side as desired, as the side of the base and side of the bar are in one plane. The bar itself is of channel construction and in some cases small work can be clamped directly to it. The clamping device for the bar is capable of locking the bar to the base with a powerful and centralized grip, eliminating the tendency to spring the bar. Gage blocks for setting common angles without figuring can be furnished if desired, the outfit when so ordered being packed in a hardwood box.

Drilling Machine, Independent Feed Rail No. 23

Defiance Machine Works, Defiance, Ohio

"American Machinist," May 29, 1919



Capacity in solid steel, 2 in.; maximum distance, nose of spindle to top of table, 32 in.; distance from center of spindles to face of column, 12½ in.; minimum distance center to center of spindles, 8 in.; maximum distance center to center of outside spindles, 78 in.; length of power feed, 12 in.; working surface of table, 20 x 98 in.; vertical adjustment of table, 12 in.; speed changes, six, 25 to 186 r.p.m.; feed changes, three, 0.006, 0.009 and 0.014 in. per spindle revolution; diameter of spindle nose, 3 in.; diameter at driving point, 3 in.; diameter of spindle sleeve, 4 in.; Morse taper in spindle, No. 5; drive pulley, 20 x 5½ in.; speed of drive pulley, 350 r.p.m.; horsepower required, 10; floor space, 56 x 144 in.; net weight, 12,180 lb.

Profiler

Oliver Instrument Co., Adrian, Mich.

"American Machinist," May 29, 1919



For the production of duplicate irregular parts from sheet metal up to 5/32 in. thick. The machine is built with a deep throat and a short stroke, the punch used being round in section, and having a heel on the back which does not rise out of the die when the machine is in operation. There is an eccentric bearing on the head by means of which the punch can be raised § in. in order that the work may be passed under the punch when it is desired to work out a hole in a piece of metal. A templet is first made to the exact shape of the part desired, this templet being doweled to the work. The work is proportioned so that the punch clears the stock only and cuts into the metal until the templet rubs against the body of the punch; the work being guided by hand. The machine is motor driven. The speed is 250 strokes per minute and the stroke ¼ in. The total weight is 601 lb.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$29.80
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	25.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅜-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Near Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.37	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.27	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.22	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.17	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.05	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 1/32, 3/64, 1/8, 1/32, 5/64 No. 8, 3/32 and No. 10 1/8 No. 12	25.50 to 33.00	1/16 by 12 in. long	14.00
		1/8 by 19 in. long	12.00
		3/16 by 19 in. long	10.00
		1/4 by 21 in. long	10.00
5/32, No. 14 and 1/16 No. 18 No. 20		Special Welding Wire, Coated	
		1/8	33.00
		3/32	30.00
		1/16	8.00

Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardiy A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	½ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	½ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	47%	31%	46½%	31 %	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.75	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	95.00
Lead	5.20	5.25	7.00
Spelter	6.50	6.55	7.00
ST. LOUIS			
Lead	4.95	5.00	6.80
Spelter	6.15	6.20	6.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	23.00	22.50	31.50–33	24.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	24.00	34.00	22.00	31.00
Brass sheets	20.50	23.75–28	30.75	24.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	31.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	43.00	41.25	39.00	55.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00	$25.25
New York	19.50	26.25
Cleveland	23.00	30.00
Chicago	24.00	28.00

June 19, 1919 American Machinist Vol. 50, No. 25

Mechanical Achievements of United States Railroad Administration

By FRANK McMANAMY
Assistant Director Mechanical Department, Division of Operation

Adverse decision of a man's case without hearing his side of the story is bad law and equally bad horse sense. Taking a crack at the United States Railroad Administration has become such an everyday proceeding that a counter blow is a welcome novelty. This statement by a high official of the Railroad Administration gives an inkling of some of the difficulties encountered when the railroads were taken over and sketches briefly the steps taken to overcome them. In scope it is confined to equipment and mechanical problems, those of most moment to machine-tool men. The figures quoted by the author show a healthy improvement in the state of the rolling stock and a locomotive reserve which should improve operating conditions.

IT IS not possible to set forth what the Railroad Administration has accomplished without taking into consideration the conditions which existed at and prior to the time the Government assumed control of the railroads. In order to comprehend the difficulties encountered by the Railroad Administration and to appreciate what has been accomplished, a knowledge of some of the conditions found in motive power and car departments will be necessary. The following statement of conditions is therefore given:

The Federal Government assumed control of the railroads not because it was desirous of adding to the enormous task it already had on hand, but because it was forced to do so as a war measure, for the railroad machine had, to an alarming extent, ceased to function, and in the emergency which confronted the nation it was essential that the railroads should function at their highest degree of efficiency.

The statement has been made and is generally accepted that the principal cause for the railroad's failure to function was the car and locomotive shortage, and while this correctly represents the situation so far as the shipper was concerned, from a standpoint of railroad operation such a condition did not exist.

When a railroad or a number of railroads in a section of the country are congested with cars, there can be, in so far as those railroads are concerned, no car shortage. When the shops and roundhouses on a railroad or a number of railroads in any section of the country are blocked with locomotives undergoing or awaiting repairs, in so far as those railroads are concerned there can be no shortage of locomotives. These conditions existed on every railroad which was congested with traffic at the time the Railroad Administration assumed control. Therefore congestion was not primarily due to shortage of cars or locomotives, but to the inability or failure to use to their maximum efficiency the cars and locomotives on hand.

It was not possible at the time the railroads were taken over to say to what extent the condition of locomotives and cars was responsible for the situation which existed, and as the Railroad Administration had at that time no mechanical department organized to check up shop practices and handling of equipment at terminals and to outline plans for improvement, the Interstate Commerce Commission was asked to assist in obtaining accurate information relative to the general situation.

The records of the Commission contained much valuable data with respect to general conditions throughout the country. The inspection forces of the Commission were assigned to various congested terminals, particularly throughout the East and Middle West, to investigate and make daily reports of the actual conditions of locomotives and cars and train movements.

These reports showed that a serious condition existed on account of the number of cars in bad order at various terminals and also on account of the general defective and run-down condition of motive power, which, together with overcrowded and inadequate shops and roundhouses, had resulted in trains being held at terminals on account of shortage of efficient motive power. This also seriously slowed up movement on the road, often to the extent of blocking several divisions. The immediate remedy for these conditions was not so much the building of new locomotives and cars as the proper maintenance of locomotives and cars that were in service and more prompt movement of trains.

At a time when the various war industries were clamoring for skilled mechanics at almost any rate of pay, and the supply had been substantially decreased by the selective draft, the problem of improving the condition of locomotives and cars in the midst of exceptionally severe winter weather was an extremely difficult one.

A survey of the situation indicated that shop facilities were sufficient if efficiently used. Therefore, one of the first acts of the Railroad Administration was to nationalize the railroad-shop facilities so that locomotives could be assigned to shops where repairs could be made regardless of ownership.

Prompt handling of locomotives was seriously hampered by the poor condition of roundhouses and the lack of facilities at many points to make running

repairs to large locomotives. Roundhouses built 20 years or more ago for locomotives in service at that time, were still being used to house locomotives more than twice the size of those for which they were designed. Consequently, repairs had to be made out of doors or at open roundhouses with a temperature below zero.

Similar conditions existed in shops at many points for it was found that there had been no improvements made for many years and consequently there were no crane facilities or proper tools with which to handle and make repairs promptly to modern power. This was resulting in locomotives being held out of service an excessive period of time receiving classified repairs. Only two methods of improving the general condition of equipment existed; to increase the shop facilities and forces or to use more efficiently the facilities and forces which were available. Increasing the facilities and forces under war conditions was clearly impossible; this left as the only practical means of improving equipment conditions the adoption of some plan whereby existing facilities and forces could be made to produce greater results. The first step in this direction was to call on the representatives of the organized railroad employees to agree to a modification in certain particulars of their agreements and contracts with the various railroad companies relative to hours of labor, and to agree to modifications, under proper safeguards, of the rules governing the promotion of apprentices and helpers to mechanics. This was agreed to by the employees' organizations and on Feb. 14, 1918, a letter directing the manner in which this should be done was sent to the representatives of the employees and to the various railroad companies by the Director General and immediate steps were taken to increase the shop hours of men working in locomotive repair shops and roundhouses to 70 per week, where the condition of equipment required it.

The average increase in locomotive shop hours for the entire country amounted to about 16 per cent., and the effect became immediately apparent in the increased number of locomotives repaired per week in comparison with the most accurate records available for the corresponding week of the preceding year. This increase in shop hours applied to roads where locomotives were in good condition and shop facilities ample, as well as to roads which were not so favorably situated, and enabled a comprehensive program of nationalization of railroad-shop facilities over the entire country to be carried out. Locomotives from roads where shop facilities were not sufficient and motive power was in bad condition were sent to shops on other lines for repairs. This distribution of locomotives was so arranged as to reduce, in many instances, distance to the repair shops. Therefore the cost of transporting locomotives to the shops was no greater and under this plan all shops were kept working at their maximum capacity with a full force.

The plan of considering the condition of equipment as a whole and taking steps to improve it by uniformly increasing shop hours on all railroads in the country and utilizing to their full capacity the facilities of all shops, which could only be done under Federal control, is really what improved the condition of the locomotives and cars. Not only was the existing congestion of traffic cleared up, but trains were moved by locomotives in good repair, with promptness, and with reasonable assurance that they would reach their destination without delay. The result of the policy of nationalizing railroad-shop facilities made it possible to overhaul and in some cases practically to rebuild at other line shops, 3003 locomotives for railroads which lacked sufficient shop space and shop organization, thus improving the general situation without detriment to the railroads that furnished this help. In addition to this, during the period Jan. 1, 1918, to Apr. 30, 1919, there were 310 new locomotives constructed in various railroad shops under Federal control. See Table I. Investigation was also made of the facilities of the different locomotive builders with a view to having locomotives repaired by them, but it was found that this could not be done to any material extent without disarranging their schedule of new work both on domestic and foreign locomotives. In view of the need for both, this was not considered advisable, although both the Baldwin Locomotive Works and the American Locomotive Co. did endeavor to make use of surplus facilities to repair what locomotives they could without interfering with their output of new locomotives.

TABLE I. NEW LOCOMOTIVES ADDED TO EQUIPMENT JANUARY 1, 1918, TO APRIL 30, 1919

1918	Constructed by Locomotive Builders	Constructed in Railroad Shops	Russian Government	Total
January	103	20	..	123
February	92	21	49	162
March	123	21	93	237
April	135	37	40	212
May	195	26	18	239
June	167	25	..	192
July	174	12	..	186
August	203	14	..	217
September	251	18	..	269
October	265	19	..	284
November	203	20	..	223
December	253	22	..	275
1919				
January	190	17	..	207
February	127	11	..	138
March	231	13	..	244
April	196	14	..	210
Total	2908	310	200	3418

Illustrative of the improvement in motive power and the changed conditions in railroad shops is the fact that it was possible to grant the request of the Baldwin Locomotive Works, made on Sept. 13, 1918, for assistance in machining locomotive frames, driving boxes, rods, etc., to facilitate the construction of locomotives for our Army in France, and this work was continued in railroad shops until the armistice was signed.

TABLE II. CLASSIFICATION OF STANDARDIZED LOCOMOTIVES AND NUMBERS BUILT

Specification	Type	Number
1A	Light Mikado	625
2A	Heavy Mikado	233
3A	Light mountain	40
4A	Heavy mountain	15
5A	Light Pacific	46
6A	Heavy Pacific	20
7	Light Santa Fe	94
8	Heavy Santa Fe	175
9	6-wheeled switcher	255
10	8-wheeled switcher	175
11	Light Mallet	30
12	Heavy Mallet	106
Standard consolidation		30
Total		1,844

NOTE.—In addition to the above, 86 locomotives are on order, but the types of these locomotives have not as yet been decided.

The increased working hours in railroad shops under the instructions issued on Feb. 14, 1918, were continued until after the signing of the armistice, and without this loyal support from the employees the increased number of locomotives repaired during this period and the assistance rendered locomotive builders would not have been possible. After the signing of the armistice shop hours were reduced to nine per day, effective Nov. 25, and to eight per day, effective Dec. 9.

In addition to the vigorous action which had been taken to improve the condition of existing equipment, the necessity of adding to the available stock was recognized and designs were worked out for standardized locomotives and orders placed for their construction.

Specifications were prepared and orders were placed for 1844 locomotives of standardized types, divided as shown in Table II.

These locomotives are provided with every known device for efficient and economical operation. All the road locomotives with the exception of the light Pacifics have mechanical stokers and locomotives not provided with stokers are furnished with coal pushers. All locomotives are equipped with superheaters, brick arches, automatic fire doors, power grate-shakers, power reverse gears, and electric head and cab lights.

This order was divided between the American Locomotive Co., Baldwin Locomotive Works and the Lima Locomotive Corporation. The first locomotive was turned out by the Baldwin Locomotive Works on July 4, 1918, and it is expected that the order will be completed so as to have this entire consignment of locomotives in service early in July, 1919.

TABLE IV. TON-MILES, FREIGHT LOCOMOTIVE AND TRAIN-MILES

1918	Total Revenue Ton Miles	Total Freight Locomotive Miles	Revenue Ton Miles Per Locomotive
January	24,665,552,565	55,442,425	819,181
February	26,591,083,000	55,251,000	865,116
March	31,341,327,931	59,039,387	1,099,927
April	34,250,247,914	62,066,394	1,125,875
May	33,978,650,000	64,983,000	1,085,000
June	34,336,703,000	61,656,000	1,171,000
July	35,979,291,000	62,210,000	1,241,000
August	35,660,217,000	60,970,000	1,263,374
September	35,763,381,000	61,459,000	1,224,360
	Total Ton Miles	Total Train Miles	Total Ton Miles Per Train Mile
October	39,548,562,000	54,843,000	721
November	35,533,026,000	51,293,000	693
December	33,659,507,000	50,402,000	668
1919			
January	30,383,169,000	48,463,000	627
February	25,681,943,000	40,857,000	629
March	28,952,925,000	43,972,000	658

NOTE—The above figures from January to September inclusive were taken from forms originated by the Bureau of Railway Economics.

From October to March inclusive were taken from forms prepared by the Operating Statistics Section of the Division of Operation which gives the data on a slightly different basis.

Reasons for Locomotive Standardization

The locomotives were built from standardized designs for various reasons, the principal of which are as follows:

First—To reduce to a minimum the time required to prepare drawings, patterns and dies, and thus enable deliveries to begin quicker than where separate drawings and patterns would have been necessary for each lot of locomotives allocated to a particular road.

Second—To secure quantity deliveries.

This method of construction has resulted in delivery being made at a quantity rate which could not have been approached had the locomotives been ordered to individual designs.

The increase in the rate at which standardized locomotives can be turned out is clearly shown by the following comparison of two of the principal shops of the American Locomotive Co. during a portion of July and August when the locomotives built were of individual design, with a similar period in September and October when they were building standardized locomotives.

During five weeks, beginning July 20, an average of 13⅓ locomotives per week were turned out at the Dunkirk plant, while during five weeks, beginning September 14, an average of 19½ locomotives per week were turned out at the same plant. For Schenectady, during the five-week period beginning July 20, an average of eight locomotives per week were turned out, while for the corresponding period beginning September 14, an average of 13⅔ locomotives were turned out. It will be seen that the increased production due to the standardized locomotives was about 50 per cent.

Third—It has also provided a supply of equipment, the parts of which are largely interchangeable, which is available for use anywhere in the event of congestion. This removes the necessity of carrying a large stock of repair parts for each locomotive and avoids the delay which results when repair parts must be ordered from a distant owning road.

Standardized Cars

The freight-car situation was handled along the same lines as were the locomotives. After careful consideration, designs were prepared and orders placed for the following cars, about 50 per cent. of which were delivered prior to May 30, 1919: 25,000 single-sheathed box cars of 50 tons capacity; 25,000 self-clearing steel hopper cars of 55 tons capacity; 25,000 double-sheathed box cars of 40 tons capacity; 20,000 composite gondolas, with drop doors, of 50 tons capacity, and 5000 low-side gondolas of 70 tons capacity.

In addition to the designs for freight cars for which orders have been placed, designs have been prepared for all-steel box cars of 50 tons capacity, refrigerator cars of 30 tons capacity, general-service gondola cars of 50 tons capacity, steel-framed stock cars of 40 tons capacity, flat cars of 55 tons capacity, oil tank cars of 7000 gal. capacity, oil tank cars of 8000 gal. capacity, oil tank cars of 10,000 gal. capacity, acid tank cars of 7000 gal. capacity, acid tank cars of 8000 gal. capacity, and acid tank cars of 10,000 gal. capacity. While no cars have actually been built from these drawings, they are available at any time that the traffic needs show them to be desirable.

Plans for All-Steel Cars

Complete plans and specifications of all-steel baggage cars in both 60-ft. and 70-ft. lengths have been prepared, and tentative plans prepared for 70-ft. steel coaches, and for steel passenger and mail, passenger and baggage, passenger, baggage and mail cars.

Under private operation, at many points complete

organizations for the maintenance of a comparatively small number of locomotives or cars were maintained side by side, which resulted in a duplication of work, heating plants and supervising forces. Wherever a saving could be made without adversely affecting efficiency such duplicate facilities were eliminated. Consolidations have been made at 820 points and the annual saving effected thereby amounts to $4,200,000. Additional consolidations are under way and will be made as fast as complete investigations and necessary minor changes can be completed.

In connection with this work extensive investigations were conducted covering shop and engine-house operation, resulting in changes and improvements which have materially increased the output. It was also possible by rearranging the method of handling work in engine houses, to release hundreds of employees who were sorely needed in other departments, and the saving effected in engine-house operation by such reduction in force, while not obtainable for all railroads, on one railroad alone amounted to $15,000,000 per annum.

It was also possible by rearranging methods of handling locomotives at terminals to secure greater efficiency from such locomotives and thus overcome what otherwise would have been a shortage in motive power. For example, on one railroad an appeal was made for an additional assignment of 25 Mallet locomotives, but by changing the method of handling work at the important terminals on that line the delay to locomotives at such terminals was reduced to a minimum, and by thus increasing the efficiency of the locomotives in service, it was found that it would not be necessary to build and furnish the additional 25 Mallet locomotives, valued at $2,145,400. Instead of this they were able to release for service on other lines nine Mallet locomotives, valued at $772,344.

Improvement in Condition of Locomotives Under Federal Control

The condition of motive power on all lines under Federal control has shown a gradual improvement, and the locomotives in service are in much better condition than they were 18 months ago. On some lines that last spring required extensive assistance from other line shops, the condition of power has shown such a marked improvement that they are now doing all of their own repair work, and in addition are repairing locomotives for other lines.

The tabulations furnished by the railroads show an average increase of 20.93 per cent. each week in the number of locomotives receiving classified repairs during the period of increased shop hours.

Table II. shows the number of locomotives in actual service and the number stored which have been repaired and made ready for service.

The locomotives in the column headed "Number Repaired and in Storage Ready for Service," are being held in reserve and are available for service with any increase in business beyond the capacity of the locomotives now being used. With this stored power, together with the deliveries which are yet to be made by the builders, there is no doubt that all lines under Federal control will have a sufficient number of locomotives in serviceable condition to handle all business offered.

Tables IV and V are included to illustrate the changes in the condition of the rolling stock as indicated by the miles traveled and loads carried. Comment is hardly necessary, as the figures speak for themselves.

TABLE V. LOCOMOTIVE FREIGHT TRAIN AND FREIGHT CAR PERFORMANCE

1918	Average Miles Per Freight Car Per Day	Average Miles Per Locomotive Per Day	Tons Per Loaded Freight Car Mile	Tons Per Freight Train Mile
January	18.3	59.4	29.6	577
February	23.9	65.8	28.8	625
March	24.9	66.8	28.1	673
April	25.9	68.0	29.4	696
May	26.4	67.0	27.6	663
June	26.8	64.9	28.3	698
July	26.5	64.2	30.1	723
August	26.0	64.6	30.1	729
September	26.8	65.0	29.7	728
October	26.2	*	29.7	721
November	24.6	*	29.5	693
December	22.8	*	29.8	668
1919				
Janury	21.4	*	29.0	627
February	20.3	*	27.7	629
March	20.4	*	27.6	658

NOTE.—The decrease in average miles per freight car per day is due to the large surplus of freight cars which are in storage because of decrease in traffic. *Information not available.

Obsolete Machinery Replaced

As previously stated, many shops and roundhouses were found to be obsolete. In order to overcome this condition extensive improvements, including the replacement of obsolete machinery and tools with those of a more modern design, have been started and are now under way on many lines of railroads, and when these are completed, shops and roundhouses on those lines will be in condition to take care of the most modern power with efficiency. These improved facilities should make it possible to prevent power from ever again getting in the condition it was at the time the Government assumed control.

TABLE III. LOCOMOTIVES IN SERVICE AND IN STORAGE

Month—1918	Number In Actual Service	Number Repaired and in Storage Ready for Service
January	49,204	379
February	49,700	323
March	49,361	382
April	49,688	386
May	50,199	397
June	51,236	450
July	52,969	798
August	53,398	708
September	53,774	994
October	53,874	901
November	53,050	1021
December	53,280	1167
Month—1919		
January	53,113	1582
February	52,704	3009
March	52,717	4043
April	52,598	4604
May	52,809	4477

How Would You Prevent Oil from Discoloring Finished Surfaces?

By C. P. Bloomer

Regarding your query on page 802 let me suggest a liberal use of kerosene oil once a week as a preventive. Saturday is a good day to apply it, as the machines are idle over Sunday and if the kerosene is "sloshed" on the sides, etc., and through the various plain bearings, you will have little bearing trouble or discoloration. The kerosene smell is mostly gone by Monday morning. To remove the discoloration already present use a little wood alcohol on waste.



THE WAR
and the
MACHINE TOOL INDUSTRY

By
Fred H. Colvin,
PRINCIPAL ASSOCIATE EDITOR, AMERICAN MACHINIST

The distribution of the machine-building capacity of the country has been more or less disputed. This shows for the first time accurate data as to just what each section was doing at three periods; before the great war, at the time of our entry into the struggle and at the close. The map shows this graphically and gives Ohio first place, with Cincinnati almost as large as the second state, Connecticut. If the shops across the river in Kentucky were included, it would put Cincinnati in the lead.

NOW that the abnormal demand for machine tools due to war needs has subsided, it is not only interesting but also profitable to survey the field and see exactly what has happened during the last four and a half years. Previous to the war there were about 300 concerns in this country making metal-working machinery. These concerns employed about 30,000 people and had an output of approximately $50,000,000 per year. It is estimated that in the machine-tool plants previous to the war about 30 per cent. of the product was built for export.

The year 1914 had seen a distinct depression in the metal-working trades and it was not until the late fall that the demand from Europe, as well as from concerns in this country having European contracts, began to be felt. During the next two years the great majority of the machine tools built were either for the manufacture of munitions by the Allies or for the manufacture of munitions in this country for them. A number of new firms entered the machine-tool field, for the most part confining their activities to the manufacture of special machinery or the copying of simple standard machines. According to the statistics of the Machine-Tool Section of the War Industries Board, however, the number of new firms going into the machine-building business after our entry into the war was not as great as many have supposed. The increase from July, 1914, to April, 1917 was considerable; from 310 to 367 or nearly 20 per cent.

Machine-tool builders and users generally are familiar with the activities before the formation of the Machine-Tool Section just referred to, and nearly all have had occasion to become acquainted with its workings from securing its assistance in procuring material and needed machinery, as well as in assisting the compilation of statistics by making weekly and monthly reports. This information included an inventory of all the available machine tools, not omitting those which were held on the docks at various ports for shipment; this amounting to approximately $10,000,000. Coupled with the data as to the possibilities of manufacture, this information made it possible to advise the various Governmental departments as to the placing of orders for machine equipment for various contracts.

Figs. 1, 2, 3 and 4, and the tables give an interesting resume of the data as to cause of delay, distribution of products, and equipment purchased through the purchasing commissions for the various governments. The figures are for the month of October, 1918, when production was at its height.

This taking of machines from the docks required well-balanced judgment to avoid the antagonizing of foreign governments, and most of all, to prevent disturbing manufacturing capacities in this country. If, for example, certain machines could be secured direct from the builder it was better to do so than to take machines from the dock and so perhaps cause the builder to close his shop or disturb his organization. On the other hand, machines like cylinder grinders and those needed for toolroom work, were taken at once to enable Ford and others to get started on Liberty motor work, as the builders could not supply them.

In order to keep advised in regard to the condition of the industry a monthly questionnaire was sent to each firm. The data given indicated the condition of each plant and if falling behind in production indicated the cause, and knowing this, it was often possible to help rectify the trouble. This data also indicated from its percentage of war work, etc., to what priority it was entitled to in the way of securing transportation privi-

leges, fuel, materials, labor, etc., and was kept for ready reference for use of the various departments.

It is interesting to learn that only 9.2 per cent. of the employees were working more than 10 hr. a day in May, while in October 61 per cent. exceeded the 10-hr. limit. The comparison between the standard working day and the actual working day is computed as follows: The standard day is the number of hours for which straight time is paid. The actual day is the total number of working hours including those for which overtime is paid. It is also well to note that

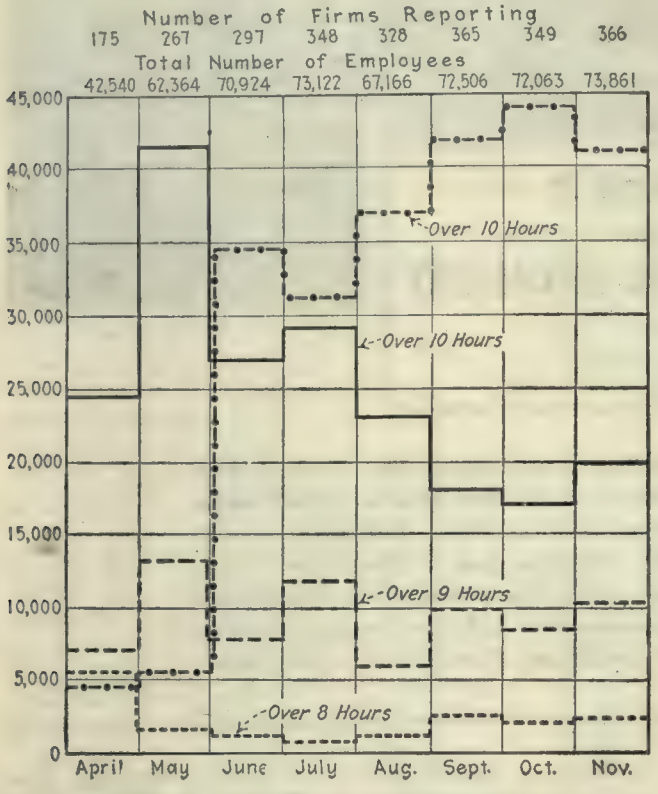


FIG. 1. LENGTH OF WORKING DAY

TABLE I. CAUSES OF DELAY IN FILLING SCHEDULE

	May, 1918	Oct., 1918
Firms reporting	257—100%	345—100%
Firms reporting delays	71—27.6%	223—65%
Firms reporting no delays	186—72.3%	132—35%
Firms reporting labor troubles	31—12%	6—1.7%
Firms reporting labor shortage	132—51.4%	187—54.2%
Firms reporting shortage of material	75—29.2%	92—26.6%
Firms reporting shortage of fuel	13—5.0%	4—1.2%
Firms reporting shortage of transportation	38—14.8%	21—6.1%
Firms reporting shortage of cars	27—10.5%	8—2.3%
Firms reporting Government delay	14—5.6%	19—5.5%

while labor shortage had increased from 51 per cent. in May to 54 per cent. in October, the number of cases of labor troubles had decreased from 12 per cent. in May to less than 2 per cent. in October. This may have been partly due to the work or fight legislation.

TABLE II. DISTRIBUTION OF PRODUCT

	Number of Employees	
U. S. Government	41,721—68%	58,643—82%
Allied	10,396—17%	7,086—9%
Miscellaneous	7,732—12.6%	5,284—8%
Stock	1,495—2.4%	890—1%
Total	560,985—100%	71,903—100%
Firms reporting source of orders	231—60,985 Emp.	350—71,903 Emp.

The purchase of machine tools by our Allies was made through the purchasing commission, and where these purchases were made through a loan to the government desiring the tools, negotiations were in many cases made by the Machine-Tool Section with the manufacturer of the machine desired. In all such cases the price paid was subject to approval by the Machine-Tool Section, as we had agreed to purchase machine tools for our Allies at the same price we paid for them. In most cases, however, they were permitted to place their orders as they pleased, subject, of course, to the approval of the Machine-Tool Section of the War Industries Board.

During the year ending Sept. 1, 1918, the purchases through the purchasing commission were as follows:

For the French government	$2,970,435.00
For the British government	7,636,086.00
For the Italian government	1,764,302.00
For the Belgian government	26,126.00
For the Russian government	61,186.00

The total exports of machine tools to the allied countries from February until October, 1918, follow: Based

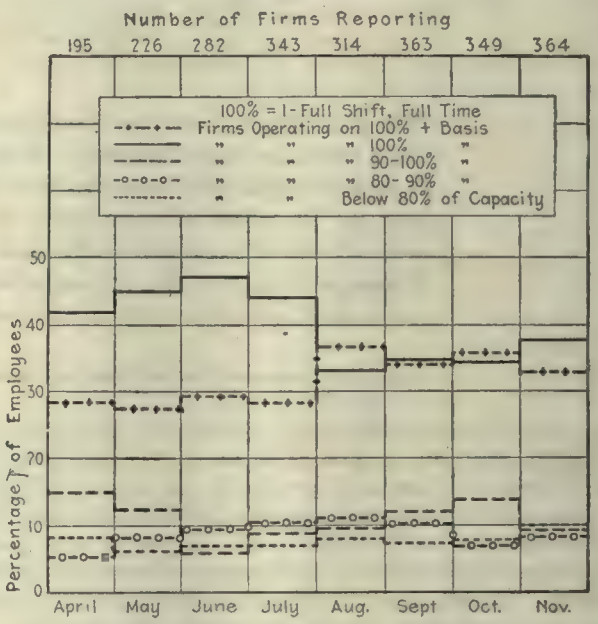


FIG. 2. FULL TIME AND OVERTIME

on these figures, the total annual export for 12 months would amount to approximately 83,000 tons, having a total value of $50,000,000:

	Weight in Pounds	Value
France	33,685,109	$10,624,923.00
Italy	7,678,343	2,179,026.00
Portugal	32,596	13,621.00
England	28,584,630	11,137,697.00
Japan	17,268,365	3,398,277.00
Russia	31,020	9,831.00
All other countries	31,934,893	7,679,996.00

During the month of July, a survey was made of the material likely to be required by the machine-tool industry for the six months ending Dec. 31, as this would also serve as a guide for future requirements had the war lasted. Table III has been compiled as showing the material which would be required by the machine-tool industry and the manufacturers of metal-

TABLE III. REQUIREMENTS OF MACHINE-TOOL INDUSTRY

Average demand of power from central stations	292,892 kw.
Coal required for heat and power (not including central stations)	802,629 tons
Iron castings required (50% scrap)	917,366 tons
Pig iron	489,683 tons
Foundry coke	351,650 tons
Steel forgings	43,392 tons
Screw stock	44,210 tons
Black stock	91,567 tons
Ground stock	5,778 tons
Carbon tool steel	10,542 tons
High-speed tool steel	2,083 tons
Steel castings	57,429 tons
Bronze castings	10,720 tons

working machinery for a period from July, 1918, to July, 1919.

According to the statistics which were secured, there were 310 firms engaged in the production of metal-working machinery in the United States in July, 1914. These employed 30,082 people and had an annual output of approximately $50,000,000.

In April, 1917, the number of firms had increased to 367 and the number of employees to 67,229. In October,

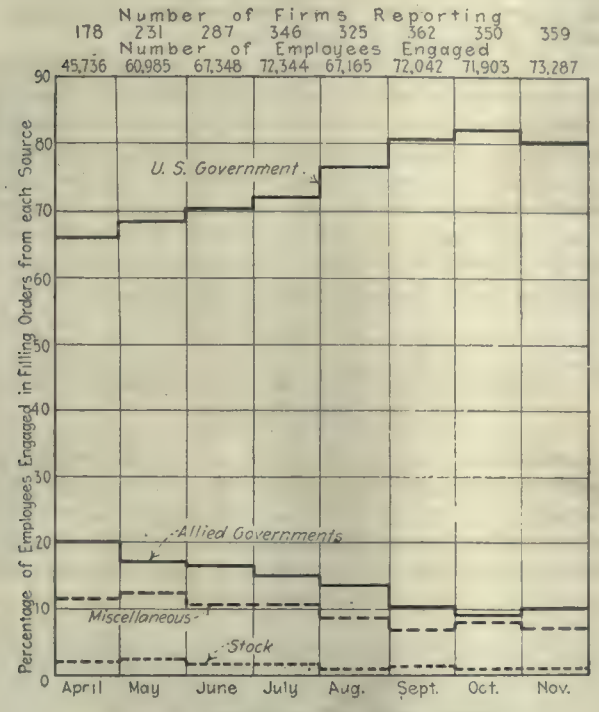


FIG. 3. NUMBER OF EMPLOYEES

1918, the number of plants was 378 and the number of employees, 77,154.

These figures do not in most cases include those plants which made only a few tools on contract for the regular manufacturers, nor those who engaged temporarily in the production of metal-working machinery but who have since gone into other lines of work. It is believed, however, that had firms of this kind been included it would not have increased the total by more than 5 per cent. in either case.

It is extremely interesting to learn that, according to all records, the industry had been sufficiently expanded so that, when hostilities ceased, it had a yearly capacity of turning out 1,000,000 tons of metal-working machinery with an estimated value of $500,000,000. In contrast with this, we are informed that the German Empire during 1917 is supposed to have produced $200,000,000 worth of metal-working machinery, while the British output is given at $50,000,000.

Table IV gives an idea of the distribution and location of the metal-working plants by states and also the number of men employed in each. This gives a good idea of the distribution of the machine-building industry and leaves no doubt as to the predominance of Ohio in this line, as it shows more than any other two

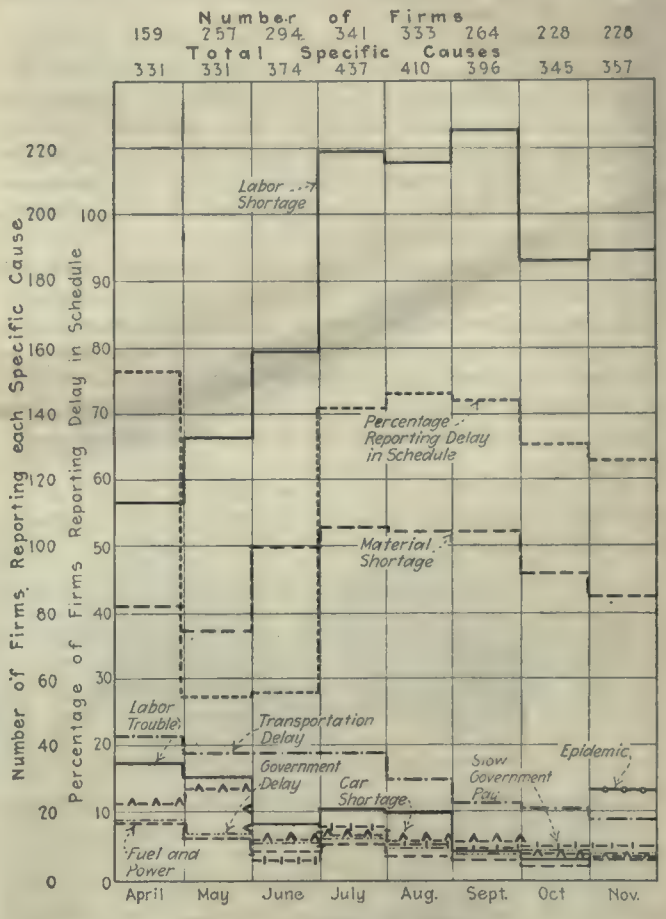


FIG. 4. CAUSES OF DELAY

states combined. According to its size and population, however, Rhode Island holds the palm, with a total of 6382 employees. The map shows distribution by cities.

The accompanying map in the form of a double page insert, however, gives a good idea of the distribution of both the firms and the men in all the states where metal-working machinery is of sufficient size to warrant it being noted.

TABLE IV. METAL-WORKING MACHINERY MADE IN U. S.

	July, 1914	April, 1917	Oct., 1918
No. of firms	310	367	378
No. of employees	30,082	67,299	77,154
Yearly value of product	$50,000,000	.....	$500,000,000
No. of Employees by States:			
California	0	25	30
Connecticut	3,425	7,897	9,363
Delaware	221	318	328
Illinois	1,564	3,680	4,201
Indiana	450	1,940	2,145
Iowa	68	273	448
Kentucky	191	417	585
Maine	250	450	405
Maryland	200	200	210
Massachusetts	2,865	7,192	8,111
Michigan	593	1,737	2,065
Missouri	58	115	140
New Hampshire	117	254	222
New Jersey	1,017	2,206	2,488
New York	3,430	5,897	6,880
Ohio	7,855	19,048	20,895
Pennsylvania	3,212	6,202	6,467
Rhode Island	2,698	4,354	6,382
Tennessee	5	10	15
Vermont	893	2,315	2,276
Virginia	20	40	155
Wisconsin	950	2,729	3,363
	30,082	67,299	77,174

How to Prevent a Grinding Trouble

By Richard J. Jacker

On page 705 of *American Machinist*, John Vernon wants to know how to grind one side of a ¼-in. cold-rolled steel plate 2½ in. wide and 12 in. long without having it warp. I would suggest grinding both sides of the plate before riveting on the cast-iron bracket, and then grinding the side opposite to the desired finish.

A Course in Industrial Engineering

By F. A. Hobart

Instructor of Machine Shop Practice and Management, University of Illinois

The need for men who have had specific training in Industrial engineering, which is purely an arbitrary title, has been long felt. At the present time some of the leading universities are offering pioneer courses in scientific management and its allied branches. These courses are offered, as a rule, in connection with the regular commercial or business courses and have an affiliation with the engineering departments in so far as the fundamental general engineering and shop courses are concerned.

At the present time, however, the teaching of industrial engineering is largely of an experimental nature. The courses as outlined in the curricula are liable to be more attractive and flattering than efficient but the general aim is to produce graduates who will be able to apply the fundamental principles of scientific management and to obtain maximum production in a manner peculiar to the shop in question.

It is an accepted fact that the true industrial engineer must understand, primarily, methods, material, markets and men, as they apply directly to manufacturing problems. The student who contemplates following the profession of a manufacturing expert must possess, as part of his natural equipment of initiative and practical ability, a fair working knowledge of the four factors mentioned above.

Let us, therefore, analyze two plans of teaching industrial engineering now in use, and for comparison consider a third plan.

(A) A Lecture Course Without Shop Practice

This plan is of use to institutions without shops in which to give practical demonstrations of the principles of shop management and which are not fortunate in having the available funds necessary to do otherwise.

(B) A Course of Intensified Shop Practice

In this plan the shops of the institution are organized according to the principles of efficient management. A standard machine is designed and manufactured for the purpose of giving its readers actual shop practice and demonstrations in the principles of management involved. This work is supplemented by related lectures. To assure each member of the class actual contact with the various managerial duties the class is divided into groups. These groups are assigned to certain divisions of the work so that each student will cover every detail of the office and shop routine employed in manufacturing the machine. Inasmuch as over 80 per cent. of freshmen students know little or nothing of modern manufacturing methods the practicability of this procedure is obvious.

(C) A Demonstrative Course

This plan attempts to acquaint the students with a general knowledge of practical shop work and the functions of shop management. The course includes a semester of elementary shop practice together with lectures pertaining to the same, and a semester of advanced shop practice and the manufacturing of a standard machine, with preliminary lectures on shop management. These courses are prerequisites to a third course on the application of the principles of scientific management.

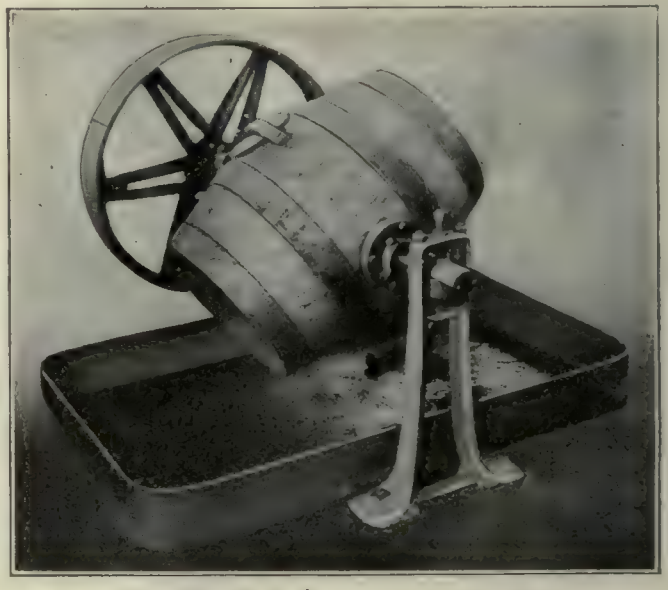
This method permits instruction in the care and operation of machine tools and in preparing the sequence of operations to be followed in working out assigned problems. It also allows a better understanding of instruction cards. This seems to be the logical procedure to follow. The manufacturing of a standard machine is done by the students of the first two courses under the supervision of students of the third who have advanced from the shops to engineering duties in managerial capacities. It can be readily seen that a course of this kind covers the work in as thorough a manner as is possible in educational institutions.

In teaching industrial engineering according to plan (B) it seems that shop practice is necessarily presented for production purposes alone without any relation to allied subjects such as general engineering and applied mechanics. In other words, the work is quite similar to that of trade schools. All the objectionable features of plans (A) and (B) are removed in (C) as the work may be presented in such a manner as to be directly correlated with regular engineering subjects.

A Cheap and Efficient Tumbling Barrel

By John Drew

A tumbling barrel, all parts of which except the central feature may be found in any machine shop, is shown in the cut. A pair of shaft hangers, two flange castings, two short pieces of shafting and a suitable pulley being the principal requirements. The barrel itself, while not exactly indigenous to the machine shop, will, after July 1, probably be a drug on the market.



A HOME-MADE TUMBLING BARREL

The construction is clearly shown by the picture. The floor pan, which is a necessity if the tumbling is to be done wet, may be soldered up from sheet metal if a cast-iron pan is not available as in this case, while if the tumbling is dry the pan may be omitted altogether. The opening in the side of the barrel will of course depend upon the nature of the material to be handled. In this one a swinging strap is attached by a bolt and hasp to the barrel, and a round cover fitted with a rubber gasket is held to the opening by a setscrew.

Making Water-Gage Fittings in a Railroad Shop

By FRANK A. STANLEY

This article covers sets of tools for turning, boring, facing, threading and otherwise machining various parts entering into the construction of gage cocks and fittings. The tools are all used on the brass lathe, are of a practical character, and may be of value on similar kinds of work.

THE halftone and line engravings illustrate complete sets of brass lathe tools made and used at the Sacramento, Calif., shops of the Southern Pacific Co. for turning out water-gage cocks for all classes of locomotive boilers. These tools, like other equipment made specially for various classes of brass fittings, have effected an important saving compared with results obtained with earlier apparatus, and it is believed that details of the several tool outfits herein described will be of value to readers engaged in similar lines of shop work.

Figs. 1, 2 and 3 illustrate the various tools used for finishing the fittings for the water gage in Fig. 4. As the top and bottom fittings here shown are alike, except for the pipe connection at the bottom of the latter, only one of the fittings is included in the group of parts and tools in Fig. 1. The one shown is for holding the lower gage-glass stem and is seen at *A*, Fig. 1.

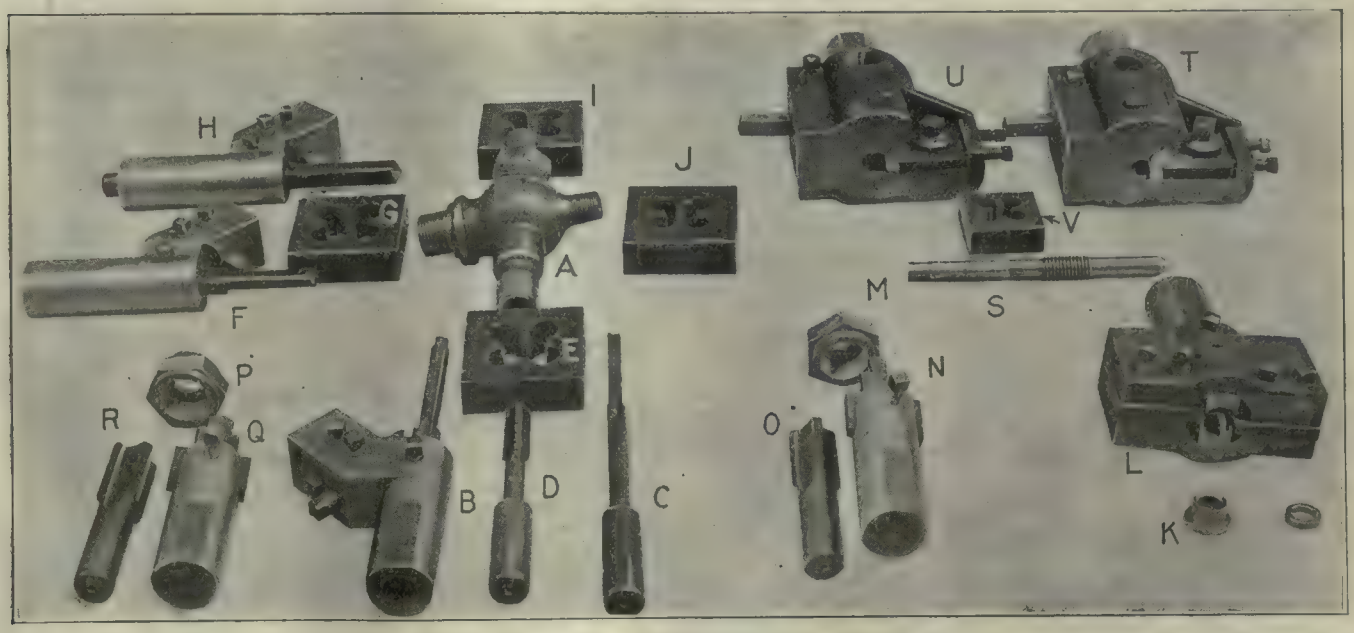


FIG. 1. GROUP OF TOOLS FOR GAGE FITTINGS

The tools for finishing the upper and lower valve seats and valve-packing nipple are represented at *B*, *C* and *D*, Figs. 1 and 2. The combination box tool and drill at *B* starts the $\frac{3}{8}$-in. hole for the passage under the valve seat, drills the $\frac{1}{2}$-in. hole for the valve stem, drills the $\frac{3}{4}$-in. hole in the nipple for the reception of the packing gland, turns the outside of that nipple to $1\frac{1}{8}$-in. diameter for the threading for the valve-seat packing cap and finishes and rounds over the end of the nipple, all at one operation. The drill carried in the tool *B* has three diameters, the shoulder from the outer or $\frac{3}{8}$-in. diameter to the $\frac{1}{2}$-in. portion being carried upon a radius of $\frac{1}{4}$ in. to rough out the seat in the valve for the spherical end of the valve stem which, as seen in Fig. 4, is finished to a semicircle of $\frac{1}{2}$-in. diameter. This seat in the valve and the $\frac{3}{8}$-in. hole forming the passage through the end of the same nipple are finished by means of the tool *C*, Figs. 1 and 2, which is guided by its $\frac{1}{2}$-in. body in the valve-stem hole drilled by the first tool *B*, and thus used for putting the $\frac{3}{8}$-in. hole clear through the outer nipple and at the same time finishing the $\frac{1}{2}$-in. seat for the valve. The tap *D* is then run in to tap the stem hole.

The turning cutter in the box tool *B*, Fig. 1, has already been referred to as sizing the outside of the valve-packing nipple for the threading for the packing cap. The surface thus turned is threaded with a $1\frac{1}{8}$-in. by 14-thread die *E*, Fig. 1.

The box tool at *F*, Figs. 1 and 2, is for finishing the nipple for holding the lower gage glass, and its work consists of drilling out the $\frac{1}{2}$-in. passage through the nipple into the valve chamber, enlarging the outer end of the hole to $\frac{11}{16}$ in. for a depth of $\frac{1}{2}$ in. to receive the end of the gage glass, turning the outside of the nipple to $1\frac{3}{16}$ in. for the threading for the packing nut and facing off the end of the nipple.

The arrangement of the tools in the box holder *F*,

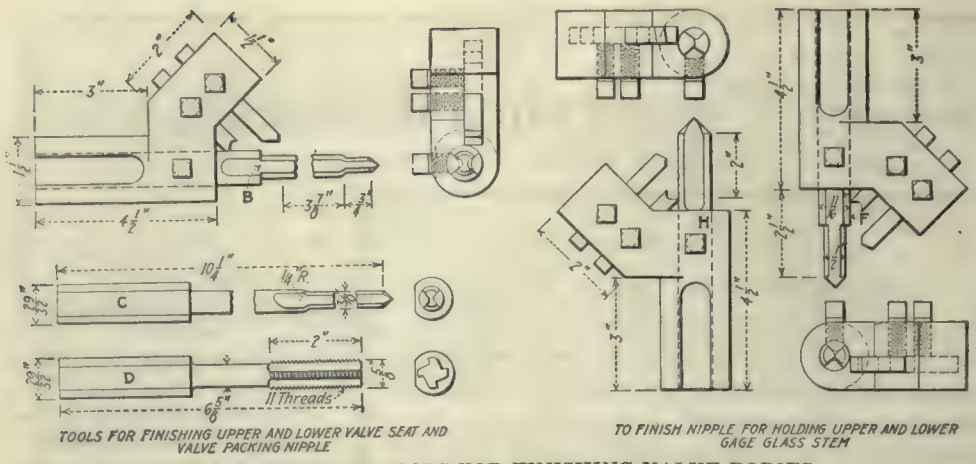


FIG. 2. DETAILS OF TOOLS FOR FINISHING VALVE BODIES

Figs. 1 and 2, is similar to that at *B* already described. As in that instance, the inserted cutters are so placed as to admit of ready adjustment for the desired diameter.

The nipple body sized by the tool at *F* is threaded with the die at *G* to $1\frac{3}{16}$ by 12 threads per inch.

A similar type of tool is used for the corresponding nipple of the other fitting for the upper gage-glass stem, this tool being included at *H* to show one modification in the drill, which is in this case a straight $\frac{11}{16}$-in. tool to put a straight hole of that size in the upper fitting, as shown in Fig. 4. The thread on the outside of the fitting is also $1\frac{3}{16}$ in. by 12, and so the same die *G* is used as for the corresponding thread on the lower gage-glass nipple.

On both lower and upper gage-cock bodies there is a taper-threaded nipple measuring 1 in. outside diameter at the small end and having a taper of $1\frac{1}{2}$ in. per foot. This thread is cut with the die *I*, Fig. 1.

The lower gage cock has also a nipple at the bottom for a standard $\frac{1}{2}$-in. pipe connection, 14 threads per inch, which is run on with the die *J*.

The packing gland for the valve is shown at *K*, Figs. 1 and 4. It is $\frac{3}{4}$ in. in diameter in the body, $\frac{5}{8}$ in. long over all, and has a flange 1 in. in diameter by $\frac{1}{8}$ in. wide. It is machined by the turret tool *L*, Figs. 1 and 3. The two inserted cutters in this box tool turn the body to size and face the end and the under side of the flange or head. The work as turned to diameter runs in the open, case-hardened guide *a*, Fig. 3, which is cut away at the sides, leaving bearing surfaces $\frac{3}{8}$ in. wide at opposite sides, as indicated in the drawing. The interior of the gland is bored out to $\frac{1}{2}$ in. in diameter by the flat drill or reamer *b* whose shank is secured in the box tool. The same tool *b* also forms out the bevel countersink in the mouth of the gland to the desired angle. The valve-seat packing cap *M* Figs. 1 and 4, is bored out and threaded to $1\frac{1}{8}$ by 14 threads for a depth of $\frac{3}{4}$ in., the closed end of the cap being bored to $\frac{1}{2}$ in. for the admission of the valve stem. The tool for boring for both sizes from one end of the cap is shown at *N*, Figs. 1 and 3. The reamer diameter for the tapping size is given as $1\frac{3}{4}$ in. to be followed by the $1\frac{1}{8}$-in. tap *O*. The reamer or flat cutter also faces off the open end of the cap and thus brings it to length. A similar tool is used for the gage-stem packing cap *P* which has an internal thread $1\frac{3}{16}$ in. by 12 threads per inch, and a hole for clearing the gage glass $1\frac{1}{16}$ in. in diameter through the bottom of the cap. The reamer or boring cutter is represented at *Q* and the tap for the internal thread at *R*.

Valve-Stem Tools

The valve stem, like all other parts described, is of brass, and it is shown in place in Fig. 4 at *S*. For the greater portion of its length it is $\frac{1}{2}$ in. in diameter, but near the middle there is a portion $1\frac{1}{4}$ in. long which is $\frac{5}{8}$ in. threaded 11 per inch. This stem is also shown in Fig. 1, where it is seen at *S*. This view also shows the round end, which has a radius of $\frac{1}{4}$ inch.

The valve stem is machined in two operations from opposite ends by the box tools *T* and *U*, Figs. 1 and 3. The first of these turns the long plain end, while at the same cut an inserted tool near the rear of the box reduces the end of the stem to a diameter of $\frac{3}{8}$ in. for the fit in the hand knob.

When the work is reversed and the second tool *U* applied the other end is turned to size and the enlarged central portion turned for threading. At the same time the rounded end is finished to the radius required by the formed tool inserted at the rear of box *U*. The character of the turning and end-forming cutters in both box tools is shown by the drawing. The threading

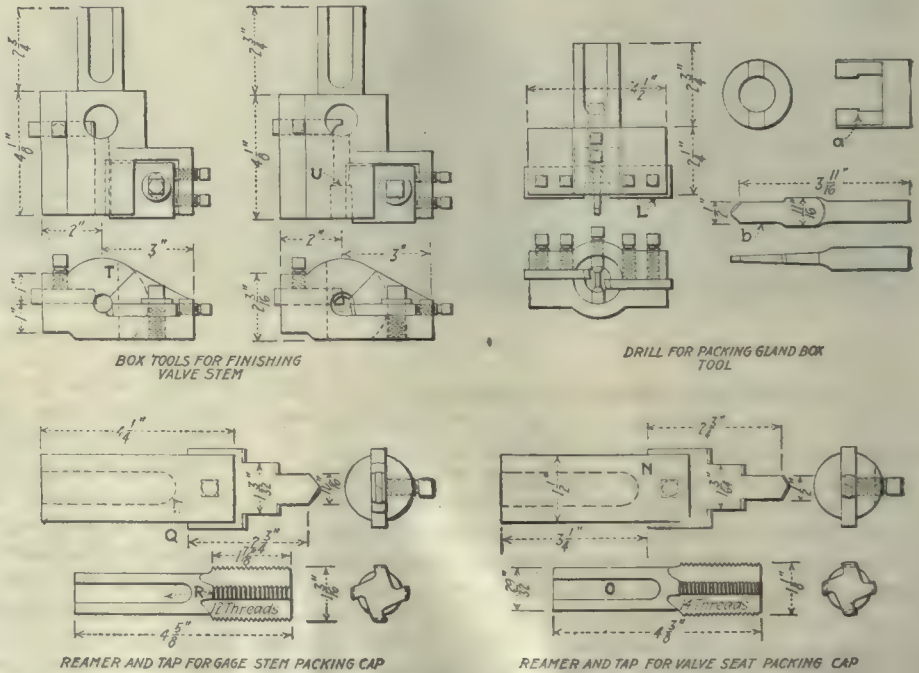
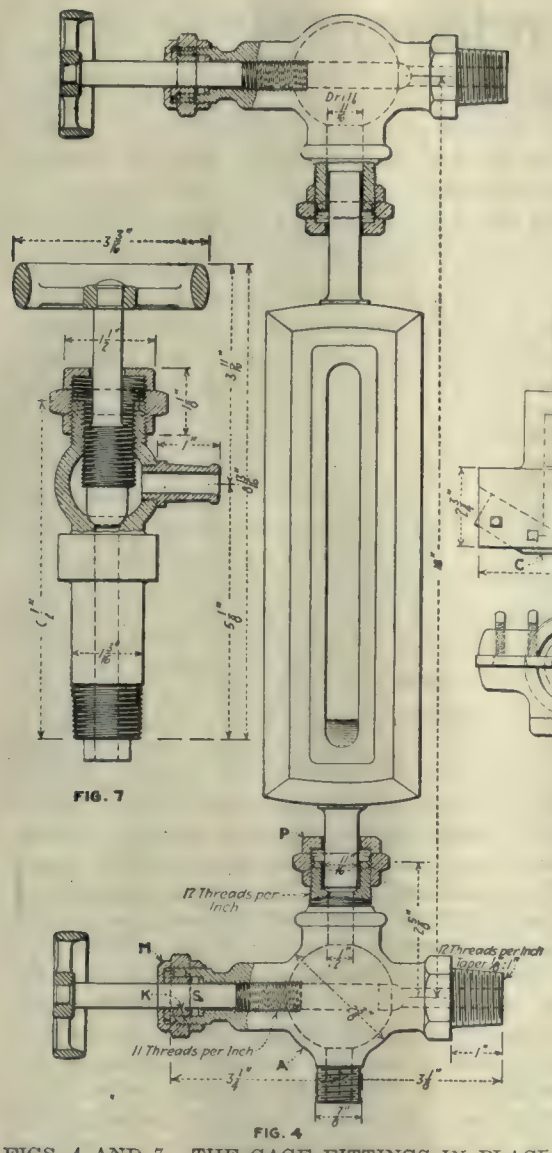


FIG. 3. DETAILS OF TOOLS FOR FINISHING FITTINGS



FIGS. 4 AND 7. THE GAGE FITTINGS IN PLACE AND THE ASSEMBLY OF GAGE

of the body of the valve stem is accomplished by the die *V*.

Figs. 5 and 6 should be of interest here, as they show another set of tools for a somewhat different style of gage cock in which a shorter valve stem is used and one with much larger thread and valve end. Details of the parts of this cock are given in Fig. 7. The stem is only 4⅛ in. long over all, while the threaded portion is ⅞ in. in diameter and the round end $\frac{11}{16}$ in. in diameter with a radius of $\frac{9}{16}$ inch.

The gage-cock body is shown at *A*, Fig. 5. At *B*, Figs. 5 and 6, is the tool for turning the end for threading and for boring the valve-stem opening. The tap for threading the hole to receive the threaded portion of the valve stem is shown in the line drawing at *C*, Fig. 6.

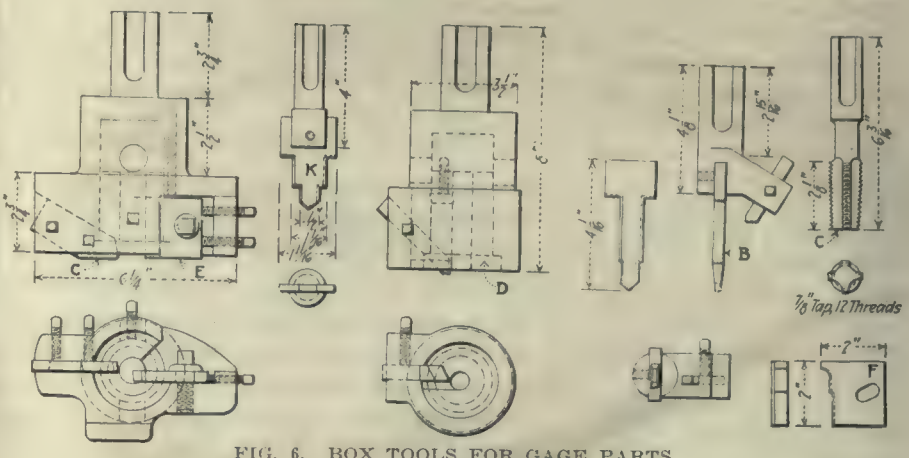


FIG. 6. BOX TOOLS FOR GAGE PARTS

The box tool for turning the long, plain end of the stem is shown at *D*, Figs. 5 and 6. This carries a guide bushing with a ½-in. hole and a tool at the outer end for turning the stem size as well as a tool at the rear of the guide bushing for reducing the end of the stem to ⅜ in. for the fit in the hand knob.

The Turning Tool

The box tool *E* is for the larger end and turns the body size for threading to ⅞ in. at the same cut, forming the spherical end for the valve to a radius of $\frac{9}{16}$ in. The turning tool for this cut is shown at *F* and is a formed cutter which establishes the two diameters referred to, being preceded in its cut along the large diameter by the opposite tool *G* in the holder which is placed at the usual angle to permit of adjustment.

The dies for the stem and for the pipe connection are at *H* and *I* respectively.

The finishing of the gland cap *J* consists in boring out to $1\frac{1}{16}$ in. for the tapping size and boring the closed end to ½ in. with the flat cutter *K*, then following with the tap *L*.

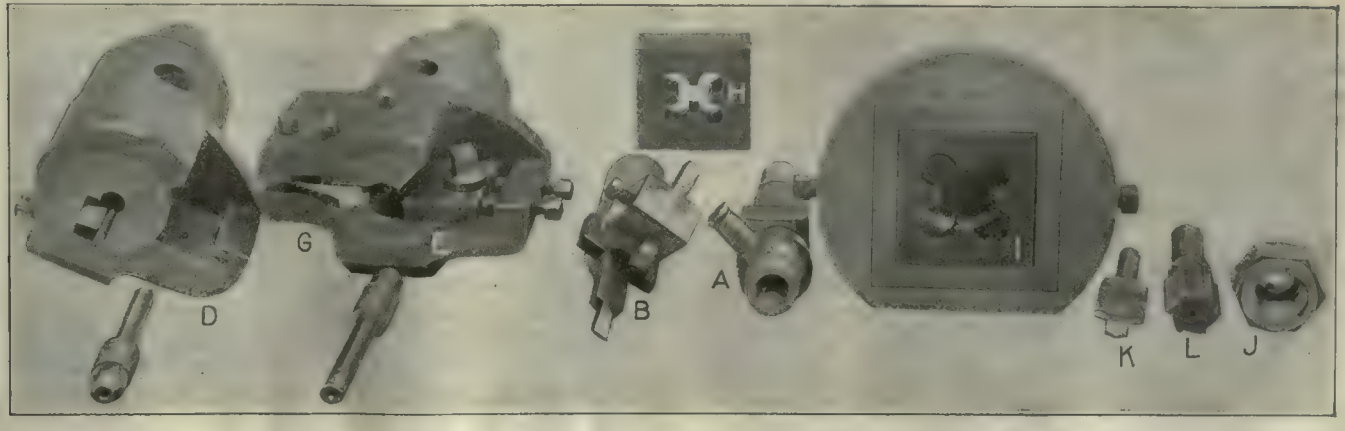


FIG. 5. ANOTHER GROUP OF GAGE-FITTING TOOLS

The Riddle of Dependency—I

By CHESLA C. SHERLOCK

ONCE a workman is injured and it is determined that the employer is liable for the payment of compensation under the workmen's compensation acts, a multitude of legal questions arise, or may arise, which in no small degree affect the employer's liability.

We have found in previous discussions that the payment of compensation to an injured workman, once it becomes due, is a comparatively simple matter. But if the workman dies as a result of his injuries, or is killed outright by the accident, then a whole mass of situations may grow out of the death, all of which are alive with a complexity of questions affecting the employer in his legal liability.

It is not proposed to make the question of dependency appear in an unnatural and distorted light, but it does involve many problems which, if not solved properly, may cause the employer no end of trouble and loss. Therefore the matter is here discussed fully in order that employers may have complete general information upon the subject.

As we have already noted, the primary purpose of the workmen's compensation acts was to cause industry to share a workman's loss with him in case of accidental injury. It is in no sense the purpose of the compensation acts to provide damages or indemnity. A workman who is protected by a compensation insurance policy, whether that policy be issued by the state or by private companies, is not justified in assuming that he is protected to the extent that a life insurance policy would afford protection, or that his dependents are in the relation of beneficiaries under that policy.

There is no such term as "beneficiary" under the workmen's compensation acts, but we do have a term which may be said loosely to correspond to it and that term is "dependency." But there is a vast difference between the two, and it is because so many people hold to the opinion that the two are the same that such a thorough understanding of the compensation principle of dependency is necessary.

No employer insures the life of a workman when he pays the premium on his compensation policy. Nor does the claim which the injured workman had under that policy for loss of earnings accrue to his estate upon his death, unless it can be proved that there was a dependency resting upon the deceased in favor of some other person, conforming to the law. If such a dependency exists, then the liability of the employer will extend to such person, even though the workman may himself be dead and the law makes references to the employer's liability in a way which infers that the liability ends at death. This is true, but the survival value of the workman's claim after death rests entirely upon the question of dependency. Hence, an employer is in a very difficult situation in many cases, especially when he has no way of knowing the facts in the case or the law upon such facts as he does know.

As a rule, the statutes are very careful to enumerate just what persons may be deemed to have been dependent upon a deceased workman, but they have been very lax in establishing a standard of dependency, so that it can be said that while there is such a thing as dependency under the acts, there is no fixed standard of dependency. The matter has largely been the result of the growth of judicial decisions touching upon the question from cases actually arising. Even then, there can be no doubt but that actual fraud has been practiced upon the American employers time and again, because of this lack of a fixed standard. This is particularly true in cases where the alleged dependents were not living with the deceased at the time of his injury, or were aliens living in a foreign country.

The writer has seen numerous cases of this nature which will be explained later. It is only necessary to point out at this time that there is every reason for employers to be cautious in such instances. The mere fact that the alleged dependents were not living with the deceased at the time of his injury and death, should be sufficient to put the average employer upon his guard.

The real question in the first instance is to determine what dependency is. Most of the acts define it, or attempt to define it. If the state law under which the employer is operating defines dependency, it will of course be necessary for the employer to follow the interpretation placed upon the subject. While these statutory definitions vary more or less in wording, they are in their essential principles identical.

What Constitutes Dependency

How much must a workman contribute to the support of some one to make that person a dependent under the law? How often must payments be made? Must they be made regularly? There are dangers for both workmen and employers from a misunderstanding or ignorance of the laws and their interpretation, which might well be avoided by a little study of the subject.

Courts Agree on Definitions

If the employer cares to take the time to examine the decisions of the courts, he will find that they have quite generally sifted the matter down to a common basis, but that, while they may agree in definitions, they do not always agree in the practical application of those definitions.

In a general way it may be said that any person who looks to another for support, who depends upon another for the necessities of life for a person of his or her class or station in life, is a dependent. This does not mean that the measure of dependency will be the same in every case. In order to be entitled to compensation as a dependent, it is not necessary for the claimant to support himself if he is able to do so, or to so reduce his expenditures or "station in life" as to be able to support himself. An English case which is quite generally looked upon as being the leading case on the subject, said: "The test of dependency is not whether the family could support life without the contributions of the deceased, but whether they depended upon them

as part of that income or means of living." If the deceased workman was in the habit of contributing toward the support of the claimants and such contributions had been used in providing the necessities of life for them in their rank or station, then dependency existed.

The contributions might have been made under legal or moral obligation, or they might have been merely voluntary. The fact as to what motives were in the background which prompted the dead workman to divide his earnings with others is of small consequence in determining the question of dependency. If any contributions were made, however slight, then a dependency may be established and the employer held liable.

Employers very often strenuously object to the payment of compensation to certain dependents because they feel that such payments are unnecessary and beyond the spirit of the law. If an indulgent father supported, or aided in supporting a minor son, who had earnings of his own, in a station slightly beyond what the average father would consider necessary, there is sufficient reason in the mind of the employer as to why he should deny compensation to such dependent.

The Spirit of the Acts

But while the law does not attempt to condone the mistakes of indulgent fathers, it is constantly necessary to recall to employers the spirit underlying the acts, which is that if industry deprives a workman of his earning power industry must share his loss with him. If industry cuts off the earning power entirely by killing the workman, then industry must share the loss with such persons as were, in fact, dependent upon such workman for support, or a portion of their support, at the time of the accident. Hence, the "riddle" of dependency.

Occasional gifts in the form of money to another do not establish dependency, and while a claimant cannot be compelled to reduce his expenditures in order to conform to his own earnings and income, he cannot collect compensation from the employer of the deceased workman merely to add to his own bank account or savings. If the money so received from the deceased workman was used in any other way than for support, there is no dependency under the law and no liability devolving upon the employer.

Some Typical Examples

In New York, it was held the dependency was established when the claimant was an unemployed school girl who was largely supported by the earnings of her brother, and the employer was obliged to pay compensation to her.

In a California case, a situation arose which clearly indicates the trend of the decisions upon the question of dependency. It was shown that the mother of the deceased workman had been receiving contributions from her son. She was at the time living with her husband, who was regularly employed, and with other sons who were earning money and contributing to her support. The court held that while it did not appear that the contributions of the deceased workman were necessary for her support, it did appear that they had been made, and that this fact made her a dependent entitled to compensation.

In another California case, however, a father of a deceased workman claimed dependency on the ground that he was a paralytic and unable to support himself. It was shown that the father had been receiving support from a lodge of which he was a member, and that he had received no contributions from his son for more than a year preceding the date of the accident. It was held that there was no dependency established.

And in another case arising in the same state, it was shown that the deceased workman had for several years supported his mother, but that for a few years immediately preceding his death he had discontinued such contributions, using them instead to pay for a small ranch to which he intended to bring his mother as soon as he had completed payments. It was held that there was no dependency.

Intention to Support Does Not Establish Dependency

In this connection it is well to note that a mere intention to provide support for another is not evidence of actual dependency in fact. Nor is dependency established by showing that irregular contributions were made. If it is clearly shown that no regular payments were made toward the support of the alleged dependent, the presumption is that such payments when made were in the nature of gifts rather than contributions toward support, and unless this presumption can be overcome there will be no dependency established.

Dependency does not depend upon the size of the contribution by any means. It may be, and very often is, of small amount, but the real test is whether it was made with sufficient regularity to establish that it was for support or to aid in the support of the claimant.

The moral obligation to support must not be confused with a legal obligation, or with actual evidence that support was rendered. It is not necessary that there be a legal or a moral obligation to support, as was pointed out previously, but while a moral obligation undoubtedly has some weight in establishing dependency, it is not sufficient to establish it without a fuller showing of facts.

The Michigan court, in this connection, said: "The claimant did not belong to the class conclusively presumed by the compensation law to be a dependent. On the date of the accident, it is conceded claimant was not dependent by reason of any support furnished her by the deceased. . . . A son is always under moral obligation to assist his indigent mother, but he is under no legal obligation to do so until proceedings under the statute have resulted in an order compelling him to do so. No such order was in force at the time of the accident; therefore . . . he was under no legal obligation at that time to support his mother."

In New York, the court has said that the death benefits under the act are not limited to those persons whom the deceased workman was legally charged to support, but that dependency includes those persons who were supported by the workman's voluntary contributions.

The mere fact that a deceased workman was a minor does not prevent his parents from being dependent upon him for support, in the opinion of the New York court.

In a Connecticut case, the court announced a test of dependency in the following words: "A dependent under the act is not necessarily one to whom the contributions of the injured or deceased workman are necessary to his or her support of life; the test is whether the contributions were relied upon by the dependent for his or her means of living, judging this by the class and position in life of the dependent. . . .

Partial dependency may exist though the contributions be at irregular intervals and in irregular amounts, and though the dependent had other means of support. . . . Dependency is thus in each case a fact to be determined."

Lord Halsbury, an English jurist, speaking of the question of dependency, said: "I decline to assume that the legislature has contemplated a particular 'standard' . . . dependent upon . . . the ordinary course of expenditure in the neighborhood and in the class in which the man lived . . . What the family was in fact earning, what the family was in fact spending for its maintenance as a family, seems to me to be the only thing which the judge could properly regard."

The Effect of English Opinions

It may be objected upon the part of American employers that English opinions are not American opinions and therefore may not express the spirit of the law here. But it should be kept in mind that our compensation acts are largely borrowed from the English acts, and that, therefore, English constructions of the English act are generally expressive of the construction which will be given to American acts.

In fact, the Massachusetts court has said, in this connection: "The exact words to be interpreted are to be found in the English Workmen's Compensation Act, and doubtless came thence into our own act. Therefore, the decisions of the English court before the adoption of our act are entitled to weight."

In the same connection, the Illinois court said: "The Illinois act is substantially adopted from the English acts of 1897 and 1906, and it will be presumed that the construction given to them by the English courts is to be applied to the Illinois act unless such construction is inconsistent with the spirit and policy of the laws of this state."

Similar constructions are to be found in the opinions of almost every American court, so that the policy has generally been accepted of looking to the decisions of the English courts for guidance in deciding compensation questions which are new under our own acts.

A Point of Difference Between English and American Acts

There is a distinction between the American and English acts, however, which must be kept in mind in order to obtain an intelligent view of these decisions. Under the English acts, the question of dependency is entirely a question of fact to be determined wholly from the circumstances surrounding each given case. This is not altogether true in the case of the American acts. Most of our statutes have inserted provisions declaring that certain persons were conclusively presumed to be wholly dependent upon the earnings of the deceased workman, and these persons are specifically enumerated by the various acts. Generally, however, they include the husband, the wife, children of a certain age, and incapacitated children.

There is slight doubt but that these provisions were placed in the American acts for the specific purpose of avoiding the English rule that dependency is always a case of fact, and for the purpose of establishing a status of presumed dependency for these persons so that compensation may be obtained by them as dependents from the employer without having to resort to the courts before having their status determined by a legal proceeding. There may be merit, and there doubtless is, in this policy, that is not for us to say, and employers who are confronted with the question of paying compensation to these persons as dependents cannot find refuge in English decisions, or for that matter the decisions of any court where such a presumed status is not declared, and thus avoid payment in their own state.

All that is necessary for persons falling within the classes enumerated to obtain compensation, is to prove that they are the husband, or the wife or any other person named in the statutory classification, and their case is then established and the employer must pay them the compensation due.

The purpose of this classification is doubtless to save time and litigation and to establish more definitely the employer's liability; to insure compensation to such dependent with the minimum expense and delay; and to prevent employers defrauding such persons or to prevent them from receiving the compensation by other means.

It should be remembered, however, that any person claiming compensation as a dependent who is not named in this classification does not have his right cut off, but that he stands in precisely the same position as all dependents do under the English act, namely, that the question of dependency in his case, is a question of fact to be established by the evidence.

We have found, then, that dependency means dependent for the ordinary necessities of life suitable for a person of the same class and position.

We have also found:

1. That the fact of the reliance of the claimant upon the deceased workman's contributions is sufficient evidence of a status of dependency.

2. That the reasonableness of the contribution or the motives prompting it on the part of the deceased workman cannot be assailed by the employer.

3. That dependency is not determined by a legal or a moral liability to furnish support, although it may be; that a mere voluntary contribution is sufficient to establish dependency provided the contributions were relied upon to furnish, or to aid in furnishing, the support.

4. That certain classes of persons are conclusively presumed to be dependents under the American acts and that the employer is absolutely bound to pay compensation to them.

5. That so far as other persons are concerned, their status is one of fact, to be established by proper evidence.

How to Prevent Oil from Discoloring Finished Surfaces

By Walter H. Webster

While Harry Senior's experience with the brown stain caused by oil on finished surfaces, narrated on page 886, corresponds with mine, I have found a great help in reducing the amount of elbow grease required.

Up to a few years ago this brown stain bothered me a great deal. Also the thick gum caused by a combination of oil and cast-iron dust seemed to defy everything but a scraper or emery cloth. In handling denatured alcohol it occurred to me to try it and the result was almost magical, although a certain amount of elbow grease was still required.

In using alcohol the protective coating is entirely removed and the surface is rendered particularly sensitive to the action of moisture and will rust in a very short time if the surface is allowed to remain unoiled.

Safety Practice in Power-Press Work

It is a well-known fact among persons familiar with the various forms of machine-shop work that the power press is responsible for a large percentage of accidents occurring in the machine shops. The following discussion and the illustrations of various types of guards are taken from a pamphlet on this subject recently published by the National Safety Council, Chicago, Illinois.

ACCIDENT records show that more injuries occur on power presses than on any other machine except perhaps the circular saw. This article will discuss especially the metal-working, or punch press, the use of which is so rapidly increasing; but many of the principles herein described can be applied with a little ingenuity to similar machines in specialty manufacturing, leather working, printing and binding, soap making and other industries.

Causes of Accidents

In practically all press accidents the operator's fingers are caught under the ram at the point of operation. This is due to (1) the press repeating, (2) the operator leaving his hand between the dies as the ram descends or (3) an unexpected stroke caused by accidental tripping.

The report of the Industrial Commission of Wisconsin for the year 1917 shows that of 343 punch-press accidents, 333 (or 97 per cent.) occurred at the working point, and that of 111 permanent injuries resulting from these accidents 110 (or over 99 per cent.) occurred at this point.

Over 99 per cent. of the cost of these accidents, including compensation and medical attention, was chargeable to accidents occurring at the point of operation. This is convincing proof that to prevent press accidents a study of the operation of each press must be made to eliminate if possible the need of the operator placing his hands between the dies, or, if this is impracticable, to install a guard which will prevent the operator's hands being caught between the dies when the ram descends.

The most effective way to remove the operating-point hazard is by using an automatic feed. It is difficult to develop a satisfactory feed for some operations, but if the problem can possibly be solved a marked increase in production (as well as safety) will result. Types of automatic feed include roll feed, plunger feed, chute feed, dial feed, revolving dies and sliding dies, which will be taken up in the foregoing order.

Roll Feed.—This may be used in most operations where strip metal is passed through the press for blanking. The rolls, driven by small gears or by a belt, feed the stock through the machine, and the operator's hands need not be placed between the dies. A press in use in the shops of the Felt & Tarrant Manufacturing Co., equipped with this type of feed, is shown in Fig. 17. As may be seen the material is taken from the roll at the left and travels across between the dies to the right side.

Plunger Feed.—The plunger pushes the work under the ram at each stroke, the operator placing the work in a vertical feed chute. The plunger operates at the bottom of the chute and the pieces are fed to the plunger by gravity.

Chute Feed.—The press is inclined, the material is placed in an inclined chute and slides under the ram

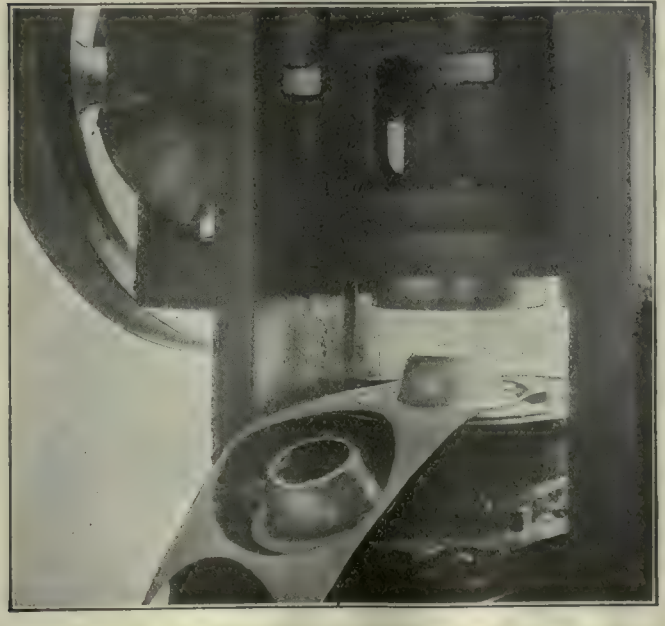


FIG. 1. BLANKING AND FORMING PANS IN ONE OPERATION

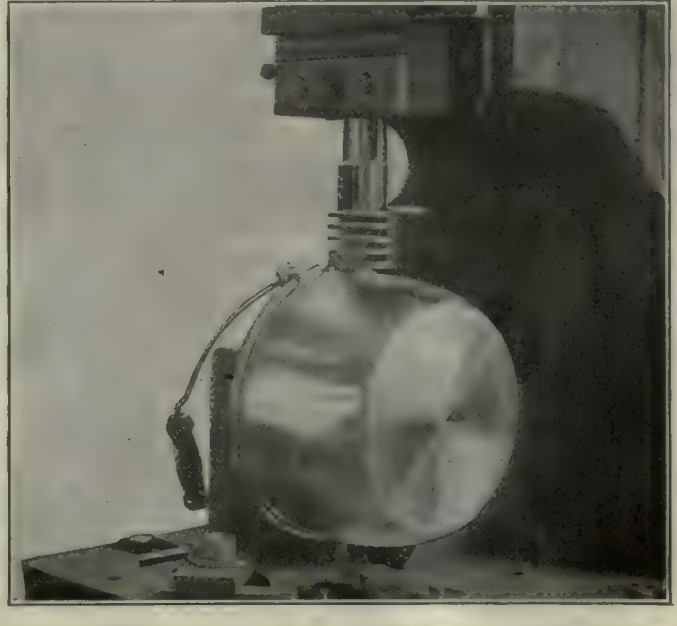
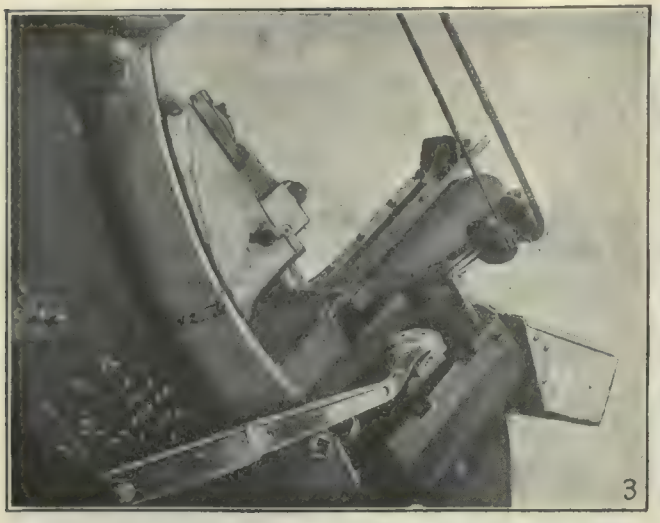
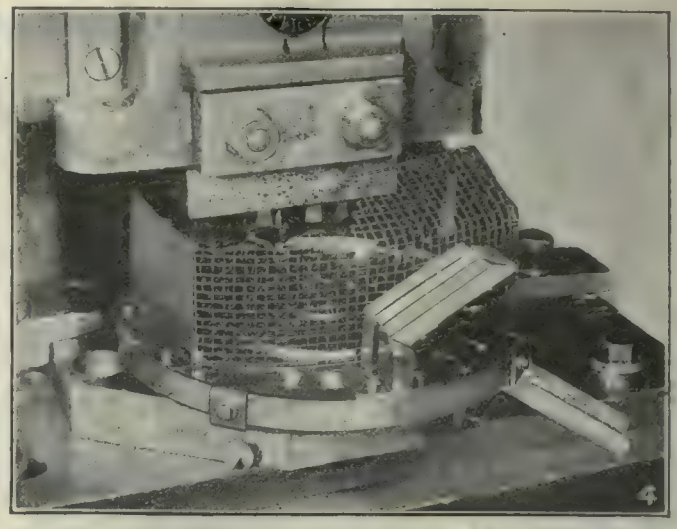
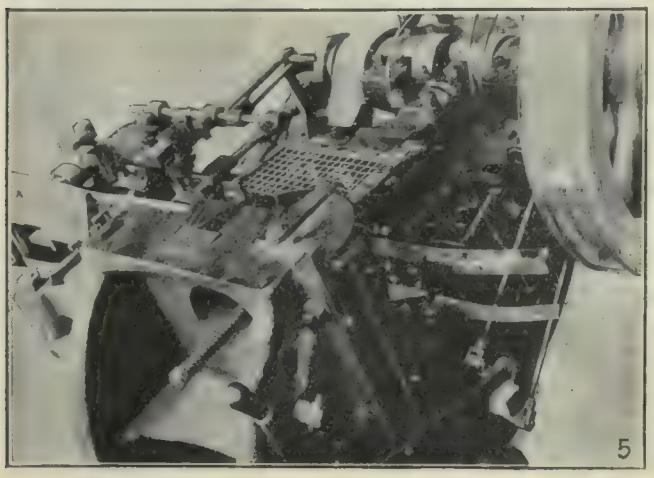
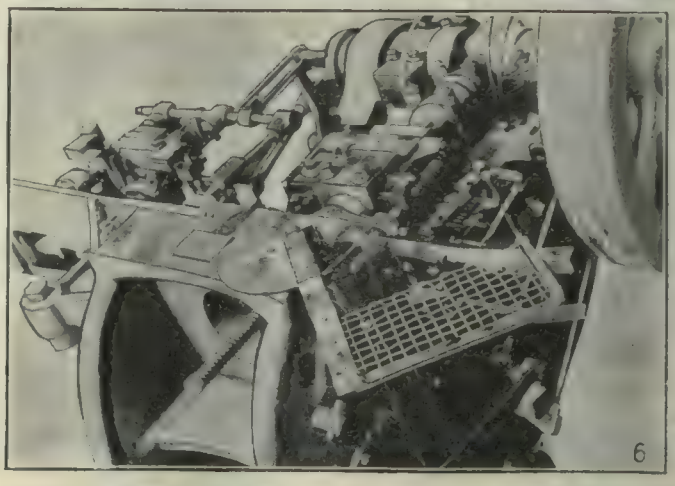


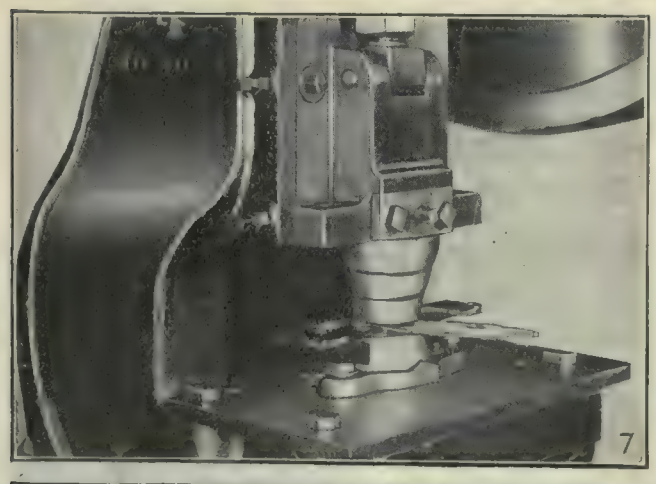
FIG. 2. RIVETING ON KETTLE HANDLES WITH A GUARDED DIE

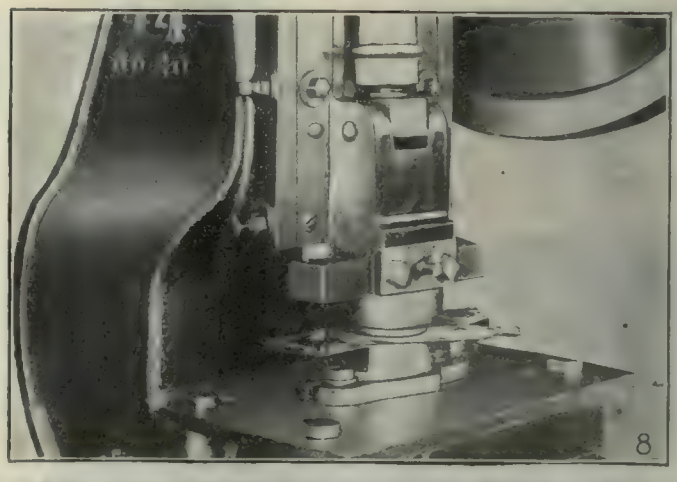


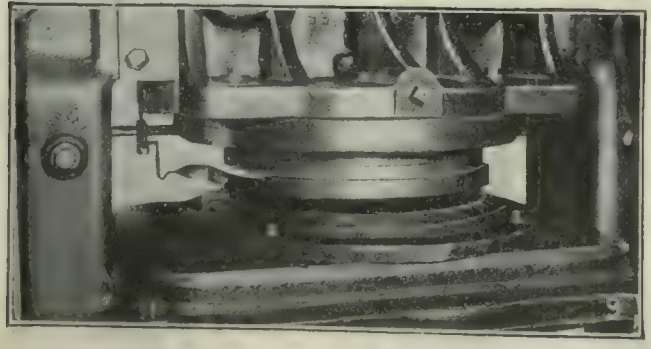


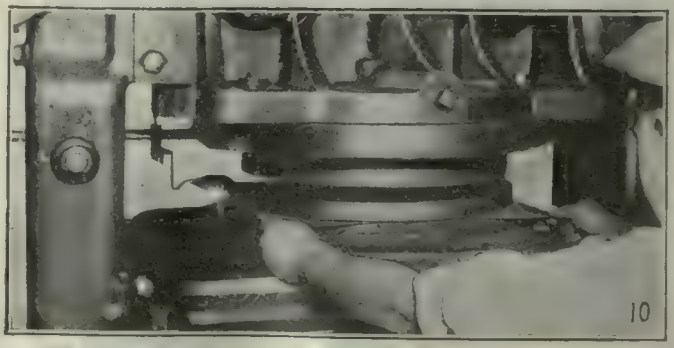












FIGS. 3 TO 10. VARIOUS SAFETY DEVICES

Fig. 3—A chute with dial feed for aluminum parts. Fig. 4—Revolving dies and a chute feed. Fig. 5—A locking device for a clutch operating lever. The guard is in place and locked by a rod connected to the operating lever. Fig. 6—Same as Fig. 5 except that the guard is out of position and the starting lever is locked. Figs. 7 and 8—A telescopic guard with the ram up and down. Figs. 9 and 10—A finger-guard telltale. The metal strip is operated by the foot treadle and descends ahead of the ram.

by gravity. A press of this kind, in use in the shops of the American Pulley Co., is shown in Fig. 11. The work is placed in the track at *C*, the guard *D* preventing the operator from putting his hands in the die. The guard *E* prevents the operator's hands from being caught under the plunger, while the guard *F* prevents contact with the plunger itself. It will also be noticed that a guard *G* has been installed at the rear to prevent anything coming in contact with the dies from this side, and that the machine is equipped with a belt guard at *H*.

Dial Feed.—The work is carried under the descending ram by a revolving dial, fed by hand or by a gravity chute. The press shown in Fig. 3 is one of this type, in use in the shops of the Aluminum Goods Co. As the material is too light to slide down the chute by gravity a rotating disk was placed below the slide and the friction between this and the work helped to feed it to the dies. This operation was formerly done on a vertical power press with hand feed and many accidents resulted. It is stated by the company that this change resulted in a large increase in output and entire freedom from accident, as the operator's hands never come near the ram.

Revolving Dies.—Two or more dies are constructed on a plate which revolves at each stroke of the ram. The operator places the work in an empty die; when the die plate revolves it carries the work under the ram. Figs. 4 and 28 show two machines of this type. The one in Fig. 4 is in use at the plant of the Westinghouse Electric and Manufacturing Co. The pieces of work are placed in the upper chute, from whence they drop into the die, are carried into the plunger by the revolving die plate, and after being operated upon drop out through the chute shown at the lower right corner. The machine shown in Fig. 28 is one operated by the American Pulley Co. All plungers and dies are in the rear of the guard, and there is nothing in which the operator's hands can be caught.

Sliding Dies.—Each operation slides the die from under the ram. The operator loads the die, and with the down stroke the loaded die slides back into position. The principal hazards of an automatically fed machine occur when adjustments are being made or when the dies are being changed. If the plunger makes a stroke at such a time a serious injury may occur. Such machines should be equipped with an automatic stop which will lock the machine whenever continuous operation is interrupted. The plunger and dies should be inclosed if possible, to remove all danger of the operator's hand being caught. Figs. 5 and 6 show a press in use by the American Can Co., in which the act of moving the guard out of the way in order to make adjustment throws a clutch lock into action and prevents a stroke being made. The locking device itself is in the form of the sector of a circle attached to the guard and may be seen unlocked in Fig. 5 and locked in Fig. 6.

Blanking

In blanking operations, especially when hand fed, the plunger should be inclosed at the front and both sides by a guard of wire mesh, perforated metal or wired glass, leaving just enough space under guard to admit the stock. If of metal, the guard should contain a slot through which the operator can view his work. For hand feeding, this guard must fit the die closely; it should therefore be readjusted or a separate guard provided by the die maker or die setter whenever a new operation is put on the machine. A well-guarded gang press in use by the Westinghouse Electric and Manufacturing Co. is shown in Fig. 18. The guard consists of a horizontal bar fastened to the press and having mounted on it several sections of wire fencing, which can be slid along the bar to any desired position. The sheet of metal is inserted in the press underneath this fencing, which projects sufficiently low to prevent the fingers from following the piece too far in. The fencing may be hollowed out, as shown, to enable the fingers to go in as far as safety will permit.

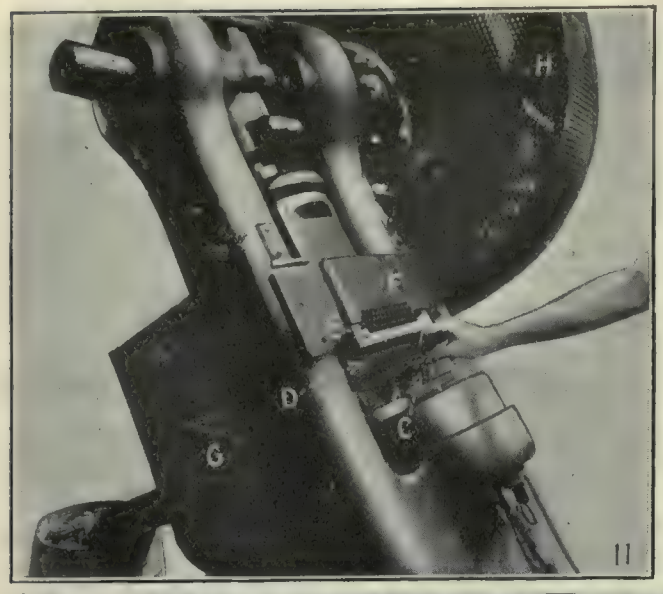
A telescopic guard attached to the ram is sometimes used in place of a basket inclosure. Figs. 7 and 8 show a device of this kind in use by the National Enameling and Stamping Co. The three telescopic sections are made of heavy sheet metal and cannot be raised by being struck with the operator's hand. The top section is easily removed from the ram to permit changing plungers when this operation is necessary. It is said to be a perfect guard for punching, as there is only space enough beneath the guard when the ram is up to admit the metal being punched.

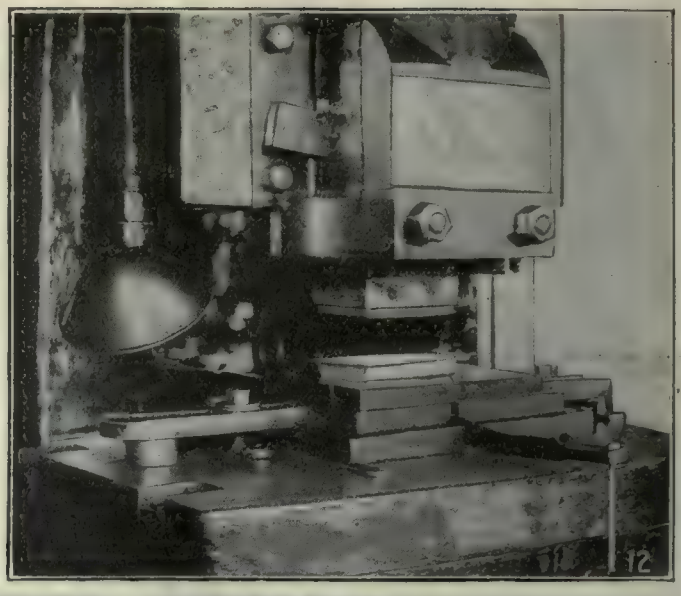
In large blanking operations using long sheets of metal the operator must ordinarily reach through the machine for the stock, unless a helper is stationed behind the machine. This hazard may be avoided and the speed of operation increased by the use of a vacuum pick-up controlled by the operator. A feeding device of this kind, in use by the Westinghouse Electric and Manufacturing Co., is shown in Figs. 13 and 14. Fig. 13 is a view taken at the rear of the press and shows the suction device picking up a single sheet and feeding it into the rear of the press, while Fig. 14 shows the two handles at the front, by means of which the operator manipulates the device. As may be seen the device consists of a sucker which moves on a specially shaped monorail at the back of the press and which is controlled by two long rods or handles extending through the press to the front. A valve in one of the handles enables the operator to open or close the suction. To operate, the handles are gripped at the front of the press and pushed as far back through the press as possible, this operation causing the sucker to drop on the top sheet on the pile of material. The valve is then opened, causing it to grip the top sheet when a forward motion of the handles pulls the sheet into position in the press. The valve is then closed and the sucker releases the sheet. A punching is then made, after which the sheet is drawn forward by the hand grasping the scrap projecting from the front of the press. With this device the helper is unnecessary.

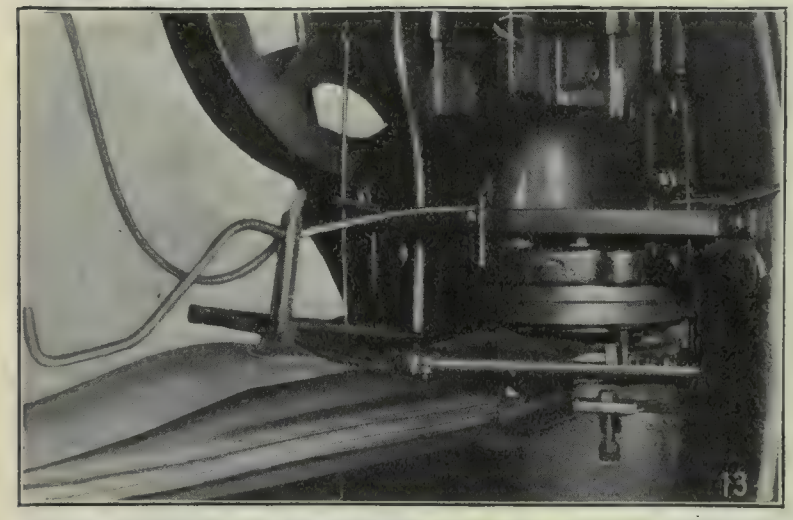
Forming

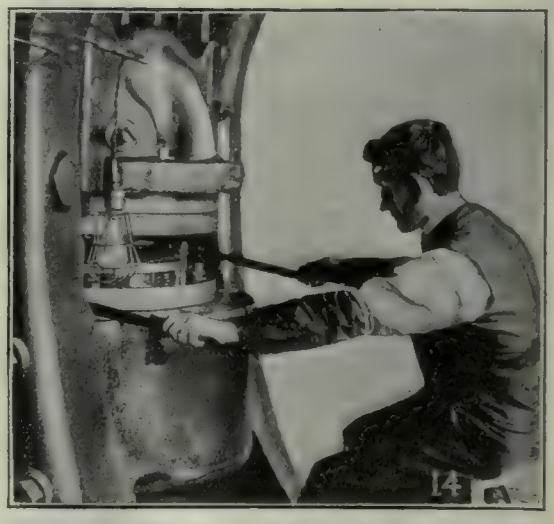
For many forming operations an automatic feed can be devised and the plunger inclosed. With hand feeding, a fixed-plunger inclosure is often impracticable. In such cases particular attention should be given to the design of dies, which will be taken up later, and in addition a device should be provided that will minimize the possibility of the operator's hand being left between dies.

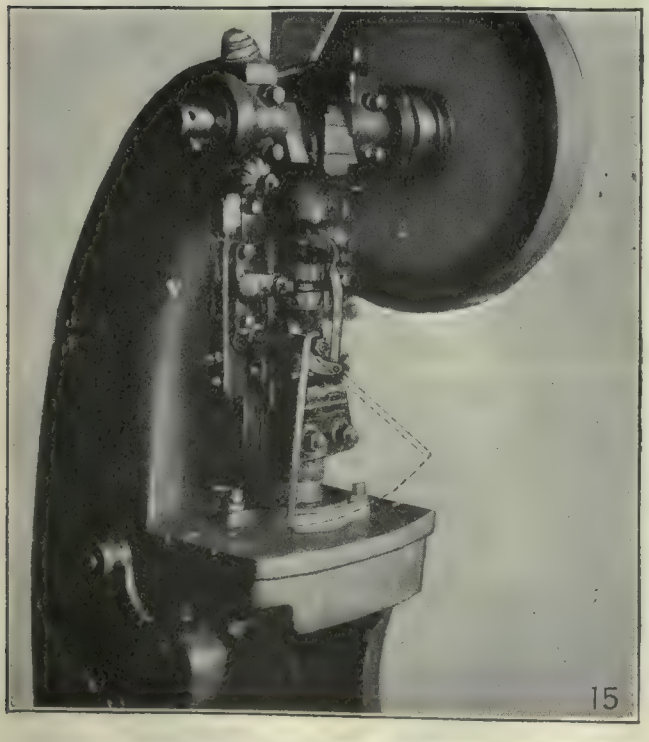
The safety devices for forming operations divide themselves naturally into a number of classes as follows: A sweep bar or gate; a swinging, sliding, dropping or expanding gate; a two-handed lever or push-button device; a telltale device; and tweezers, picks, air suckers or electromagnets.

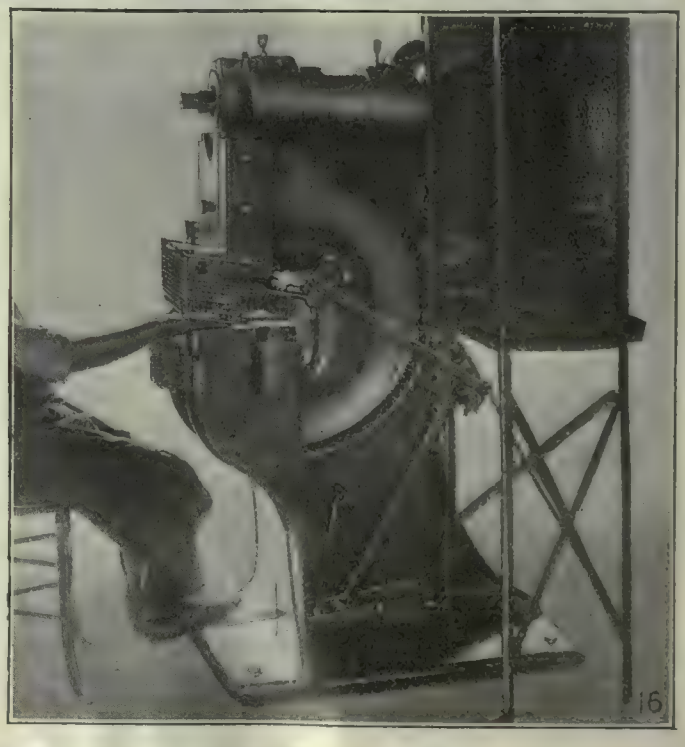












FIGS. 11 TO 16. FEEDING AND KICK-OUT DEVICES AND TWO TYPES OF GATES

Fig. 11—A gravity-chute feed. Fig. 12—A foot-operated kick-out device. Figs. 13 and 14—Rear and front views of a suction device for feeding sheet-metal strips. Fig. 15—A simple sweep guard. Fig. 16—A descending gate guard.

Sweep Bar or Gate.—A device of this kind swings across or moves upward in front of the dies or moves across the lower die as the ram descends, and thus pushes the hands out of danger. Such a guard should be operated by a movement of the ram, not by the treadle. A device of this kind in use on a press of the Simonds Manufacturing Co. is shown in Fig. 15. As the ram descends this swing moves from right to left across in front of the die, and pushes the operator's hand or hands out of the way if they happen to be near the ram. Another device for removing the operator's hands is shown in Figs. 26 and 27. This is used on an embossing press in the shops of the American Can Co.

Swinging, Sliding, Dropping or Expanding Gate.—A device of this kind forms a guard in front of the dies before the ram descends. This is operated by the treadle. If the operator's hand is in danger the gate cannot close and the treadle will not operate. A guard of this type in use by the Columbia Graphophone Co. is shown in Fig. 16. With this device in operation the pedal cannot put the press into action if the operator's hand is under the guard, which is of such size as to keep the operator away from the dies and ram.

Two-Handed Lever or Push-Button Device.—These require the use of both hands to trip the press or release the foot treadle. Where several men are employed at one large press an electric control may be arranged with push buttons in series, so each man must press two buttons (one with each hand) before the press will operate. The Ford Motor Co. employs such a press as may be seen in Fig. 24. This is a large sheet-metal press, and as may be seen each operator has to have both hands well up out of the way of the ram before the press can be operated. A two-hand, air-operated, tripping device used by the Worcester Pressed Steel Co. is shown in Fig. 25.

Telltale Device.—This warns the operator of the descending ram if his hands are in the danger zone. These are not positive in action because they do not remove the hands from between the dies. A device of this kind operated by the treadle and used by the American Can Co. is shown in Figs. 9 and 10.

Tweezers, Picks, Air Suckers or Electromagnets.—These may be used to place the material between the dies. The use of these hand feeders frequently increases the output as well as decreases the hazard.

Hand Pickers

Figs. 19 and 20 show four different styles of hand pickers used by the Westinghouse Electric and Manufacturing Co., Fig. 19 showing the pickers with the work attached and Fig. 20 the pickers alone. Figs. 21 and 23 show a pneumatic tool also used by the Westinghouse Electric and Manufacturing Co. Fig. 21 shows the front and back views of the bare tool, while Fig. 23 shows it in operation. This device was awarded a medal by the American Museum of Safety.

In removing stock from the press many accidents result from the workman's hands being caught and injured by another stroke of the press. In many operations the work is liable to adhere to the die, and a stripper or a kick-out device should be provided. A picker or compressed air may also be used to remove the work.

Blanking and forming are sometimes done in one stroke of the plunger, the cutting die blanking the piece and the forming die completing the operation. This double operation is often dangerous, unless special methods are used to decrease the hazard. Fig. 1 shows a good example of how the hazards can be overcome in an operation of this kind, the machine being in use in the shops of the Aluminum Goods Co., and the material being blanked out and made into a pan at one stroke of the press. These pans were formerly made in the reverse position, so that each one had to be removed from the die by hand with liability of accident. With the present arrangement, however, the operator does not have to place his hands under the press, but simply pulls the long sheet of material toward him and the pans fall out one after another in front of the machine. The company states that an increased output has been attained since the operation was changed over.

Most safeguards can be put out of use by the operator or can be wrongly adjusted so they will give little or no protection. Such types of guards are valueless unless they are kept in proper adjustment and the use of them strictly enforced.

Die Making

The safeguarding of presses should begin with the design of the dies. As much study should be given to the safety of the operator as to the mechanical efficiency. Safety in press operation can only be acquired by keeping the operator's hands out of the danger zone. Although mechanical safeguards are designed for this purpose, practically all types of guards may be rendered ineffective by the operator or by a slight error in adjustment. It is therefore essential to design the dies so that the operator need not put his hands between them. Many forming operations were originally done by putting each separate piece under the die by hand; but today, as a result of close study of die construction, we have sliding dies, revolving or dial dies, etc., all designed to prevent accidents to workmen and incidentally to increase production.

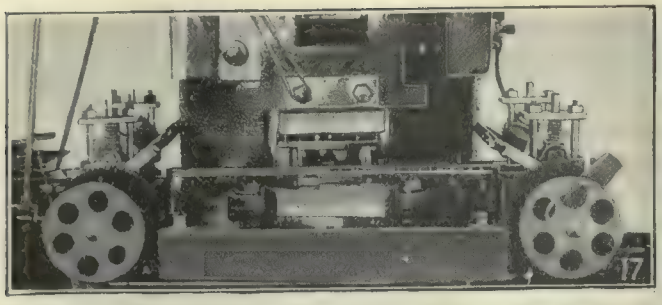
Even with hand feeding the hazard to the operator may often be reduced by cutting away superfluous metal from the die block, thus allowing more space for the fingers. Forethought on the part of the diemaker will often permit the operator to grasp the material by the sides instead of at the top and bottom.

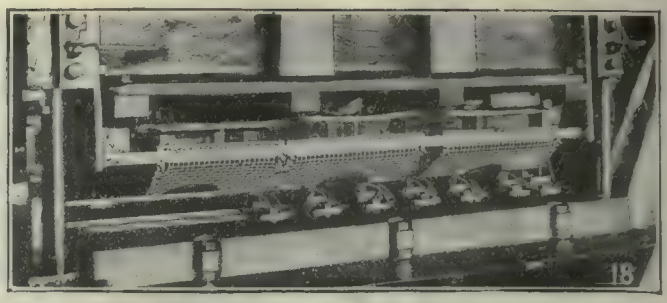
For some operations a guard can be attached to the die. This should be done wherever possible, as it insures that the guard will be properly placed and will protect the operator without interfering with his work.

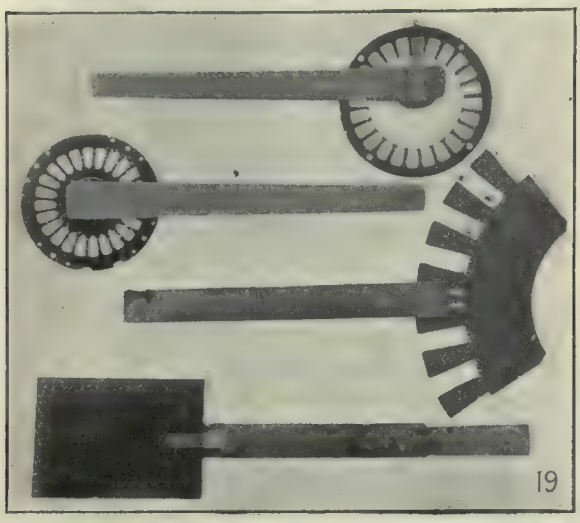
Dies of this kind for riveting the handles on aluminum kettles, in use by the Aluminum Goods Co. are shown in Figs. 2 and 22. Fig. 2 shows the device with a kettle in place, while Fig. 22 shows a number of the fixtures for various sized kettles. A guard is attached to each die, and it is impossible for the operator to place his fingers under the plunger. It will be noticed that a guard is attached to each set of dies in order to insure its always being in place no matter what size of kettle is being operated on.

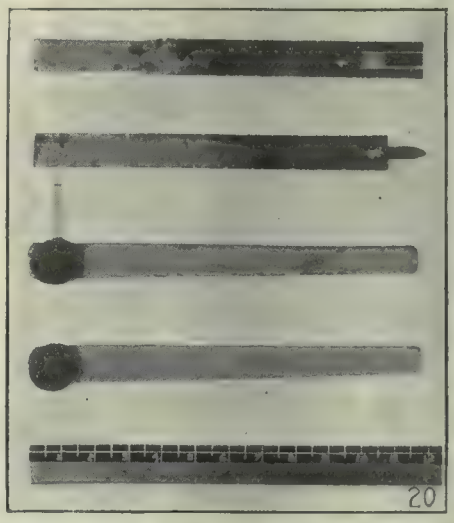
Repeating and Accidental Tripping

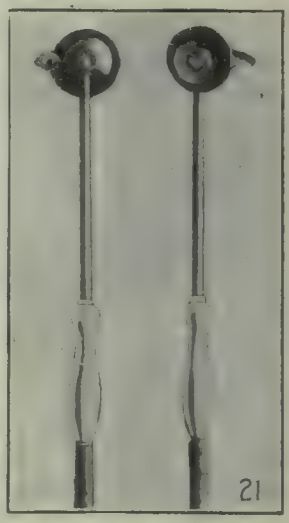
A large number of press accidents are caused by a repeat stroke of the ram catching the operator's hands under the die. Such accidents may often be prevented by a sweep or gate guard attached to the ram. Even if a guard is provided, however, every precaution should be taken to prevent unexpected strokes. These occur (1) because the operator does not remove his foot from the treadle at the conclusion of the stroke; (2) because the friction brake and guide strips are not properly

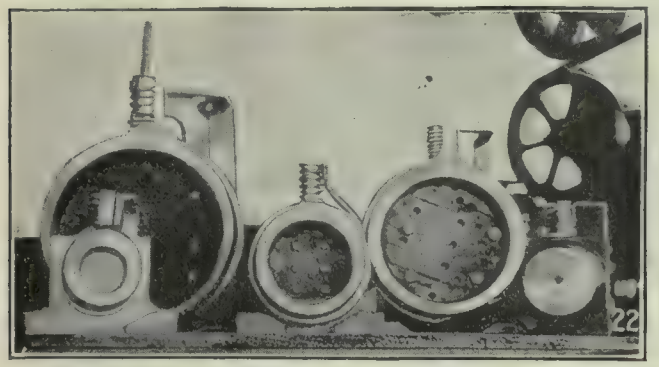




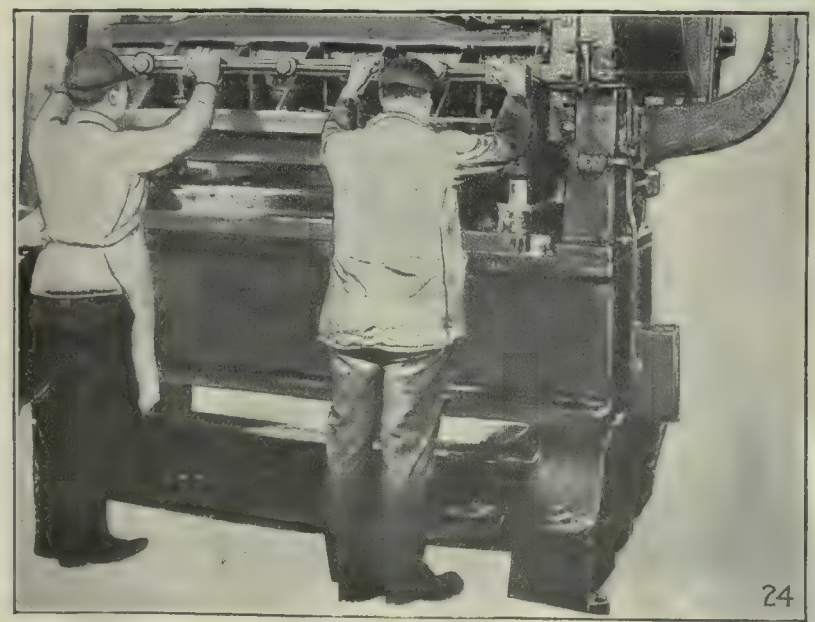


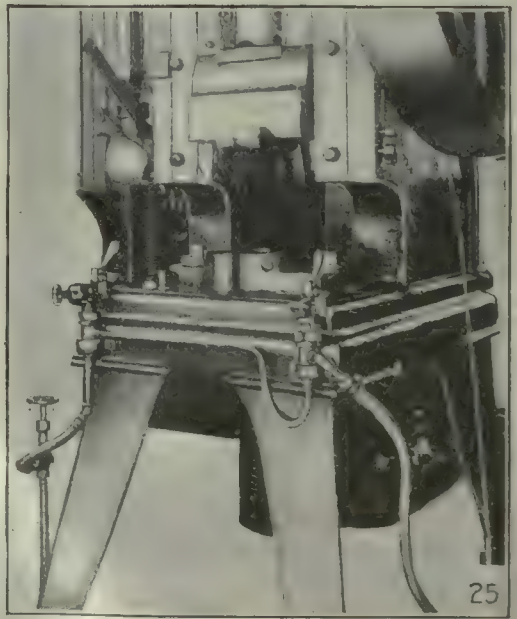






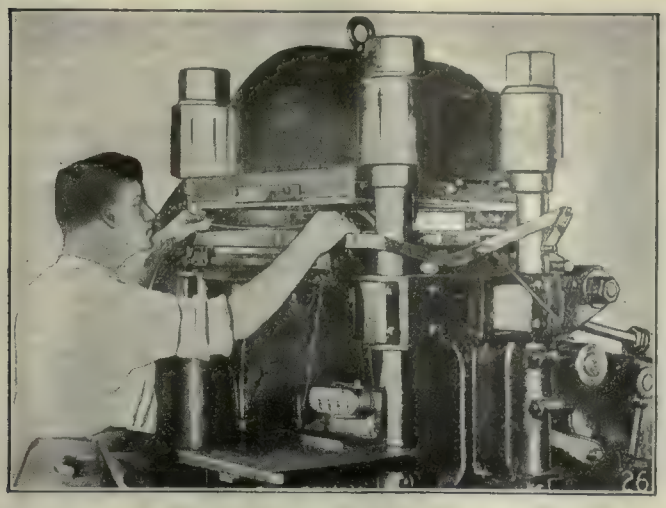


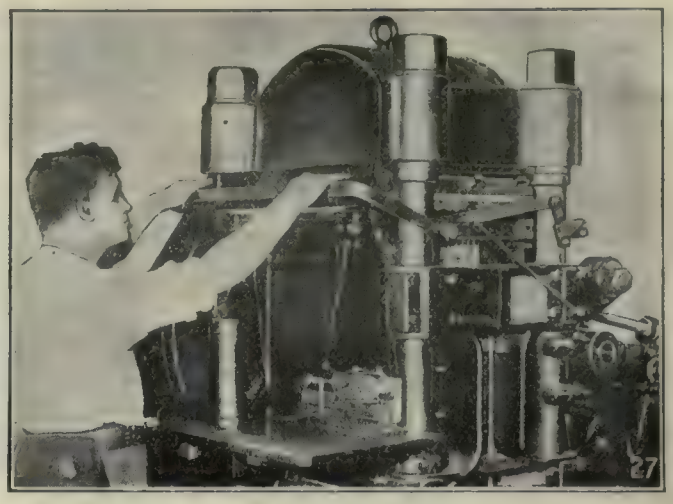




FIGS. 17 TO 25. DIFFERENT TYPES OF SAFETY AND FEEDING DEVICES

Fig. 17—Automatic roll feed for blanking from strip material. Fig. 18—A gang-press guard made of fencing material. Figs. 19 and 20—Hand pickers with and without the work attached. Fig. 21—A pneumatic work-removing tool. Fig. 22—Fixtures and dies for riveting kettle handles, as shown in Fig. 2. Fig. 23—Method of using the pneumatic tool shown in Fig. 21. Fig. 24—Electric control in which both hands of all the operators must be well away from the dies before the press is started. Fig. 25—A two-hand, air-operated, tripping device. Both handles must be raised at the same time to start the press.





FIGS. 26 AND 27. A SAFEGUARD FOR A STAMPING OR EMBOSSING PRESS THAT PUSHES THE OPERATOR'S HANDS AWAY FROM THE RAM BEFORE IT OPERATES

adjusted, or (3) by the breaking of a spring or other defect in the clutch mechanism.

Because of the monotony of power-press work it is easy for the operator to let his attention wander and fail to remove his foot from the treadle at the proper instant. It is therefore much better to have the press operated or controlled by one or two hand levers or buttons and not solely by a foot treadle. If the latter is used, a treadle disconnecting device should be provided which will require the treadle to be raised after each stroke.

The brake band, because of constant use, is subject to excessive wear, and unless it is kept in proper adjustment a repeat stroke is liable to occur. The guide strips, or gibs, should be set sufficiently tight to prevent rapid falling of the ram if the brake band breaks. Gumming of oil or lack of oil may cause the pulley to seize the shaft, resulting in a repeat stroke. If the clutch spring breaks or the end of latch becomes worn the same result may follow. To eliminate these hazards a nonrepeat device or a mechanical stop should be provided on all hand-fed presses.

Treadle Guard

Many serious accidents have occurred through objects falling on the foot treadle or the treadle being tripped accidentally by the operator or other person. Where a foot treadle must be used a hood guard or other device should be installed which will not interfere with the operation of the machine but will prevent accidental tripping. Two types of treadle guard are shown in Fig. 29.

Starting and Stopping

Every press should be equipped with a reliable friction clutch on the line shaft or with tight and loose pulleys to allow the power to be turned off when the press is not in actual use. If tight and loose pulleys are used be sure the loose pulley is kept well lubricated, so it will not seize on the shaft and start the machine unexpectedly. The belt shifter or clutch lever should be equipped with a latch or lock to prevent accidental shifting.

Adequate and substantial guards should of course be provided for all exposed driving belts and pulleys and for all gears.

The cleaning of dies or working parts of continuously operating presses while the machines are in motion should be prohibited. When repairing or cleaning a press the power should be thrown off. To lock the tripping mechanism or block the treadle is only partial protection, as it does not prevent an accidental stroke due to the pulley seizing the shaft.

Location and Lighting

The arrangement of presses on the factory floor should be such that operators and other employees will not interfere with one another and that material may be moved readily. Place the presses so a maximum amount of light will fall directly on the dies. Shadows, as from the revolving spokes of the flywheel or from belting, should be avoided. Electric lamps should be properly located, of suitable candlepower and equipped with reflectors to protect the eyes of the operators and throw the light on the work.

Do Guards Decrease Production?

An automatic feed which is recommended in this article as the best means of eliminating the operating hazard greatly increases production. A plunger inclosure for all blanking operations and for some forming

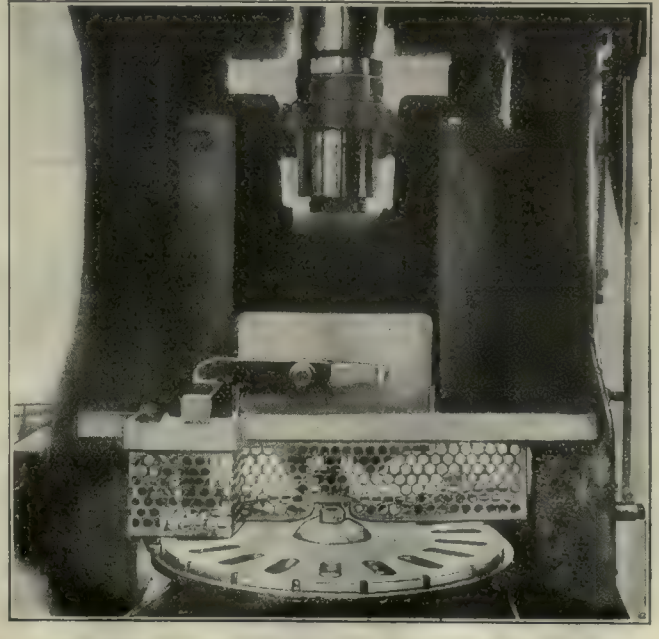


FIG. 28 A GUARD FOR REVOLVING DIES

operations increases production because it gives the operator a feeling of security against accident without interfering with his normal movements. This type of guard should therefore be used wherever possible. The same is true of the suggestion that the dies be constructed so there will be plenty of space for the operator's fingers. Automatic kick-outs and devices for inserting or removing material by compressed air or similar means also combine efficiency with safety. An automatic kick-out device used by the Aluminum Goods Co. is shown in Fig. 12. This is operated by foot power, and the company states that the hazard has been decreased and the production increased by its use.

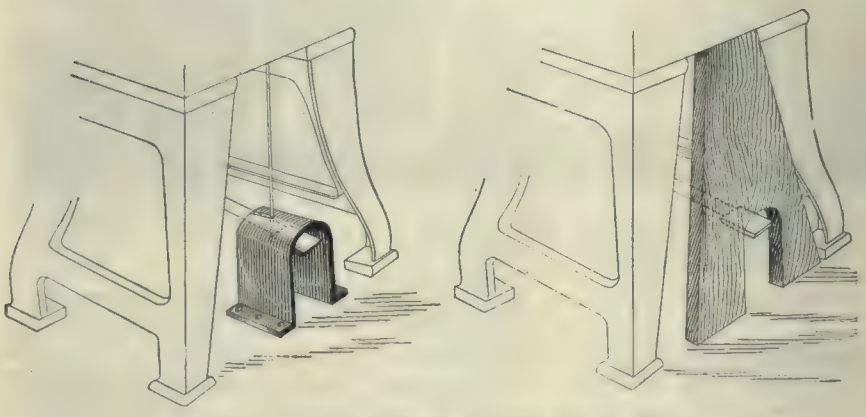


FIG. 29. TWO TYPES OF TREADLE GUARDS

Other safeguards, such as two-handed operating devices, sometimes decrease an operator's output per hour. Such types of safeguards are therefore not recommended if one of the first-mentioned types can be used. But even if one of these guards does lower the normal rate of production it must be remembered that without the guard production may be entirely stopped by an accident to the operator, while if a green operator is put on the machine he will require considerable time to attain the rate of output of the experienced operator. Production depends on keeping the operators continuously at work as well as on the hourly output while they are at work. Furthermore an initial decrease in output is often overcome or even changed into an increase when the operator becomes accustomed to the guard and realizes that he can give closer attention to his work if he does not have to be constantly on the watch to avoid injury.

Employing the Discharged Soldier

By Sergeant H. B. Riehl
School of Reconstruction, Camp Upton Base Hospital

There are three distinct types of men who have been wounded on the battle fields of France, and who, after treatment in the various hospitals, have been made fit once more (some of course to a higher degree than others) to take up the battle of life as civilians.

The three types are: First, the men who had completed their training in their trades and professions prior to their going into the service; second, the men who realize that they need further education to assure advancement in their chosen line of work, and third, the men who do not care whether, on return to civil life, they succeed or not. All that seems to interest them is that they have a job. It matters not the nature of the job, as long as it is "soft."

There are no doubt countless numbers of firms, employment managers and foremen throughout the country who intend, during the coming year, to employ, as far as possible, the returned soldier. If the firm is in the position of Henry Ford, who plans to hire all the returned soldiers residing in Detroit, regardless of their condition, mental or physical, the problem is quite simple. The policy of Mr. Ford is excellent, but all concerns cannot make such a sweeping business of hiring men. They must of necessity choose the best from their ex-soldier applicants and must recognize the three types and judge accordingly. The first type of men, those who had completed their training before service, are of course, in a sense, men of known worth, and the firms who pick men from this type will be satisfied with their choice. The men of the second type are especially worthy of consideration, not because they were better soldiers than the rest of their comrades, but because they strove, sometimes under great handicaps, to fit themselves for better jobs when they returned to civil life. The men of the third type could never be assets to any business, that is, in a competitive market or shops where men must care about themselves and their jobs.

The War Department has installed in practically every one of its hospitals in this country an educational department for the rehabilitation of its wounded soldiers. Primarily, the work was intended to have a therapeutic value; but it has developed rapidly to the extent where it has become work of a truly vocational nature. Many of the patients in the hospitals have taken advantage of the schools and the courses open to them—especially the non-English speaking men and those of the second type. These men have been quick to seize the opportunity of going to school and their enthusiasm and devotion to their classes is truly remarkable.

Most of the Men Attending the School Had Been Mechanics

The idea of writing this article came upon the interesting discovery that when men of the second type applied for work in the school—especially mathematics—they were, in almost every case, men who in civil life worked in machine shops. Even though many of these men were discharged from the hospitals before completing the course, the spirit and determination shown by them in their studies, and the loyalty shown to the school when taunted in the wards by their less industrious comrades, make them the worthy and logical choice of the firms who are looking for good men to become parts of their organizations. Spirit, determination and loyalty are three cardinal points of shop production, and men possessing these qualities will prove themselves assets in any line of work. The men of the second type have proved by their work in the schools that they have all of them.

To the men who, as far as possible, are planning to hire the ex-soldier it will be of advantage to recognize these three types and give the men of the second type the preference. I do not wish to infer that the men who did not attend school are not worthy; but that those who did make effort to improve themselves, often under great difficulties and handicaps, are the men who will make good with live, up-to-date concerns.

A Mechanical Mathematician

By

Ellsworth Sheldon,

ASSOCIATE EDITOR, AMERICAN MACHINIST





II. Construction and Assembling.

This second article continues the description of the details that go to make up a calculating machine, illustrates more of the tools and methods used and touches briefly on the assembling and testing of the finished product in which every precaution is exercised to detect imperfect machines.

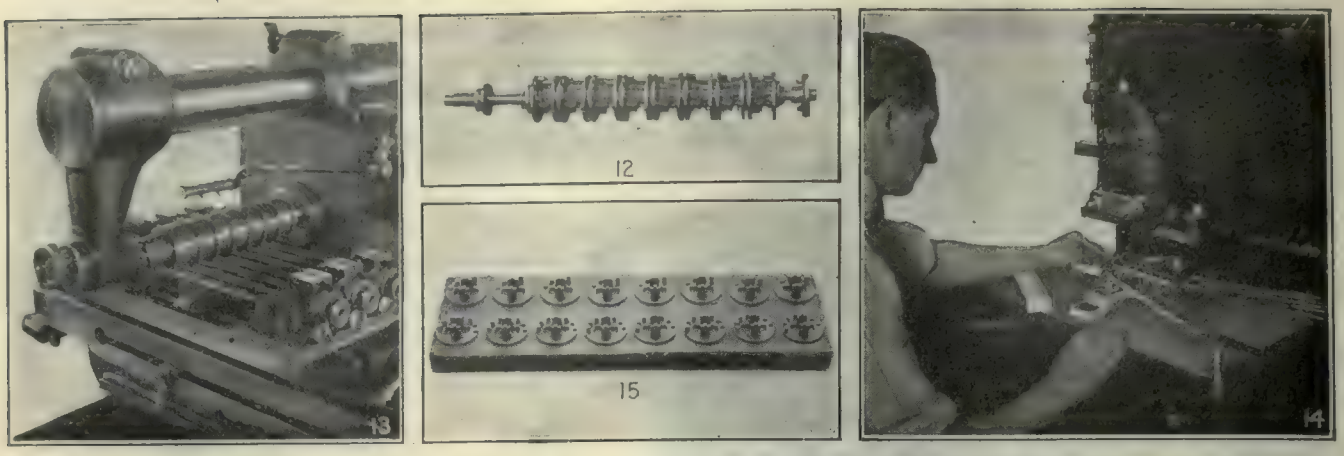
THAT portion of a calculating machine which forms the connecting link between the operator's fingers and the registering mechanism is called in this machine the swinging arm. There are eight pairs of these arms in the Monroe machine, each pair being connected to a pair of clutches to which they transmit the movement of the keys. In Fig. 11 these arms are being assembled into the machine. They lie directly under and parallel to the vertical row of keys, each such row having its corresponding pair of arms. Pressure on any key below "6" will move one, and from "6" to "9" both, of the arms, which movement sets the clutches to register upon the dial the amount indicated by the key. One of the clutch shafts assembled is shown in Fig. 12. The shafts are made on the automatic screw machine and are later ground to insure accuracy. Four splines are then cut throughout their length, the fixture used, shown in Fig. 13, taking seven shafts at one loading. Three of the indexing devices are shown in the illustration, and there are four at the other end of the fixture. Each has a hardened-steel ring, in which are cut four notches accurately spaced to 90 deg. and a latch for locating them. The indexing is done by hand, each shaft being turned independently.



FIG. 11. ASSEMBLING THE SWINGING ARMS

The four keys, or feathers, are ground to size and shape and are set into the shafts in the operation shown in Fig. 14. The upper part of the fixture used is made of tool steel and is hardened and ground. The two plates *A* are fastened to a die bed, and lengthwise through their abutting faces is a hole to fit a clutch shaft. The two pieces do not touch, but are spaced a distance apart equal to the thickness of a key. In each half-round groove thus formed in the steel pieces is a keyway, or slot, extending the full length, so that when the two pieces are in place there is between them an opening that just fits a completed clutch shaft with its four keys.

The operator slides a blank shaft into this hole from the end and drops a key into the upper slot between the faces of the steel parts. He then trips the press and the punch, a long, thin blade just fitting the slot (as also does the key) comes down on top of the key and forces it into the spline in the shaft. The gate is set at the proper height to send the key home and swage it slightly. Withdrawing the shaft, turning it one-quarter turn and reinserting it into the die the operation is repeated until all four keys have been set, the whole being completed in less than the time required to read the description. A final grinding follows on the top of the keys, or feathers, and the shaft is ready for assembling. Fig. 15 shows the clutches which operate the dials through the medium of the counting wheels. It will be noticed that one row of these parts has five studs of equal length extending from its face in a direction parallel with its axis, while in the other row there are but four studs each and they are of varying lengths. One each of these two parts constitute a pair, though, appearances to the contrary notwithstanding, no two of them are alike. The normal position in the machine of each pair of clutches is plainly shown in Fig. 12, each facing its mate with space enough between them to allow the teeth of the counting wheels to pass. There is a pair of these clutches corresponding to each vertical row of keys in the keybank. They are held apart by a light coil spring.



FIGS. 12 TO 15. OPERATIONS ON CLUTCH SHAFT
Fig. 12—A clutch shaft. Fig. 13—Milling splines in clutch shaft. Fig. 14—Setting the keys in the clutch shaft. Fig. 15—A set of clutches.

Pressing down the "1" key in any row advances the clutch which has four studs toward its mate far enough to bring the longest stud of the set into the path of the counting wheel, and when the driving shaft is rotated once this single stud steps the counting wheel one notch forward. Similarly the "2," "3" and "4" keys will advance this part of the clutch to bring a corresponding number of studs into action.

This part of the clutch does not respond at all to the "5" key, but the other side, which has the five equal studs, comes forward, and when turned by the driving shaft moves its counting wheel—the same wheel—five steps. This part of the clutch also responds to the "6," "7," "8" and "9" keys, each of which has two of the wedge-shaped projections on the lower end, as previously noted, and thus while each of these keys brings the left, or five-studded, clutch forward its full distance the right side of the clutch responds to "6," "7," "8" and "9" exactly as it did to "1," "2," "3" and "4," with the result that the combination of the two parts of the clutch moves the counting wheel 6, 7, 8 or 9 spaces for one revolution of the shaft.

Making the Clutches

The bodies of the clutches are made on automatics in the form of flanged bushings. They are then put on a fixture 18 at a time and the hub part straddle-milled, after which the oblong hole is cut through the center of the thin part on a punch press. The milling fixture is shown in Fig. 16.

The hub, or what is left of it, is then broached for the four keyways on a Lapointe broaching machine, and the flanges are drilled for the studs in jigs which locate them from the keyways. It is at this stage that these parts acquire their individuality, for as previously noted no two of them in the same calculating machine are alike. After the shouldered studs are riveted in, the clutch parts pass a milling operation which brings each stud to its required length.

Functions of Cam and Carrying Shafts

Up to this point the operation of the calculating machine is comparatively simple—certain studs controlled by certain keys get in the way of the counting wheel and push it along according to their number each time the clutch shaft is revolved. If, for instance, the "4" key is depressed and the operating crank turned once the dial above the row in which the depressed key is located will register 4; turn the crank again and we have added 4, the dial now registering 8. There are, however, but 10 steps on the dial, and if we turn the crank again, adding another 4, we will register 2. This is all right as far as it goes, but obviously there must be another movement—some way of pushing a job that has grown too big for one column of figures over onto the next one.

This is accomplished through the medium of the cam and carrying shafts, which at the time the first dial passes the 0 position cause a little sliding finger to reach out and move the dial of the next column one step forward. By this means, after the foregoing movement, the two dials together would register 12.

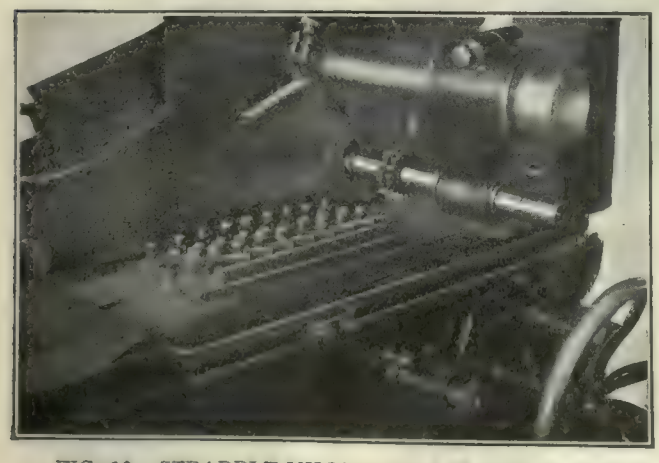


FIG. 16. STRADDLE-MILLING THE CLUTCH HUBS



FIG. 17. ASSEMBLING A CAMSHAFT

The machine under discussion will subtract as readily as it will add by simply reversing the direction of rotation, and the finger that reaches over to move the next higher dial must be equally capable of undoing its work, and further, for this latter purpose, it must operate at a different time.

"Carrying up" to the Next Column

If the sole duty of the second dial was to record the revolutions of the first dial the problem would be greatly simplified, but it is quite likely that when "carrying up" a figure from the next lower column this second dial is also registering for a key in its own column, and the two movements must not interfere. The transmitted movements must follow the direct key movement in either direction.

Assembled camshafts are shown at *A*, Fig. 17, and one in process of assembling at *B*. Its position in the machine is shown at *B*, Fig. 10. It does not revolve, but the counting wheels on it are free and are turned by studs of the clutch transmitting the movement of the latter directly to the dials which are located in the carriage. The cams are the wedge-shaped pieces *C* which may be seen lying on the bench plate in Fig. 17, and when assembled they extend through the holes in the shaft *D* where they are held in position by the slotted bushings *E*. They stand in nearly vertical position and are free to move up or down a short distance, being held up by a spring or down by the latch which is a part of the cam.

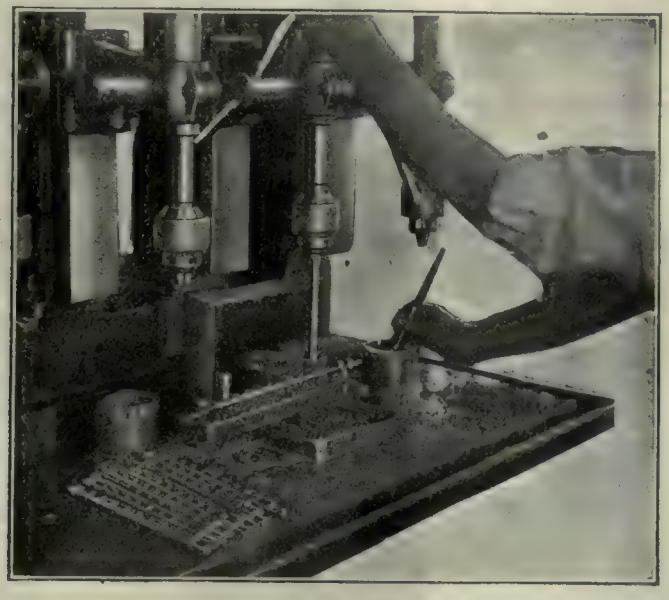


FIG. 18. DRILLING THE CAMSHAFT

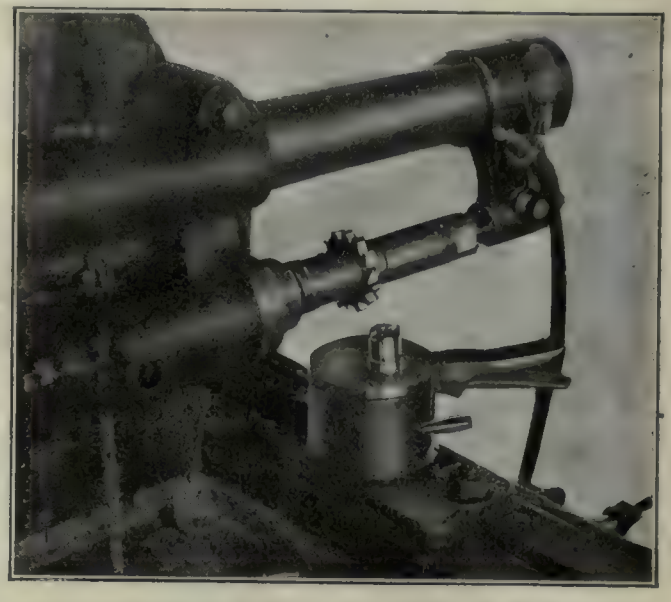


FIG. 19. SLOTTING THE BUSHINGS

Action of the Cams

The camshaft is located directly under the carriage, and when a dial passes the 0 position a stud presses down the corresponding cam, which latches and remains in position. This movement, however, does not move the next dial; it merely indicates that such movement is required, and the proper carrying dog attends to it at the right time, simultaneously releasing the latch and allowing the cam to resume its normal position so that the movement will not be repeated until the cam has again been set by its dial.

Fig. 18 shows the jig in which the cross-holes are drilled in the camshaft. The work is located on centers on the sliding carriage, being supported against the drilling pressure by a long V-block. The carriage is located for each hole progressively by the pin in the bracket on the front of the fixture. The drill bushing is of course stationary.

Fig. 19 shows a milling fixture which is used to mill the rectangular passage across the ends of the bushings through which the cams operate. A cut is also made at right angles to this passage, and the fixture is for the purpose of locating these two cuts. With the handle in the first position a cut is made straight across the center of the bushing, after which the handle is turned 90 deg. to its second position and the cutter passed again across the work. Owing to the fact that the center of the stud which locates the work is eccentric in relation of the center on which the fixture turns, this movement swings the work to one side at the same time that it is turned 90 deg., and the second passage of the cutter forms a flat spot at the end of the cam slot, providing a resting place for the latch that holds the cam down until the carrier dog reaches and releases it.

The Carriers

The carrying shaft is located in the machine back of and below the camshaft in such position that the carrying dogs when extended may reach a tooth of the counting wheel. The carriers are built up of sheet-steel stampings riveted to a hub which is produced on the automatics. Carrying shafts may be seen partly and completely assembled in Figs. 20 and 21, which show respectively the assembling and testing fixtures.

Position of Carriers Is Relative

The carrying shaft is driven by the operating crank through the same train of gears that operates the clutch shaft. The carriers are dogged to the shaft by pins extending through a slotted opening in their hubs in such manner that the carriers themselves, though positively driven by these pins in either direction, take up different positions according to the direction of rotation. When the crank is turned forward, as in addition or multiplication, the carriers collectively assume the appearance of a left-hand helix extending the

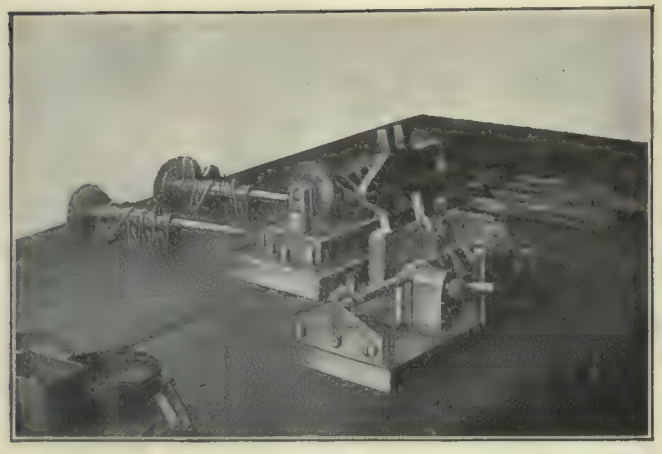


FIG. 20. ASSEMBLING THE CARRYING SHAFTS



FIG. 21. TESTING THE CARRYING SHAFT

length of the shaft. When the crank is turned backward to subtract or divide, the helical line of carriers becomes right handed. This rearrangement of the carriers according to the direction of rotation brings the "carrying" from one column to next higher or lower column, as the case may be, in its proper sequence in whatever calculation is being performed.

Figs. 22 and 23 show respectively the lower and upper row of dials. In the upper row each dial has two sets of figures from 0 to 9, one set being black and the other red. These dials count the revolutions of the operating shaft, showing forward revolutions in black and backward turns in red, thus black figures represent factors in addition or multiplication, while the red figures indicate subtraction or division. The lower row of dials have but one set of figures each, and this row represents the result of any calculation that may be performed on the machine except in the case of division when the quotient is indicated in red figures on the upper dials.

Dials of Composition

The dials themselves are of molded composition, the upper ones having a toothed wheel as an integral part. The wheels are blanked, pierced and shaved in compound dies in the same manner as the counting wheels which they resemble. The wheels, however, have a row of small holes pierced just below the root of the teeth, and when one of them is set into the mold in which the dials are made and the plastic material forced in under pressure it flows through these holes and hardens there, the result being a composite steel and composition wheel which is practically one piece.

The steel portions of the lower dials are not toothed wheels, but instead have 10 studs extending from one side, like one-half of a "lantern wheel." These studs mesh with the teeth of the counting wheels. The tenth stud is longer than the rest and serves the additional purpose of pushing down one of the cams when it is necessary to "carry up" (or down) to the next column.

All dials and counting wheels are held by spring detents, which insure that a dial may not stop short or overrun its position, thus showing but half the figure in its individual opening through the carriage cover. The dials can come to rest only with a figure in proper register.

The dials must be so located in reference to the detent that the rows of figures appearing in the carriage openings will be straight and true, and in Fig. 23 may be seen the various gages by which this alignment is tested and adjusted.

Testing the Machine

After the machine is practically all assembled the operating crank is taken off and a sprocket wheel substituted. The machine is now run for several hours by an electric motor, during which period it gets a pretty severe mechanical test of its ability to stand up under continuous operation. From this test each machine goes to a man whose sole business it is to "put it on the bum."

It is the duty of this individual to make the machine show an error, and to this end he subjects it to every conceivable use, misuse or even moderate abuse, but it is to the credit of the makers that his efforts are seldom successful. It is safe to assume that the machine gets much more severe usage during the period that it is under test than it would be apt to receive in any regular office service unless it were to be dropped on the floor or some similar accident.



FIG. 22. LOWER DIAL SHAFT

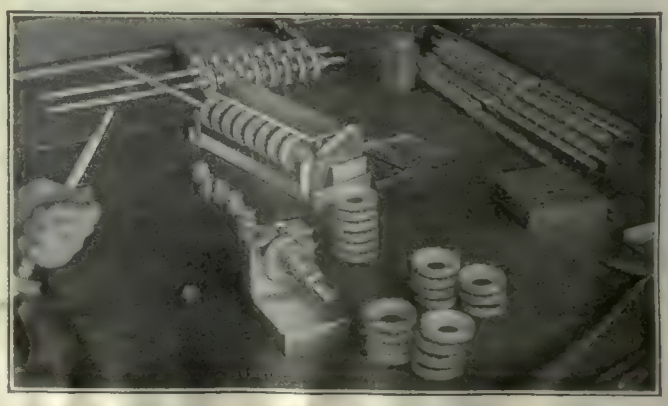


FIG. 23. UPPER DIAL SHAFT



The British Eight-Inch Howitzer—I

By I. WILLIAM CHUBB,
European Editor *American Machinist*

The British 8-in. howitzer consists of an A-tube, wire-wound over the chamber and a portion of the bore, an inner A-tube of practically the same length, and a jacket shrunk over the wire and a portion of the A-tube. The jacket bears the breech ring which supports the breech mechanism, the breech bush being screwed into the jacket. The methods here described are those of a long-established English firm which produces the howitzer complete for active service.



THE howitzer, Figs. 1 and 2, is of 8-in. bore, its total length being 148.3 in. and its weight with breech mechanism, nearly 7500 lb. The bore is 138.4 in. long; the chamber has maximum and minimum diameters of 9 in. and 8.5 in. respectively, and the rifling is 103 in. long, uniform twist, one turn in 35 calibers, the grooves being 48 in number and 0.349 in. wide by 0.06 in. deep. The A-tube, the inner A-tube and the jacket are all of nickel steel containing carbon, maximum 0.4; manganese, minimum 0.2, maximum 0.85; phosphorus, maximum 0.035; sulphur, maximum 0.035; silicon, minimum 0.05; maximum 0.2, and nickel, minimum 0.35 per cent. After rough-machining the forging is annealed at 1650 deg. F., oil-hardened at 1600 to 1700 deg. F., and tempered between 1000 and 1200 deg. F. The test pieces must show a tensile strength of between 45 and 50 tons to the square inch, the minimum elongation being 16 per cent. on a 2-in. length, the yield to be less than 0.03 in. at 30 tons. The test piece, when bent, is of U-form, the radius of the curve at the bottom being $\frac{5}{8}$ inch.

As to testing it is usual when halfway through pouring the ingot for any of the tubes to cast a small billet. This billet is hammered to about $1\frac{1}{4}$ in. square, annealed and pulled for tensile test. Turnings are also taken for analysis, and if the results are satisfactory the ingot goes forward for its purpose. The bad metal both at the top and bottom is cut off and the ingot is bored, or trepanned if for a hollow forging, and when it has been forged to shape, annealed, oil-hardened and tempered rings are cut off, one at each end, for test, after being stamped by the government officials. The test rings are 1 in. thick, and for the inner and outer A-tubes and jacket four test pieces are taken from each ring, two for tensile and two for bending tests. The positions on the flat ring of metal from which these pieces are to be cut are marked off by scriber and center punch, the four pieces being arranged equidistantly around the ring at about the middle of its width and tangential, the pieces at opposite ends of a diameter being for the same kind of test, that is, those at the two ends of a vertical diameter may be for tensile tests, in which case those at the ends of the horizontal diameter would be for bending tests. Like tests are always made on diametrically opposite specimens. Cylindrical pieces $1\frac{3}{8}$ in. in diameter by $4\frac{1}{2}$ in. long, are trepanned at opposite diameters, two for tensile and two for bending tests, this applying to all forgings for guns of more than 3-in. bore, while if the forging is more than 48 in. long when finished, test pieces are taken from each end. A machine of the horizontal boring type is used, the hole being started first with a drill, followed by the trepanning tool. The cores formed by the trepanning process are broken out with drifts. The pieces band-sawn from the rings for tensile tests are first turned to 1 in. in diameter and are then turned and finally ground on the central portion 0.564 in. in diameter by 2.45 in. long between the shoulders, a length of 2.25 in. being parallel, plus a radius of 0.1 in. at each end.

The bending samples are first shaped to $\frac{3}{4}$ in. wide by $\frac{3}{8}$ in. thick by $4\frac{1}{2}$ in. long and then finished on a disk grinding machine to snap gages. In each case the government stamp is left on the end.

The testing machine, Fig. 3, depends on hydraulic pressure and is without operative weights, multiplying levers or knife edges, the pressure being exerted direct. The maximum pressure exerted is 50 tons per square inch.

ARMY ORDNANCE NEWS



FIG. 1. EIGHT-INCH HOWITZER BODY

For the inner A-tube the ingot may be 30 in. or 32 in. octagonal by about 12 ft. long (including riser head) and from this three tubes are obtained. The ingot for the A-tube is 36 in. across the flats, octagonal, by about 18 ft. 6 in. long, including riser head, and from it four tubes are obtained, the forging sizes being shown in Fig. 4. The jackets are obtained from a 40 or 44 in. round ingot by about 12 ft. long, three jackets being produced therefrom. The forging for the inner A-tube is solid, but the jacket ingot is usually trepanned with a 16-in. hole right through before forging, and the A-tube with a 12-in. hole to take a mandrel while being forged.

In the trepanning process whether the cutting tool or the work shall revolve is determined mainly by the weight of the work, but the work is revolved wherever possible. In the case of the 8-in. howitzer ingots the tool does not rotate. Plenty of lubricant is an essential with the trepanning process and is conveyed by a pipe system through the center of the bar, running eventually from the tool into a culvert and passing through a settling tank before returning to a second tank from which it is again pumped. A mixture of soft soap and water is employed. The main object is not simply to cool the tool but also to wash away the cuttings.

The trepanning head, shown in detail in Fig. 5 has around it a series of hard-steel pads dovetailed in; these, when the tool has fairly entered, act as bearers and steady the head in the hole. The bottom part of the bar is cut away as far as possible without weakening it in order that the chips may readily pass away. The leading tool is a nicking or splitting tool shown to the right of the end view of the bar and in detail. By its action it forms two grooves in the work. It is followed by a broad tool, also detailed, which overlaps and breaks the cut into three, making five cutting edges in operation in a width of 2 in. or so. As to actual proportions a 13-in. trepanning bar will leave a solid core 7½ in. in diameter.

After trepanning the tubes are taken to a coal-fired muffle furnace for preheating to about 1500 deg. F. to insure that the metal will not crack when raised to forging temperature.

One of the presses used in forging the 8-in. howitzers is shown in Fig. 6 operating on a jacket. Its capacity is 3000 long tons. The main cylinder is of 40-in. bore by 60-in. stroke, and the clear distance between guides is 84 in. The distance between the under side of the anvil and the top cross head is 12 ft. 6 in. The working hydraulic pressure is 2½ long tons per square inch, the auxiliary accumulator service pressure being 16 cwt. per square inch.

In the chief machining operations on the three main tubes all turning and boring operations are dry, except at the finish-boring of the inner A-tube where oil is employed, this applying also of course to screw-cutting operations and the turning of radii as at the muzzle.

The A-tube when finished is 141 in. long by a maxi-

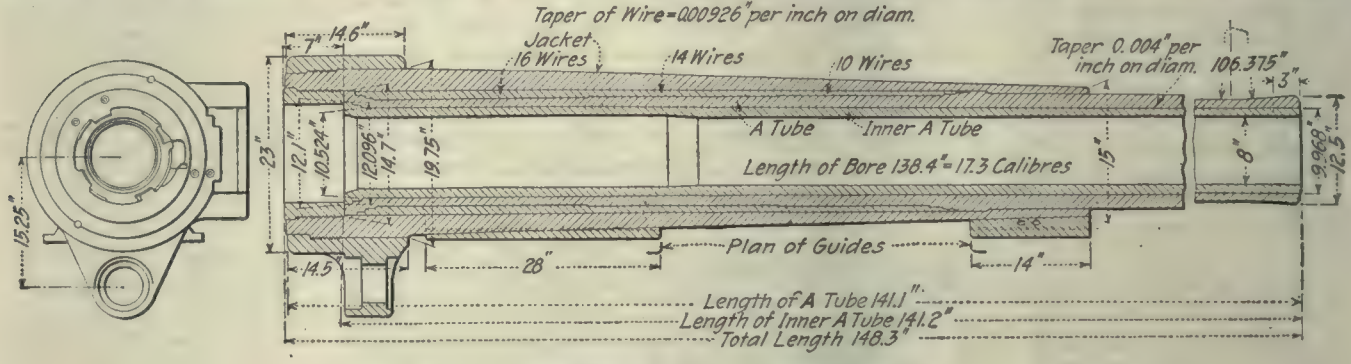


FIG. 2. SECTION OF 8-IN. HOWITZER BODY

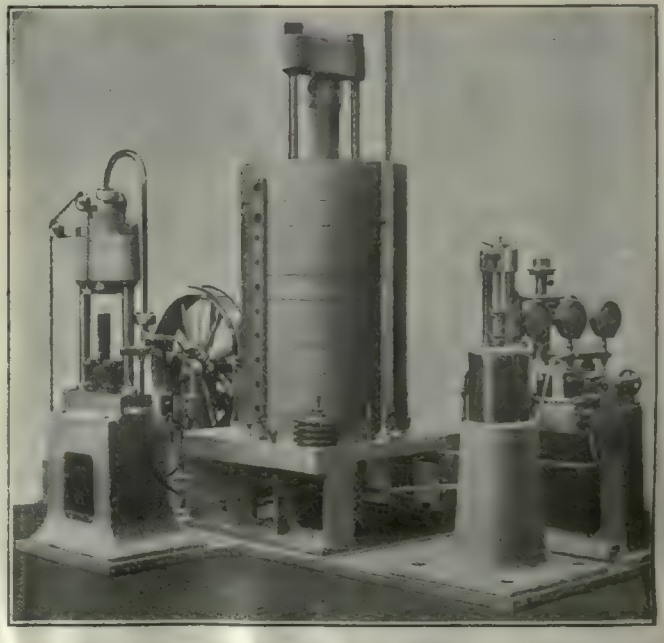


FIG. 3. FIFTY-TON TESTING MACHINE

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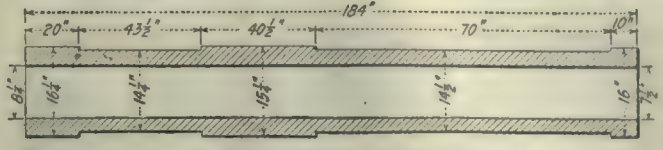


FIG. 4. A-TUBE FORGING

mum diameter of 14.7 in. at the breech end where there are three shoulders, the diameter at the muzzle end being 12.5 in., while the bore ranges from 12.1 in. at the largest step at the breech end down to 10.524 in. at the second step at this end, tapering 0.004 in. per inch on the diameter down to about 9.968 in. at the muzzle. For a length of about 136 in. the inner surface on the tube is combed.

Operation 1.—Rough-Turn—Rough-turning is done in an ordinary lathe of 36 in. swing and the cutting speed is about 18 ft. to 20 ft. per minute with a feed of 16 to the inch. It is usual to leave about 0.75 in. on the diameter, and a length of 12 in. or so, allowing for material to be removed for test purposes, etc.

Operation 2.—Rough-Bore—When boring from the solid the practice is to leave ⅜ to ¾ in. on the diameter for a second cut, this being a margin for the nonconcentricity or running of the holes when the two cuts meet at the center of the length. The cutting speed is usually 20 ft. to 25 ft. per minute and the feed about 7 in. per hour.

The operation is double-ended, the machine used being illustrated in Fig. 7. The work is held in the center by four jaws on each side of the driving head and is supported at each end in a roller steadyrest. The machine illustrated is made by Hulse & Co., Manchester, and will bore work 9 ft. long from each end, making a total of 18 ft. The central driving headstock has a cast-iron hollow spindle rotated by two sets of steel double-helical gearing controlled by clutch and lever and driven from a 20-hp. variable-speed motor. The

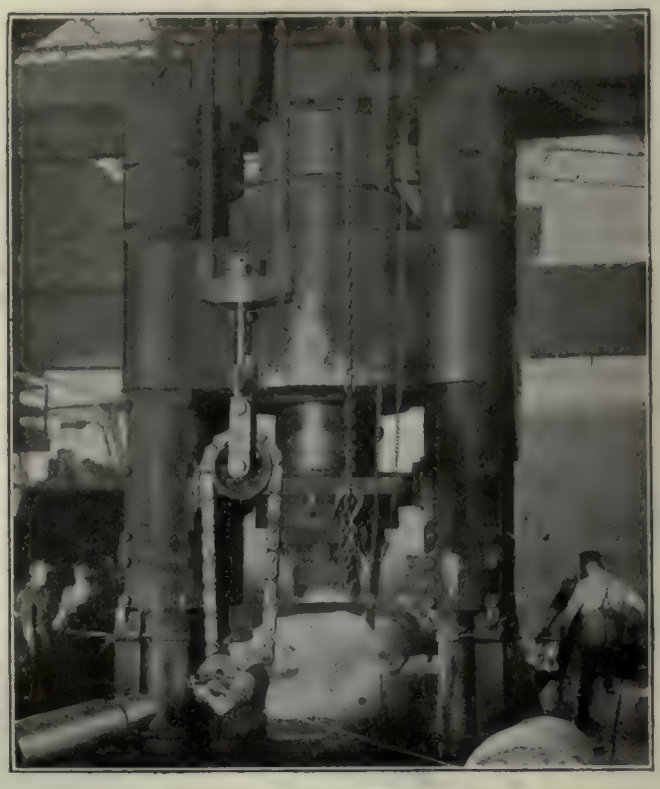


FIG. 5. THE TREPANNING HEAD

spindle speeds range from 4 to 36 r.p.m. and the center of the spindle is 18 in. above the bed. The two faceplate chucks are 4 ft. in diameter, each with four independent steel jaws and screws, steel removable extension plates being provided so that the range of tube taken is from 10 in. to 18 in. in diameter. The beds are each about 21 ft. long, of box form, with square gibs and inclined trough, each with a central screw, with wormwheel and worm at the end for self-acting motion to the carriage. The feed is reversed by the addition of an extra stud wheel on each swing frame. Quick power traverse is also obtained in either direction, with safety stop, being driven direct from a 3-hp. constant-speed reversible motor. Two carriages and two adjustable boring-bar holders are provided.

When boring from the solid each boring bar carries at its outer end an ordinary boring cutter of V-form to produce a hole 8¼ in. in diameter, the cut on each operating face being split, four notches being provided on one side and three on the other, arranged alternately. About 10 in. behind the operating end a 1 or 1¼ in. square knife tool is placed in

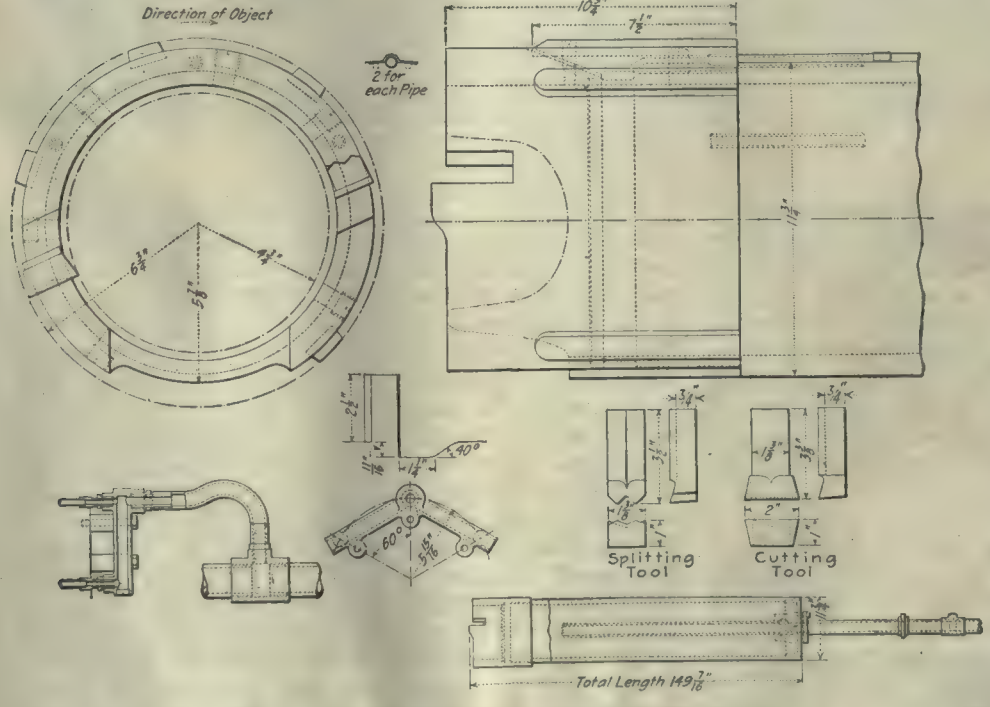


FIG. 6. THREE-THOUSAND-TON FORGING PRESS

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a slot across the bar, this opening the hole from 8¼ in. to 9¼ inches.

Operation 3.—Heat-Treat.

Operation 4.—Cut Off Test Pieces.

Operation 5.—Re-Turn and Cut Off Excess Material—The same lathe, etc., as used in operation 1 is employed, the speeds and feeds being about the same and the diameter turned leaving about ¼ in. on. As to the length it is usual to leave 1½ to 2 in. on to allow for the carrying up of the shoulders should there be any error in turning the taper. The removal of the excess metal is a simple parting-off job.

Operation 6.—Rebore and Finish Taper Boring—Reboring is done with a through bar, either with a taper slot to suit the tube or with a parallel bar set over. A single-point tool about 1 in. square is employed in this operation, though for reboring a knife tool is occasionally employed. For finishing about 0.3 in. is left on the diameter. A flat-face tool is used, with a radius tool to finish off the radii at the shoulders. In reboring the cutting speed is about 20 ft. per minute and the feed about 8 in. per hour, while for finishing with a broad-faced tool the feed is $\frac{1}{10}$ to ½ in. per revolution. Three or four finishing cuts are taken, sometimes even six, these removing any effects of cross pressure on the boring bar.

Operation 7.—Gaging.

Operation 8.—Combing—The grooves produced by combing are 0.01 in. deep by 0.05 in. wide, the pitch being 0.15 in. The combing tool of 1-in. square steel, produces five grooves at a time. The work is held in a dividing head of worm and wormwheel type and supported at the outer end on rollers, and the combing operation is from a given distance inside the muzzle end, running off at the breech end. A central bar is employed with a taper groove to take the holder for the combing tool, this being secured by two screws, one at the end and one at the side. The bar is held and supported by a pedestal at the front end of the job (see Fig. 8), and the tool is pushed along the groove by a bar operated by a carriage which receives longitudinal motion from a screw in the center of the bed. The cutting speed is 15 ft. per minute, the automatic return being in the ratio of 3 to 1. During the latter the cut is relieved by operating the cross-slide carrying the pedestal.

Operation 9.—Build—This is shrinking the outer A-tube on the inner A-tube.

Operation 10.—Finish-Turn for Wire—The work is held in a four-jaw chuck at the muzzle end, with either star or expanding center at the other end, and supported by a steadyrest, being turned up true at about half way along the length for a width of between 5 and 6 in. according to the width of the pads employed. Spotting diameters are turned at intervals to gages. The various diameters are turned to pin gages. The rest is set over to feelers between the two end diameters of the taper. The finish is with a carbon-steel tool 1¼ in. square, the tube running slowly, say at about 8 ft. or 10 ft. per minute, and the traverse of the flat-faced tool is ½ to ¾ in. per revolution.

Operation 11.—Wire—For wiring an Armstrong-Whitworth machine is used, the operation being as described in connection with the 9.2-in. gun. Particulars of the wiring tensions in tons per square inch and also of the shinkages are given in Fig. 9. The wire is 0.06 by 0.25 in. section, each hank consisting of 2 cwt., or a length of about one mile, rather less than three

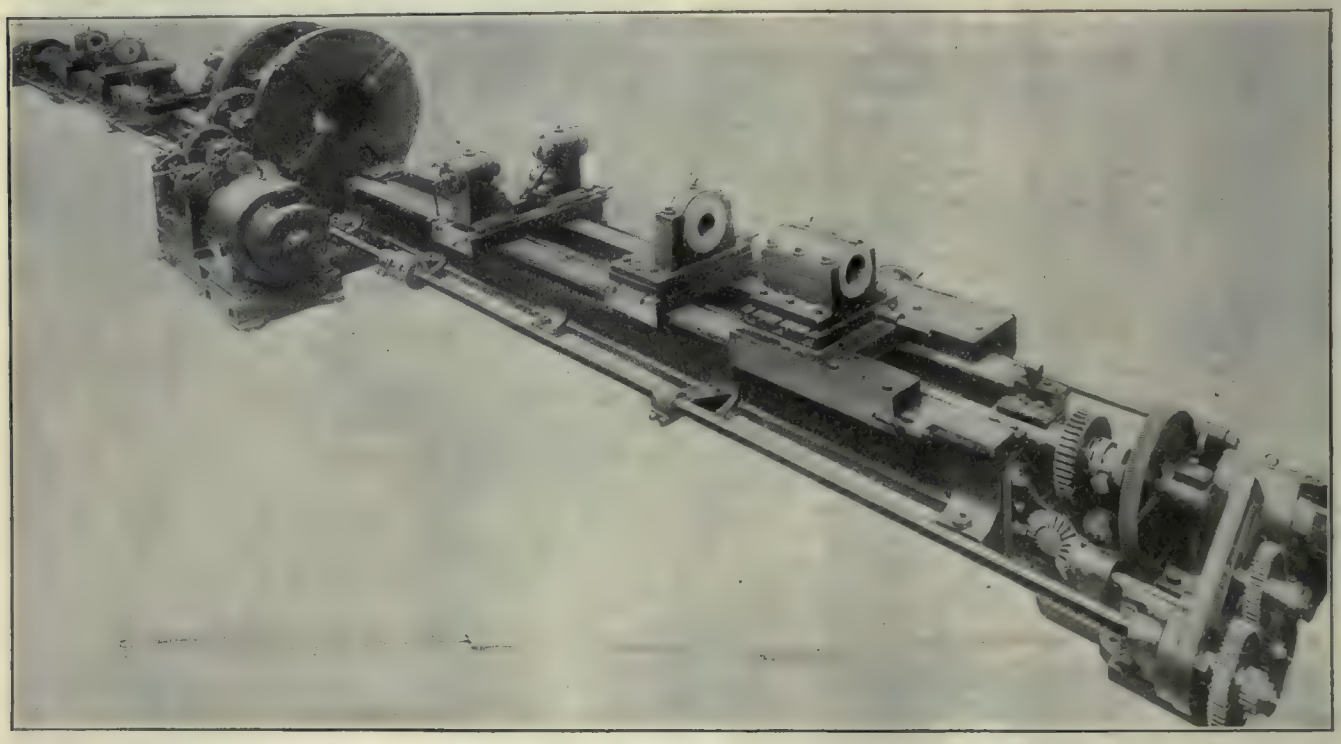


FIG. 7. DOUBLE-END BORING MACHINE

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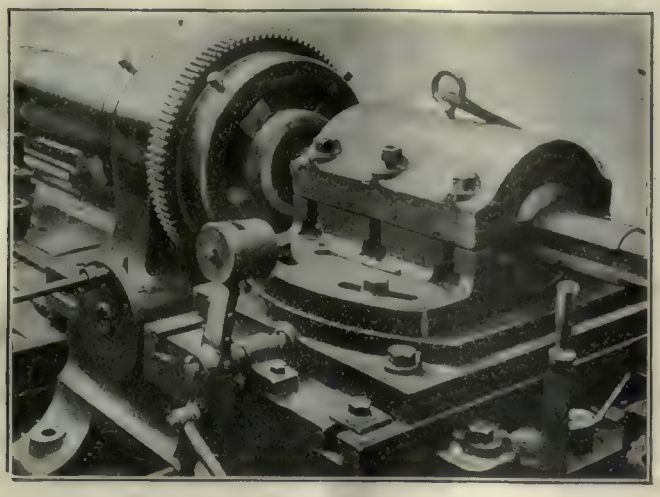


FIG. 8. COMBING OPERATION

miles being wound on this particular howitzer. To join two lengths the ends are milled taper for about a foot and these are riveted together overlapping. For this 32 holes are drilled in the 12-in. length, each $\frac{1}{32}$ in. in diameter, and countersunk for riveting, the two tapered ends being soldered together while drilling.

To start the wire on the gun a hole is drilled in the muzzle end of the tube, and from this a groove is cut in which the wire end is riveted with the ball of the hammer. For the split filling-in rings, 0.12 by 0.25 in. in section, a bending machine is used to get correct diameters.

The wire-coiling machine illustrated in Fig. 10 is electrically driven by a 5-hp. motor through a paper pinion. Hanks are slipped onto pegs on a small drum and placed, as shown in the end elevation, in bearings at the top of uprights, the wire then being brought down over a guide pulley through dies to the drum on which it is to be wound. The wire is previously cleaned by being run through paraffin. The tension in the wire-coiling machine is controlled by adjusting the cap of the tension device. The carriage bearing the dies through which the wire is fed receives a to-and-fro motion across the face of the machine, being driven by a screw which is itself driven by bevel gearing from the electric motor. A hand-controlled clutch reverses the motion at the end of the travel, the rate of which is suited to the width of the wire. The speed of the barrel on which the wire is wound varies in this case from 26 to 52 r.p.m. as controlled by the motor. This drum carries three hanks. From it the wire is wound onto others which carry up to 14 hanks, each of 2 cwt. The wire must be kept taut while being wound, as otherwise the tension might vary from that required when the wire is being wound on the gun.

Operation 12.—Turn on Wire for Jacket—For turning the wire on the jacket a 36-in. lathe is employed, the work being held in a four-jaw chuck at the muzzle end. At the other end is a star center, the bearing shoes of which carry heels in order that they may not be pushed in the tube. A bearing is turned toward the muzzle end, and after the wire has been turned as much as possible of the muzzle end is tapered by grinding. The wire is turned to diameter according to gages taken from a chart. Fig. 11 illustrates the nature of the operation. The spaces between the spotting positions are turned taper by swiveling the compound rest of the lathe, first removing its screw, and pushing by means of a bar from a second carriage on the lathe bed. The traverse is $\frac{5}{16}$ in. to $\frac{3}{8}$ in. per revolution; thus the tool is always bearing on two wires.

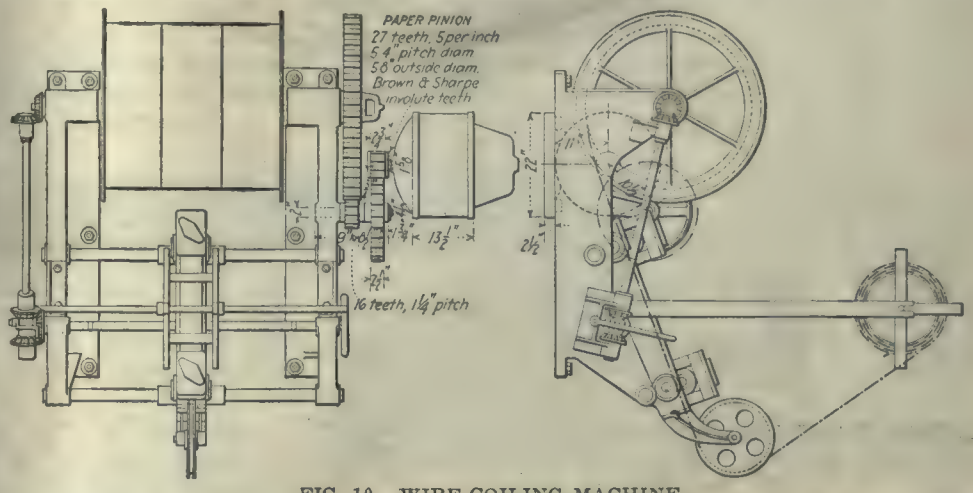


FIG. 10. WIRE-COILING MACHINE

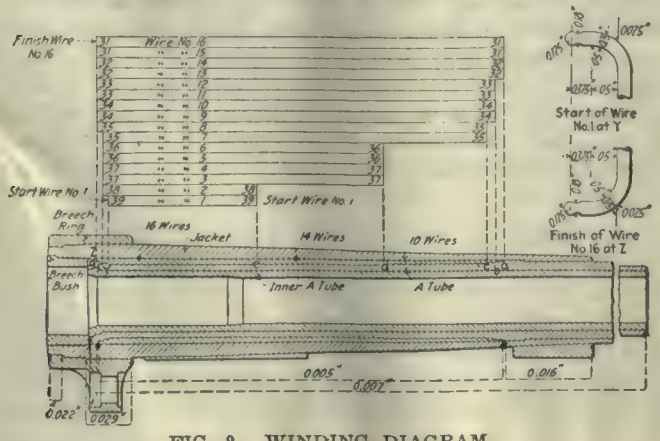


FIG. 9. WINDING DIAGRAM

At the same operation a broad cut is taken for finishing the muzzle end as far as possible which is roughed down to within 0.015 in. or 0.02 in. of size and then finished in about three broad cuts, the traverse being $\frac{1}{2}$ in. per revolution.

The inner A-tube when finished is 141.2 in. long and is bored 8 in. except at the powder chamber. A flange and shoulder are turned at the muzzle end to suit the corresponding recesses in the A-tube, the maximum diameter being 12.1 in. and the tube tapering to about 9.968 in.

Operation 1.—Rough-Turn—Rough-turning may be done in any suitable lathe of about 42-in. swing, the

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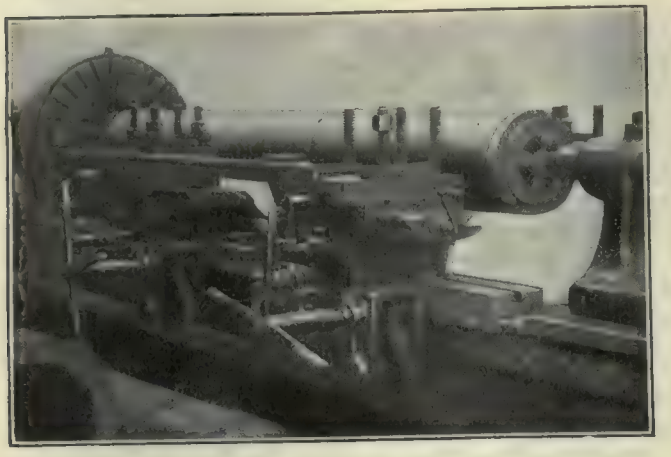


FIG. 11. TURNING THE WIRE

work being held at the muzzle end in a four-jaw chuck and the other end by a flanged center consisting of a circular metal plate centered on one side and bearing a flange taking four setscrews to hold the work. By the means employed for holding and driving, the work can readily be adjusted and centered. Four tools are used, about 1 in. coming off the diameter. The cutting speed is 25 ft. per minute and the feed is 20 per inch. The tools are of 1¾ in. square section, of high-speed steel.

Operation 2.—Rough-Bore—Rough-boring is much the same as for the outer A-tube, 0.75 in. being left on the diameter. A double-ended machine is employed, boring from each end, the work being driven by a chuck and running in a cylindrical fixture. In the case of the inner A-tube the boring is always initially from the solid. The cutting speed is 20 ft. to 25 ft. per minute.

Operation 3.—Heat-Treat.

Operation 4.—Cut Off Test Pieces.

Operation 5.—Re-Turn and Cut Off Excess Material—This process again corresponds with operation 5 on the outer A-tube, about ¼ in. being left on the diameter and 1¾ in. to 2 in. on the length.

Operation 6.—Rebore and Rough Chamber—The work is done to within 0.4 in. of finished diameters, and either a double-ended or single-ended machine may be employed, the job being run in cylindrical fixings. A knife tool of 1¼-in. square, high-speed steel is employed, backed by wooden packings on the bar, which are about 14 in. long and fit the bore, the tube face being cut by chisel in order to skim the wood blocks to the required size. The chamber is roughed parallel for a length to within about 1 in. from the start of the cone.

Operation 7.—Finish-Turn for Building—The work is driven in the lathe by a four-jaw chuck and supported at the breech end by a star center or conical expanding center. The tube is turned to within 0.015 diameter and then finished to gages supplied; a broad cut is taken, the speed being 20 ft. per minute and the feed ½ in. per revolution, three cuts being common.

PERSONALS

First Lieut. John A. Litzenberg has been discharged from the service. His duty overseas was repairing artillery. He was formerly employed by the Union Sugar Co., Batteravia, Calif.

* * *

Capt. Charles A. Straw, Jr., a Harvard graduate and whose permanent address is 1206 10th St., Washington, D. C., has received his discharge. He was formerly in the U. S. Patent Office and is a chemist.

* * *

Lieut.-Col. Charles E. Warren, of 60 East 42nd St., New York, who was transferred from the Q. M. C., as major, in May, 1917, has returned to civil life. He is a graduate of the University of California and is a banker.

* * *

Capt. Gar. A. Roush, whose home is at South Bethlehem, Penn., is a graduate of Indiana University and attended the University of Wisconsin. Before being commissioned, he was a professor of metallurgy at Lehigh University.

* * *

Capt. Floyd Evans, whose home is at 305 Fullerton Parkway, Chicago, Ill., was commissioned first lieutenant in July, 1917, and discharged in March, 1919. He is a graduate of Yale and was formerly with Butler Bros., at Chicago.

* * *

Capt. Gordon M. Evans, whose permanent address is 418 West 160th St., New York, has returned to civil life. He is a graduate of Cornell and was formerly engineering executive with the Menominee Motor Truck Co., Menominee, Mich. He has been on duty in the Manufacturing Division.

* * *

Maj. Milo M. Case was discharged recently after 21 months' service. He has been Army Inspector of Ordnance at the Bethlehem Steel Works. Major Case is a graduate of Lombard College and before entering the service was in business for himself as mechanical engineer. His permanent address is 6347 Greenwood Ave., Chicago, Ill.

* * *

Capt. Alexander Donald, whose permanent address is 825 Garfield Building, Cleveland, Ohio, and who was commissioned first lieutenant Nov. 17, 1918, has returned to civil life. His work in the Ordnance Department has been on motor vehicles and mobile repair shops. In civil life he was employed by the Hannah Engineering Works, Chicago, Ill.

* * *

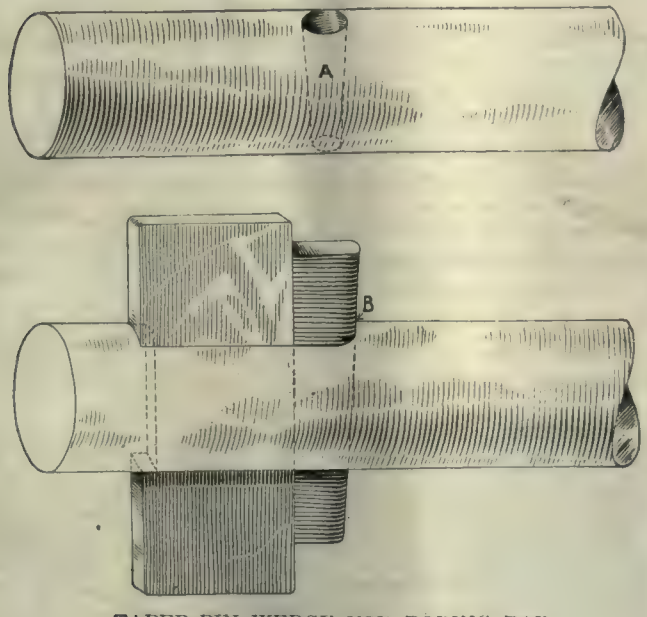
Maj. George S. Hardenbergh, whose home address is Eighth and Wacouta Sts., St. Paul, Minn., left the service on his return to America. Major Hardenbergh was commissioned first lieutenant in August, 1917, and twice promoted. In the service his work has been in connection with inspection of leather products, which is in line with his work in civil life. He is a graduate of Yale.



Taper-Pin Wedge for Boring Bar

By S. B. Royal

I consider the following to be the simplest and cheapest method of securing the tools in a boring bar. Before making the slot for the tool a hole *A* in the cut is drilled and reamed in the bar to accommodate a



TAPER-PIN WEDGE FOR BORING BAR

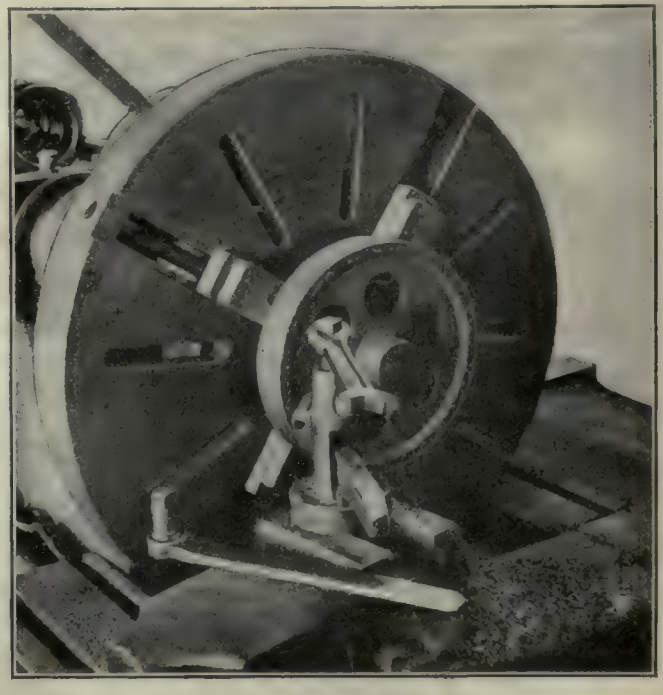
suitable size taper pin. The rectangular slot is then cut for the boring tool, the taper hole just reamed forming one end of the slot. A taper pin is filed flat on one side parallel with its axis and is case-hardened. The whole is assembled as shown at *B*, the taper pin forming a wedge that will never come loose.

An Old Lathe Chuck

By John Drew

A lathe chuck which has been in use for forty years is shown in the accompanying illustration. It was built as a special proposition, large lathe chucks not being so easily obtainable in those days as they are at present.

Notwithstanding its long period of service, the chuck is in perfect condition and has never cost a cent for repairs. This argues two things: good design and workmanship in the first place, careful and judicious handling in the second. Though constructed so many years ago, the chuck embodies some features that are usually considered as modern design. The outer piece of each jaw is held to its jaw by two fillister-head screws and a generous rib, so that its position can be reversed. The jaws are of steel and have ample bearing surfaces on the chuck body. The screws have hollow heads which come flush with the periphery of the flange and thus avoid the dangerous projecting heads that so often appear on chucks in common use. The



AN OLD LATHE CHUCK

wrench is shown lying on the apron of the compound rest.

Though the chuck is by no means heavy in proportion to its diameter of 30 in., it runs as true and grips as firmly as it did when new. As may be seen, it was right on the job when the picture was made, being stopped only long enough to make the necessary exposure with the camera.

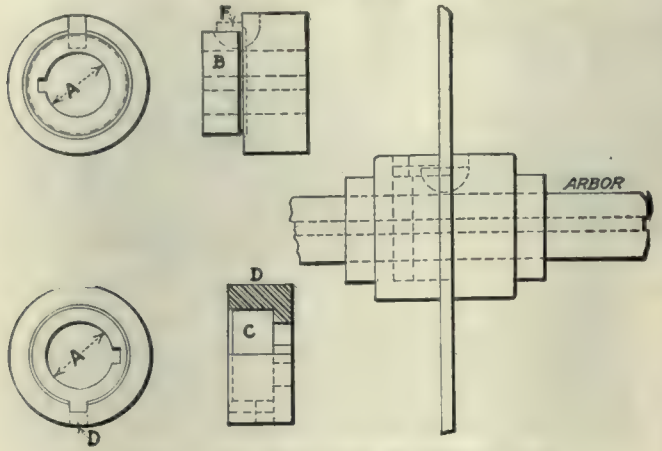
Holding a Slitting Saw on the Arbor

By Frank H. Walker

Herewith is a sketch of a special bushing for holding slitting saws on a milling-machine arbor.

It has been my experience in using large saws to have the saw bind, causing it to turn on the arbor. This often resulted in damaging the arbor, making it difficult to remove the saw and rendering it unfit for further service.

This bushing is made of machinery steel, pack-hardened, and ground. The holes *A* are made to fit the arbor. The shoulder *B* is ground to fit the hole in the saw. The recess *C* in the collar *D* is also of this



COLLAR FOR HOLDING SLITTING SAW

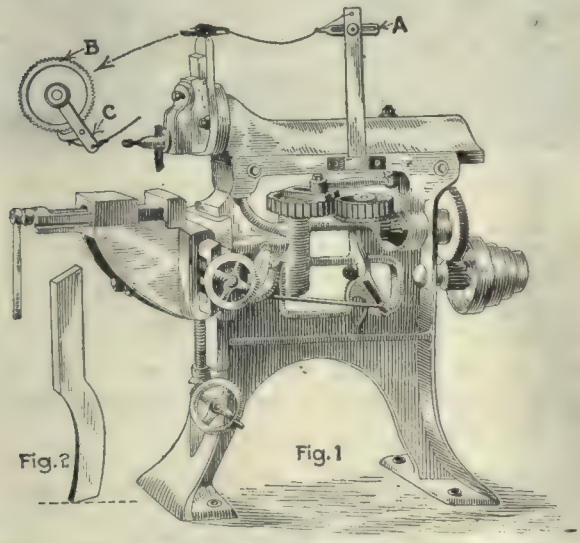
diameter. By keying the bushing to the arbor at *E* and to the saw at *F* and slipping on the collar *D*, it can readily be seen that if the saw slips it will merely shear off the key, which can easily be replaced.

Old Shaping Machine Rigged Up to Cut Off Stock

By F. W. Bach

In my apprentice days I remember seeing an old shaping machine rigged with a home-made automatic down feed which excited my curiosity and admiration.

The ram of the machine was driven through the medium of a pair of elliptic gears rotating in a horizontal plane, a moveable stud in the face of the driven gear and a connecting-rod. The stud was made with



FIGS. 1 AND 2. OLD SHAPING MACHINE RIGGED FOR CUTTING OFF AND THE CUTTING TOOL

a large T-head to slide in a radial slot on the gear, and the stroke of the ram was adjustable by loosening the binding nut on the top of the stud and setting the latter at the proper distance from the center upon which the gear revolved.

The machine was in use for cutting off 6-in. square bars of steel for drop dies, and except for resetting the bar for each cut and an occasional grind of the parting tool it required as little attention as a power hacksaw.

At the side of the machine shown in Fig. 1 was bolted a bracket and upright post carrying the adjustable bar *A*, which was slotted and held to the post by a stud and thumb nut.

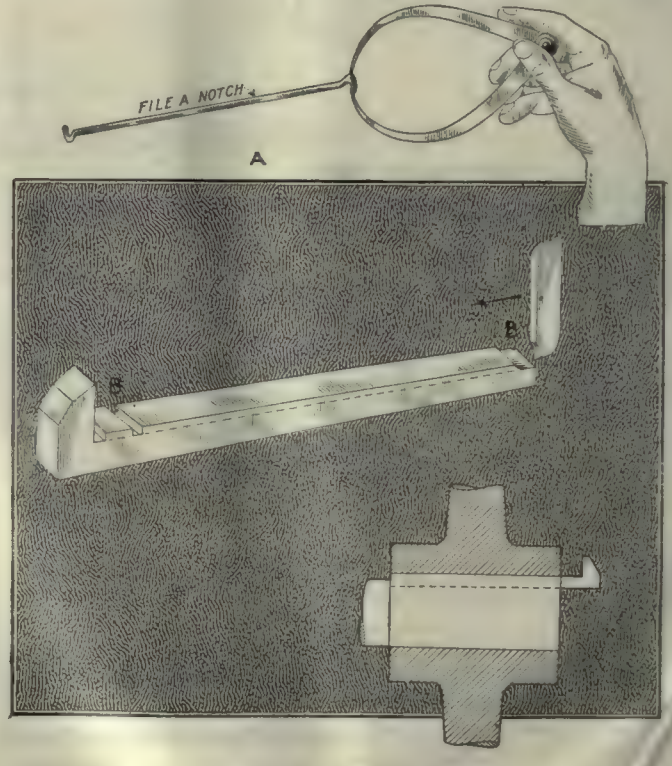
On the vertical feed screw was keyed the large ratchet *B*, on the hub of which was mounted the swinging arm *C* bearing the pawl.

A piece of belt lace completed the "feed works." The bar *A* was set so that the swinging arm struck it at the inner end of each stroke and was thus pushed forward to give the desired amount of feed while the length of the belt lace was so calculated as to pull it back at the outer end of the stroke. The tool used is shown in Fig. 2.

Fitting a Taper Key

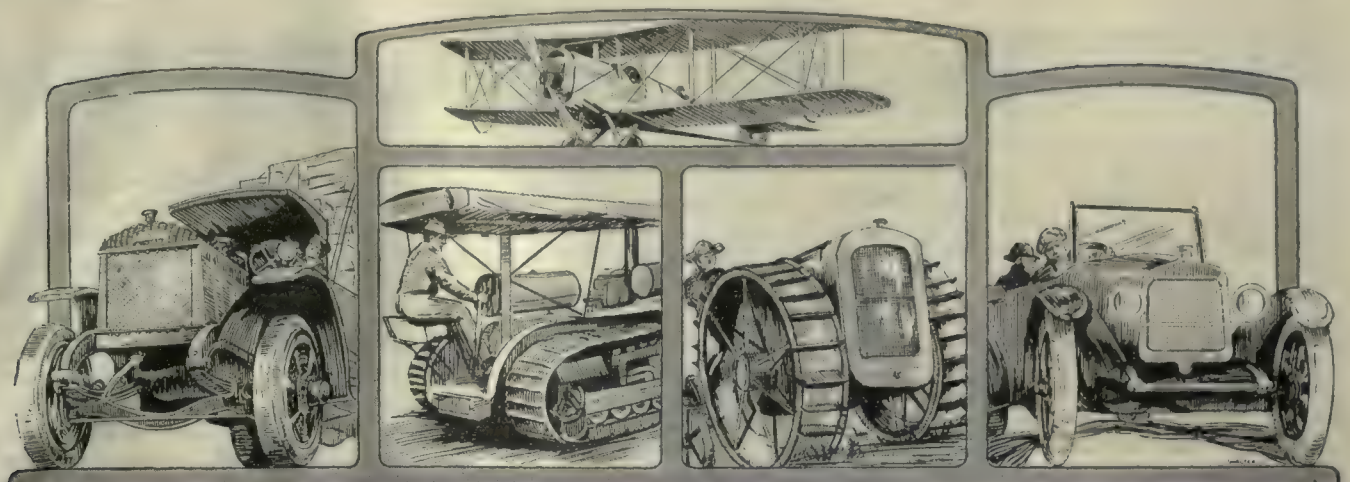
By M. Jacker

Instead of following the usual method of cut and try when fitting taper keys, take a wire of suitable size and bend it to the shape shown at *A* in the sketch. If the key is not to pass clear through the hub, determine the distance it is to enter and file a notch in the wire at this distance from one of the bent-up points. Next, file off the point of the wire until the latter goes into the keyway as far as the notch; the other point is then fitted to the large end of the keyway. Now file notches



FITTING A TAPER KEY

in the key as indicated at *B*, determining their depth by transferring the measurements from the points of the wire gage by means of ordinary calipers. The key may now be placed in the vise of the shaping machine, the tool set to the filed surface at the bottom of the notches and the key planed to the right taper on the first trial.



AUTOMOTIVE CONSTRUCTION

Finishing Operations on Liberty Motor Cylinders

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit, Mich.

The finishing operations involve the use of some interesting fixtures, as shown by the illustrations. Many of these should be equally useful in other lines of work. The data concerning machines and tools used, as well as the time required, will be of value to those who are interested in production.

BEFORE proceeding further with machine operations, a preliminary water-test inspection is given each cylinder by putting air pressure in the water jacket and submerging it in water. Any defects are then corrected in the welding repair department shown in Fig. 1.

FINISH-TURNING THE PILOT DIAMETER AND FACING THE LOWER SIDE OF THE FLANGE—This operation is done on a 16-in. geared-head Reed lathe holding the cylinder on an expansion collet and locating for length from the inside of the dome. The pilot is then turned true with the bore, the flange faced true, and at the proper distance from the inside



FIG. 1. MAKING WELDING REPAIRS

AUTOMOTIVE CONSTRUCTION

of the dome, allowing grinding stock on both diameter and face. The capacity of one machine was 300 per day of nine hours, with a cutting speed of 111 ft. per minute and a feed of 0.025 in. per revolution.

FINISH-BORING, REAMING AND CHAMFERING—This is done on 3½-in. Acme turret lathes, with a special hollow hexagon turret, as shown in Fig. 2. The cylinder is located from the diameter and flange, finished in a preceding operation, in a loose adapter plate and held in place by four hook bolts on the flange. This adapter has a dowel fit in a special steadyrest chuck, to which it is attached by bolts through four keyhole slots in the adapter plate. The cylinder is then chamfered in the skirt in the first turret station. In the second it is bored with a single-point tool and the skirt faced to the proper length. The third station has a bar in the end of which are two tools set opposite, which finish-bore. Just behind these tools in the bar is a double-blade floating reamer of the "Kelly" type. This operation straightens out the bore which is distorted by the relieving of strains in the heat-treatment, and bores it true with the pilot diameter and flange face. One man produced 80 cylinders in nine hours on each machine; 18 machines being used, with a cutting speed of 146 ft. per minute and a feed of 0.0625 in. per revolution.

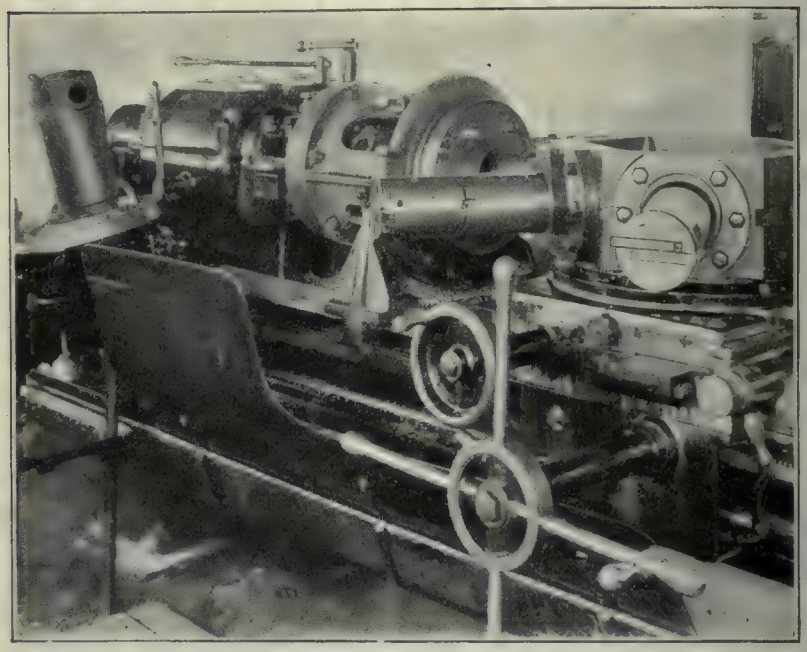


FIG. 2. FINISHING THE CYLINDER BORE

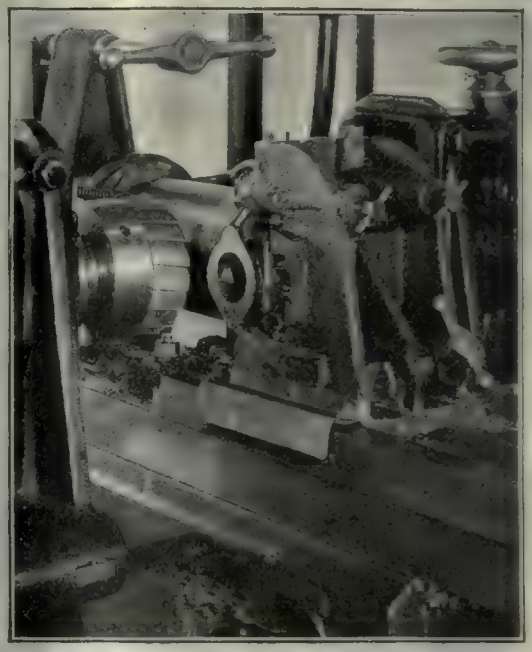


FIG. 3. MILLING THE PORT FLANGES

ROUGH-MILLING THE EXHAUST AND INTAKE FLANGES—A Duplex or double-spindle milling machine is used, with 6-in. diameter face mills, Fig. 3. The cylinder is located centrally on an expansion collet and for rotation by one of the flats on the bolt flange; this being the location point for welding on the port elbows. This operation consists of straddle-milling the port flanges allowing 0.010 in. for finish. The capacity per machine was 320 per day, with a cutting speed of 94 ft. per minute, and a feed of 0.083 in. per revolution.

DRILLING, REAMING, COUNTERSINKING AND SPOT-FACING THE VALVE-STEM GUIDE HOLES—This is done on a 21-in. drill press, using an index jig which allows both holes to be drilled in one setting. The cylinder is located centrally on a solid pilot in the bore and radially by equalizing clamps on the port flanges. This is shown in Fig. 4, which also shows the tools used.

The cylinder comes to this operation with a ½-in. hole already drilled in the elbows. The ½-in. hole is followed by a $\frac{21}{32}$-in. three-lip drill. A combination countersink and spot-face tool piloted in the drill bushing is next used, and is followed by three progressively sized pilot reamers to bring the hole to 0.685 in. in diameter, which allows 0.002 in. for hand reaming. Tool changes are accomplished by means of Wiard chucks. The capacity was 175 per day, using a cutting speed of 50 ft. per minute, and hand feed.

HAND-REAMING THE VALVE-STEM GUIDE HOLE—The cylinder is held in a fixture, which clamps on the skirt of the cylinder. The fixture is attached to a small bench, and the holes are hand-reamed to size, using a standard hand reamer and wrench. The output of this operation was about 270 per day.

DRILLING 10 BOLT HOLES IN THE FLANGE—A 20-spindle Natco multiple drilling machine is used, drilling two cylinders at a time. The tooling equipment consists of four jigs, as shown in Fig. 5. These are so situated on a rotating table that two jigs may be loaded while the other two are under the spindles and in operation.

The cylinder is hung upside down in the horseshoe ring by the bolt flange in the stationary, or lower part of the jig and located radially in relation to it by two hardened plugs in the valve-stem guide holes, locating in the slot in a hardened strip on the base of the jig. The bushing plate is a loose piece which locates over the cylinder on the pilot diameter and which locates itself and the cylinder in relation to the lower part of the jig by two hardened dowel pins. It is held down by two latches. The capacity of the machine is 900 per day with a cutting speed of 40 ft. per minute and feed of 0.048 in. per revolution.

AUTOMOTIVE CONSTRUCTION

REAMING THE EXHAUST AND INTAKE PORTS—This is done with a shell reaming machine through a bushing. The cylinder is held on an expansion collet, located by swinging the jig, Fig. 6, out from under the spindle of the drill press, and putting a three-point expansion locater through the bushing into the rough hole, before tightening up the collet, the idea being to merely clean out the welding flash in the rough hole. The capacity of the machine was 300 per nine-hour day.

REAMING, COUNTERBORING, SPOT-FACING AND TAPPING THE SPARK-PLUG HOLE—For this operation a 12-in. Cincinnati-Bickford drill press is used. The fixture has a solid pilot in the bore set at the proper angle and locating radially by a dowel in one of the bolt holes. The hole is re-drilled, spot-faced and counterbored with a combination tool, and tapped by running a tap clear through. The tap is 0.010 in. undersize on the pitch diameter to allow for hand tap. The capacity of the machine is 288 pieces in nine hours, with a reaming speed about 69 ft. per minute.

REAMING THE VALVE, CHAMFERING, SPOT-FACING AND MAKING THE VALVE SEAT—This is done on a 12-in. Cincinnati-Bickford drill press. The cylinder is hung upside down by the flange on an index trunnion. The indexing is done by a sliding pilot, in line with the drill spindle up through the valve-stem guide hole which also pilots the cutters. The operation is to ream the chamber with one bar, and seat and spot-face with another combination tool. This is shown in Fig. 7. The capacity was 255 pieces in nine hours, with a cutting speed on the reamer about 73 ft. per minute.

COUNTERSINKING THE INSIDE OF THE SPARK-PLUG HOLE—For this operation a 12-in. Avey drill press is used with a 13-in. riser in post. The cylinder hangs upside down, by the flange, in a trunnion which allows both holes to be countersunk with a $\frac{15}{16}$-in. drill. About 1000 pieces per day were produced on one drill press.

ROUGH-MILLING THE CAM HOUSING BOSSES—This is done on a No. 6 Whitney hand milling machine, with a 1½-in. six-fluted end mill. The fixture locates the cylinder for length from the under side of the bolt flange, and axially on an expansion collet in the bore. The capacity was 920 pieces per machine with a cutting speed of 35 ft. per minute.

DRILLING AND TAPPING THE CAM HOUSING BOSSES—A 10-in. Cincinnati drill press with tapping attachment is used. The cylinder is located axially on a solid pilot in the bore and radially from one of the holes in the bolt flange, as in Fig. 8. The holes are drilled and then the bushing is swung out of the way and the holes are tapped. With a cutting speed of 32 ft. per minute, one man did 350 pieces in nine hours.

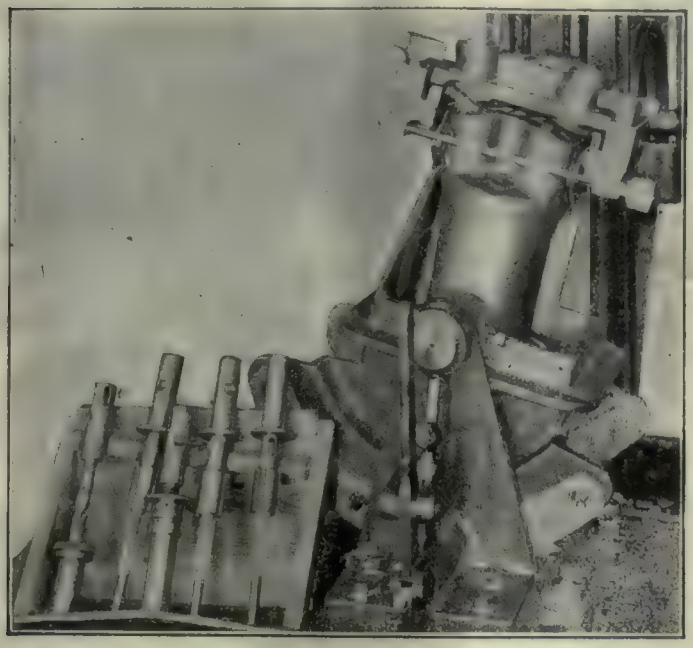


FIG. 4. DRILLING THE VALVE-STEM GUIDES

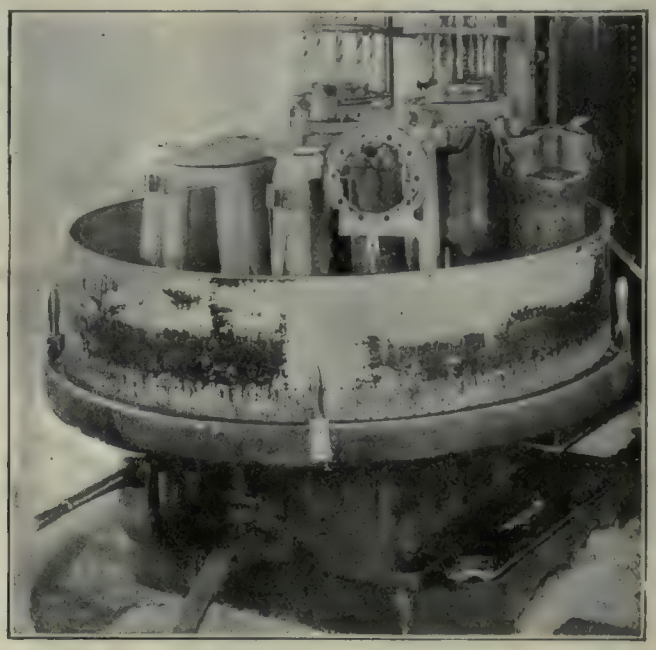


FIG. 5. DRILLING BOLT HOLES IN THE FLANGE

SLOTTING THE FLANGE BOLT HOLES—A No. 2 plain Cincinnati milling machine is used, having two cutters suitably spaced on the arbor. The cylinder is located from the pilot diameter, clamped on the flange, and located radially by one of the bolt holes in the flange. The operation is to mill two slots, take the cylinder out, turn it over and mill the other two slots. The capacity of the machine was 900 in nine hours, with a cutting speed of about 63 ft. per minute.

HAND-TAPPING THE SPARK-PLUG HOLE—The same kind of a stand and fixture is used in this operation as in hand-reaming the valve-stem guide holes. Both holes are then tapped with a standard handtap 18 mm. x 1.5 mm. with a special extension tap wrench. The capacity was about 280 per day.

The cylinder is now washed in a hot soda solution to remove the grease and oil before grinding. It is next given a rough inspection before further operation.

ROUGH-GRINDING THE PILOT AND FLANGE TO REMOVE BURRS—The swivel table is removed from a Norton 10 x 32 plain grinding machine and a special head substituted which holds the cylinder on an expansion collet in the bore and locates for length from the inside of the dome. The output was about 800 per day.

AUTOMOTIVE CONSTRUCTION

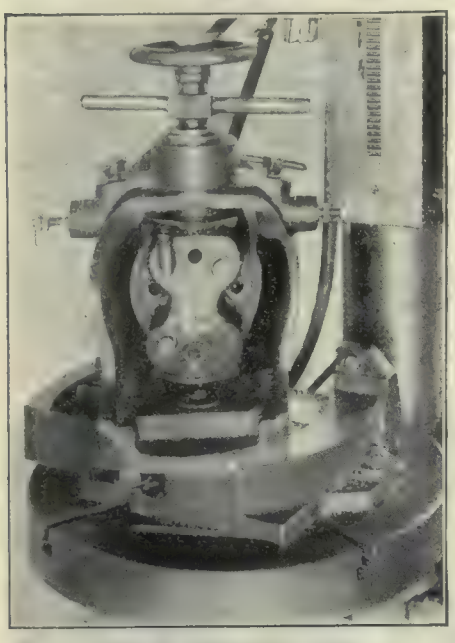


FIG. 6. REAMING THE PORTHOLES

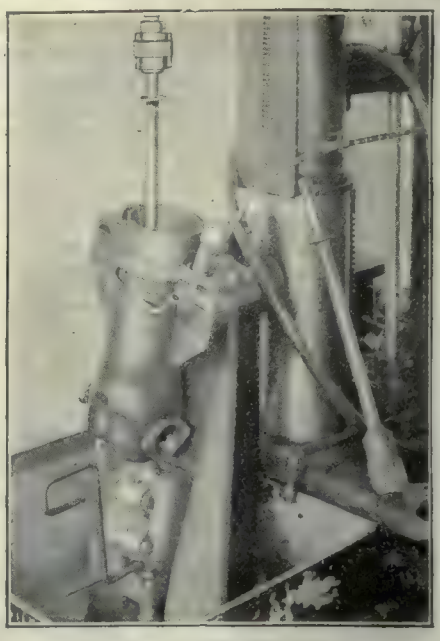


FIG. 7. MACHINING THE VALVE SEAT

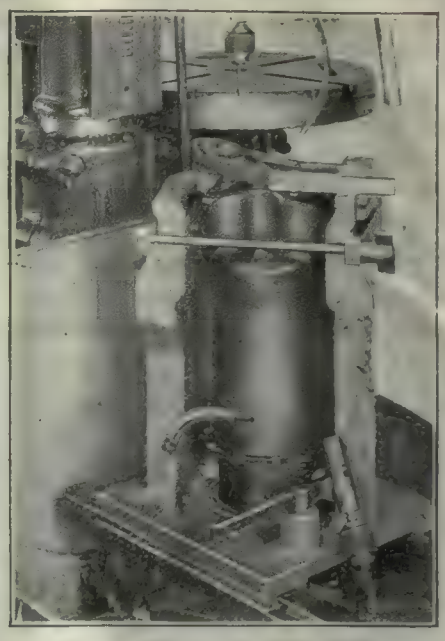


FIG. 8. DRILLING FOR THE CAM HOUSING

ROUGH-GRINDING THE BORE TO 4.993 IN.—This is done on a Heald No. 60 cylinder grinding machine, the cylinder being located in the fixture by the pilot diameter and the bolt flange. From three to four cuts are required to bring it to size. The capacity of the machine was 45 cylinders per day, with the wheel having a cutting speed of about 98 surface feet per minute, and the longitudinal feed, about 0.144 in.

FINISH-GRINDING THE BORE TO 4.999 IN. TO 5.001 IN.—The machine and tools are the same as in the preceding operation, this operation being to bring to size and a good finish. Fig. 9 shows the cylinder in the fixture. The cylinder is given a second washing to remove the emery and grit of the grinding operations.

FINISH-GRINDING THE PILOT AND THE BOLT FLANGE TO SIZE—The machine and tools are the same as for rough-grinding the pilot and the flange, with the exception that a special indicator is attached to the special headstock for gaging the face of the flange from the inside of the dome. The wheel used is a Norton 20 x 3 x 12 in., combination 3836 M., with a surface speed of about 235 ft. per minute. The capacity was 170 pieces per day.

FINISH-MILLING THE CAM HOUSING BOSSES—This is done on a No. 2 plain Cincinnati milling machine, using a spiral slab mill. The cylinder is located from and clamped on the flange face. The fixture shown in Fig. 10 is used, with a test fixture, and two dial indicators.

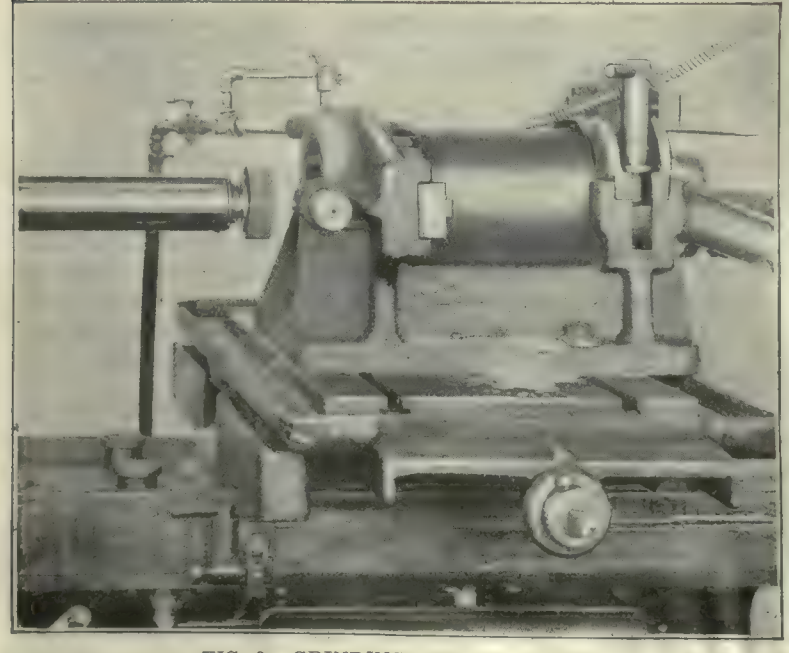


FIG. 9. GRINDING THE CYLINDER

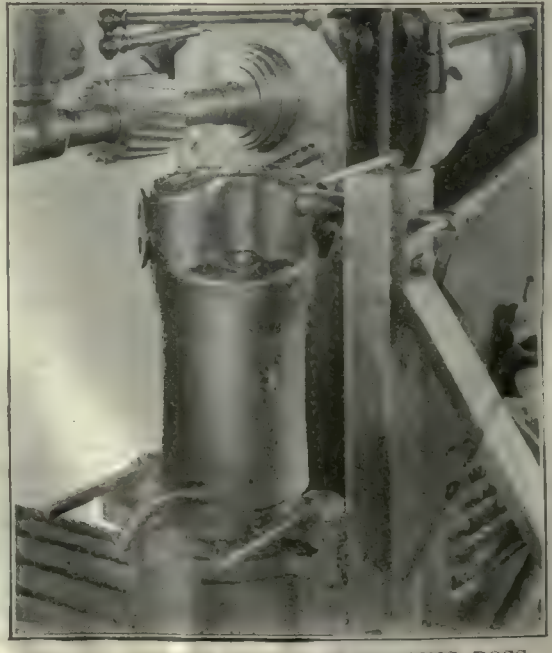


FIG. 10. MILLING THE CAM-HOUSING BOSS

AUTOMOTIVE CONSTRUCTION

The capacity of one machine was 350 pieces per day, with a surface speed of 84 ft. per minute and a feed of 0.071 in.

REAMING 10 HOLES IN THE BOLT FLANGE—This operation is done on a single-spindle 24-in. Reed-Prentice drill press with a 10-spindle head. The operation is to bring the holes to size and concentric to the pilot diameter. The production was 1000 pieces per day, with the speed of the drills running at about 30 ft. per minute.

FINISH-FACING THE TOP OF THE FLANGE—In this operation the cylinder is held on an expansion collet in the bore, on a 16-in. lathe, Fig. 11, and located for length on the under side of the flange. A special hook

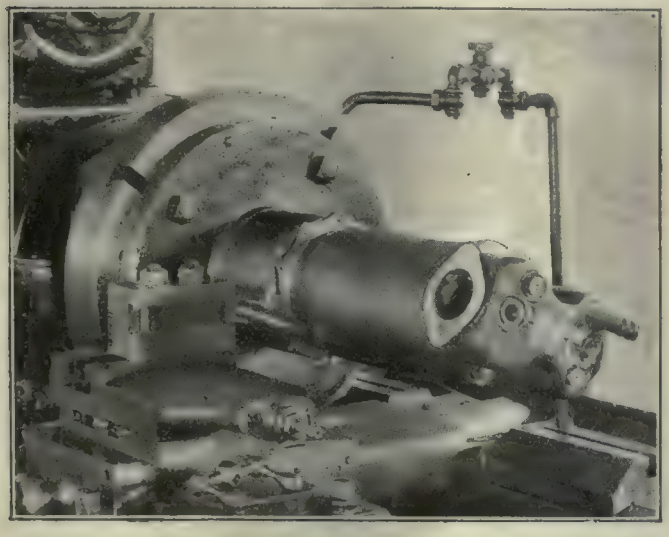


FIG. 11. FINISHING THE TOP OF THE BOLT FLANGE

toolholder is required to dodge the lower water pipe. The production was 150 pieces per day, with a cutting speed of 71 ft. per minute and a feed of 0.016 in. per revolution.

FINISH-MILLING THE INTAKE AND EXHAUST FLANGES—This is done on a Garvin duplex milling machine and is practically the same as the rough-milling operation except that the cylinder is located axially on the pilot diameter and clamped on the flange instead of a collet in the bore. The production was 300 per day on one machine, with the cutting speed about 141 ft. per minute, and feed of 0.0435 in.

DRILLING THE EXHAUST AND INTAKE PORT FLANGE HOLES—A 14-in. single-spindle Leland-Gifford drill press is used. The cylinder is located in the reversible jig by the pilot diameter, clamped on the flange and located radially by hardened blocks on the port flanges. The production was 350 pieces per day.

TAPPING THE PORT FLANGE HOLES—This is done on a Garvin automatic tapping machine, the cylinder being held in a cradle while under operation. The tap used is $\frac{3}{8}$ in. x 24 in., about 0.010 in. undersize. The production was 300 pieces per day.

COUNTERSINKING THE HOUSING AND PORT FLANGE HOLES—An 82-deg. countersink is used in a single-spindle Leland-Gifford drill press, the cylinder being set on the table for the housing boss holes and held up to the cutter on the port flange holes. The capacity was 900 per day.

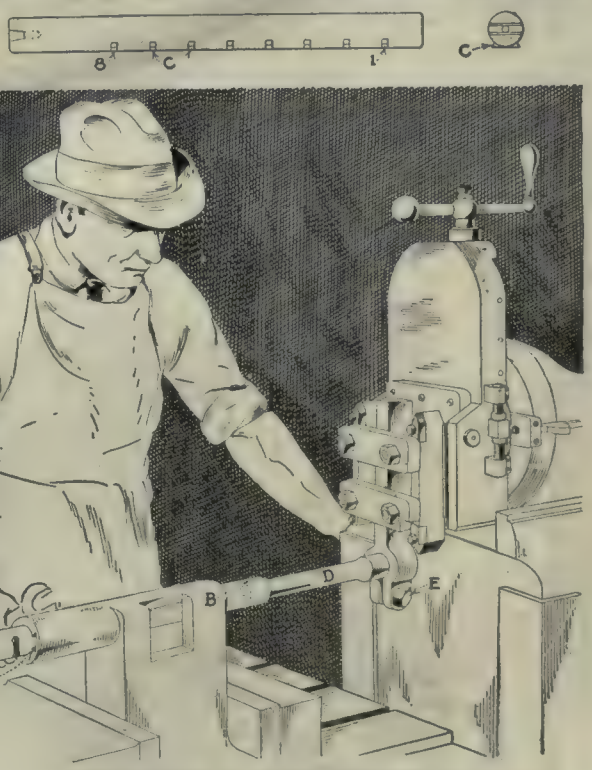
The cylinder is then washed out and cleaned all over in boiling soda water. A final inspection is given before the studs and valves are assembled to it.

Broaching in a Shaping Machine

BY CHARLES RUNZI

The problem of cutting the dovetailed slot at *A* in the rear sight bracket shown in the figure was solved by the construction of six special broaches and the holder shown at *D*. The slot had to be perpendicular to the base of the bracket and its depth was limited to a variation of 0.0005 in.

The job was done in a shaping machine and the holder mentioned above was made up to fit the toolholder of the ram. An auxiliary ram, shown in position in the holder, was constructed with a tongue to fit the groove *B* in the end of each broach. The broaches were made



BROACHING A SIGHT BRACKET

of machine steel turned down 0.0005 in. smaller than the hole in the bracket and the cutters were peened in place as shown at *C* and ground. The widths of the eight cutters increased uniformly, and as there were six broaches for the job, this meant the making of 48 cutters of assorted sizes.

The actual operation was performed in the following manner. The holder was fastened in the toolpost of the shaping machine, and the capscrew *E* was loosened to allow the auxiliary ram to be set so that the bases of the cutters were square with the table. When the broach and work had been squared up they were champed to the holder and table respectively, and the job was quickly done by pushing the broaches through in order.

CHART FOR USE IN APPRAISAL OF STANDARD MACHINE TOOLS TO DETERMINE SERVICE VALUE.

A IN USING THIS CHART ASCERTAIN FROM BEST SOURCES, AS COMPLETELY AS PRACTICABLE, PREFERABLY FROM SHOP SUPERINTENDENTS, FOREMEN, U S INSPECTORS OR PLANT RECORDS, FOR EACH TOOL OR GROUP OF TOOLS:
1. ACTUAL TIME OF USE IN YEARS,
2. AVERAGE NUMBER OF HOURS PER DAY IN USE,
3. CLASS OF USAGE AND UPKEEP (SEE CURVES BELOW).

B REDUCE THE ACTUAL TIME OF USE (A1) TO THE EQUIVALENT STANDARD 8 HR DAY USAGE BY THE REDUCTION FACTOR OBTAINED FROM SMALL CHART ON THE RIGHT.

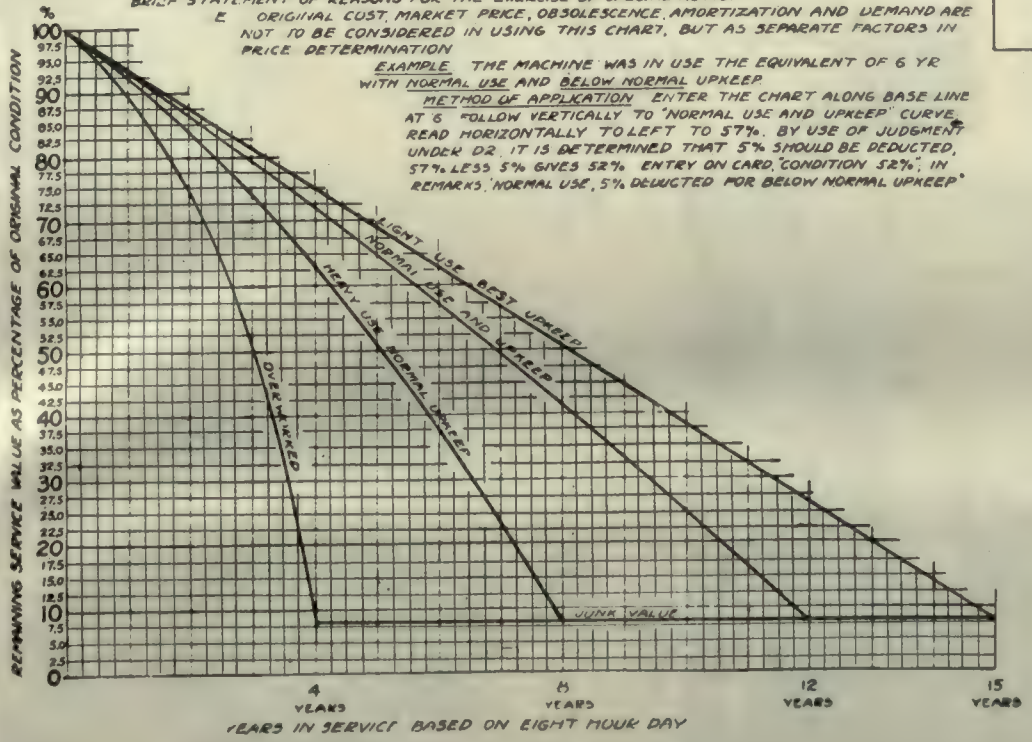
C ENTER MAIN CHART BELOW WITH EQUIVALENT YEARS OF USE (B) ON BASE LINE, READ VERTICALLY TO APPROPRIATE CURVE (A3), THEN HORIZONTALLY TO LEFT FOR PERCENTAGE OF CONDITION. THIS PERCENTAGE IS TO BE RECORDED ON INVENTORY CARD UNLESS ALTERED IN ACCORDANCE WITH PARAGRAPH FOLLOWING (D).

D EXAMINE THE TOOL FOR EVIDENCES OF:
1. EXCEPTIONALLY GOOD CARE MAINTENANCE AND OPERATION, ABOVE NORMAL. IF JUSTIFIED, THE PERCENTAGE DERIVED UNDER PRECEEDING PARAGRAPH (C) MAY BE INCREASED, BUT NOT TO EXCEED FIVE (5%) PERCENT.
2. ABUSE OR EXCEPTIONALLY POOR CARE, EITHER IN USAGE, UPKEEP, HANDLING OR STORAGE, BELOW NORMAL. IF JUSTIFIED THE PERCENTAGE DERIVED FROM PRECEEDING PARAGRAPH (C) MAY BE DECREASED, BUT, IN GENERAL, NOT MORE THAN TEN (10%) PERCENT. THE USE OF THE OVERWORKED CURVE WILL COVER MOST CASES.
3. BROKEN OR MISSING STANDARD PARTS OR EQUIPMENT. THIS CAN BE TAKEN CARE OF BY AN APPROPRIATE REDUCTION FROM THE PERCENTAGE PREVIOUSLY DETERMINED, UNLESS COST OF REPLACEMENT CAN BE ESTIMATED WITH REASONABLE ACCURACY, WHICH IS PREFERABLE.
4. THE PERCENTAGE DETERMINED BY CONSIDERATION UNDER PARAGRAPH C, AS ALTERED UNDER PARAGRAPH D, IS TO BE ENTERED ON THE INVENTORY CARD, AND NOTED IN "REMARKS" WITH BRIEF STATEMENT OF REASONS FOR THE EXERCISE OF SPECIAL ACTION.

E ORIGINAL COST, MARKET PRICE, OBSOLESCENCE, AMORTIZATION AND DEMAND ARE NOT TO BE CONSIDERED IN USING THIS CHART, BUT AS SEPARATE FACTORS IN PRICE DETERMINATION.

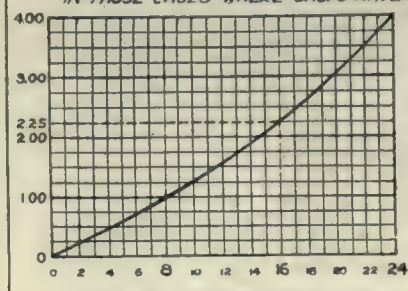
EXAMPLE. THE MACHINE WAS IN USE THE EQUIVALENT OF 6 YR WITH NORMAL USE AND BELOW NORMAL UPKEEP.

METHOD OF APPLICATION. ENTER THE CHART ALONG BASE LINE AT 6, FOLLOW VERTICALLY TO "NORMAL USE AND UPKEEP" CURVE, READ HORIZONTALLY TO LEFT TO 57%. BY USE OF JUDGMENT UNDER D2, IT IS DETERMINED THAT 5% SHOULD BE DEDUCTED, 57% LESS 5% GIVES 52%. ENTRY ON CARD, "CONDITION 52%"; IN REMARKS, "NORMAL USE, 5% DEDUCTED FOR BELOW NORMAL UPKEEP."



REDUCTION FACTOR

THIS CHART IS TO BE USED IN CONJUNCTION WITH THE MAIN CHART TO OBTAIN UNIFORMITY OF RESULTS IN THOSE CASES WHERE SHOPS HAVE OPERATED AT OTHER THAN 8 HR PER DAY, ON WHICH THE MAIN CHART IS BASED.



HAVING DETERMINED THE NUMBER OF HOURS PER DAY AT WHICH THE TOOL WAS OPERATED (A2), READ FROM THIS NUMBER ON BASE LINE VERTICALLY TO CURVE, THEN HORIZONTALLY TO THE SIDE FOR THE REDUCTION FACTOR.

EXAMPLE. THE MACHINERY IN THE PLANT WAS OPERATED FOR A PERIOD OF 1½ YR (A1) AT 24 HR PER DAY (A2).

METHOD OF APPLICATION: FROM THE CHART THE FACTOR IS FOUND TO BE 4.00. FOR 24 HR USE MULTIPLY THE PERIOD OF ACTUAL USE, 1½ YR, BY FACTOR, 4.00. RESULT 6, WHICH IS THE EQUIVALENT NUMBER FOR YEARS ON 8 HR USAGE AND IS THE TIME TO BE USED IN READING THE MAIN CHART.

CONDITION APPRAISAL CHART

PREPARED BY CONFERENCE WITH VARIOUS WAR DEPARTMENT BUREAUS AND THE WAR INDUSTRIES READJUSTMENT COMMITTEE, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
APPROVED BY THIS COMMITTEE AS BEING IN ACCORD WITH BEST ENGINEERING PRACTICE BY CHARTS AND LETTER, MAY 23, 1919.

RECOMMENDED BY
CLAUDE E FITCH
MAJOR ORD DEPT U S A
SALVAGE BOARD, ORDNANCE DEPARTMENT

APPROVED BY
DWIGHT K SHURTLEFF
LT COL ORD DEPT U S A CHAIRMAN

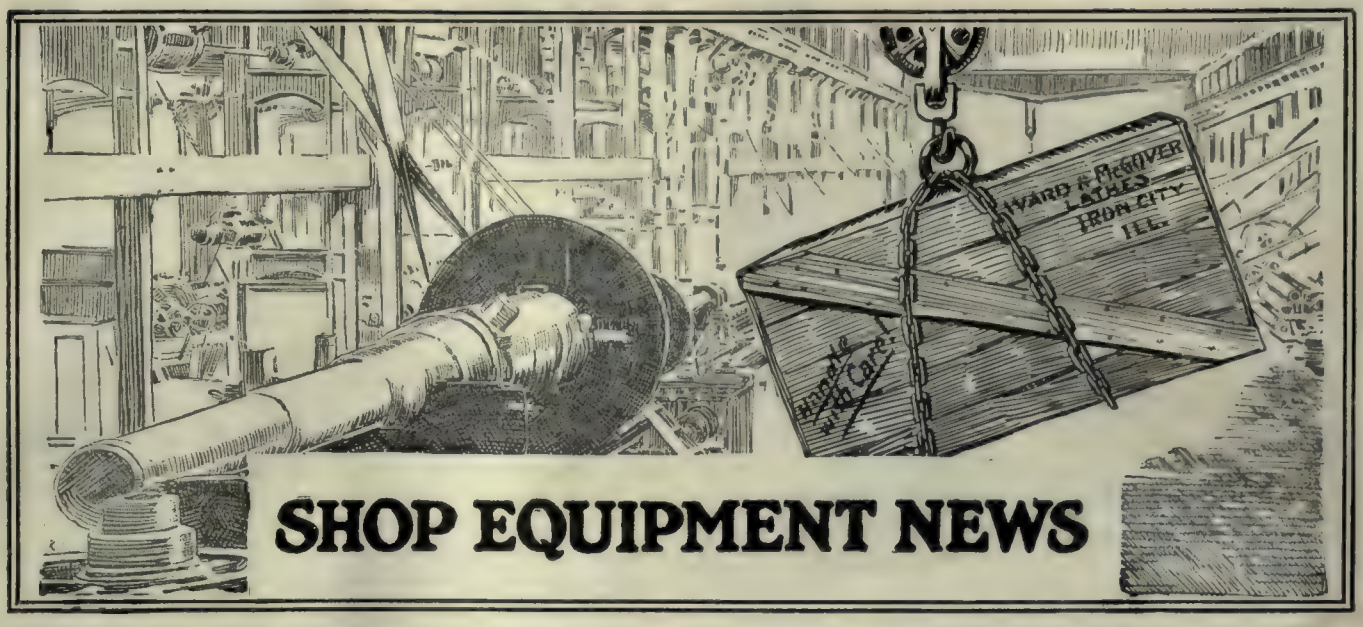
D L LAWRENCE
C S SHOTWELL
CAPT AIR SERVICE, U S A
MATERIAL DISPOSALS DEPARTMENT AIR SERVICE

R P ADAMS
CAPT ENGINEERS U S A
C F GOODWIN
MAJOR ENGINEERS, U S A
MACHINE TOOL SECTION, M O & M SURPLUS PROPERTY DIVISION, PURCHASE STORAGE & TRAFFIC

V C KYLBERG
V C KYLBERG
ASSISTANT CHIEF
C E HILDRETH
C E HILDRETH
CHIEF
MACHINE TOOL SECTION, OFFICE DIRECTOR OF SALES P S & T, GENERAL STAFF, WAR DEPARTMENT

APPROVED
E E MOREE
E E MOREE
FIRST ASST DIRECTOR OF SALES
C W HARE
C W HARE
DIRECTOR
PURCHASE, STORAGE AND TRAFFIC DIVISION GENERAL STAFF, WAR DEPARTMENT

MAY 26, 1919 AAD 440



SHOP EQUIPMENT NEWS

Heald 8- and 12-Inch Rotary Surface-Grinding Machines

Two new rotary surface-grinding machines, the No. 20 with an 8-in. chuck and the No. 22 with a 12-in. chuck, have just been placed on the market by the Heald Machine Co., Worcester, Mass., and while primarily designed for manufacturing purposes, they are capable of producing very accurate and finely finished surfaces. These machines are quite similar, and have been built with the idea of giving a more economical machine than the large-sized ring-grinding machines and also give the same production and finish. The new 8-in. machine is considerably heavier than the other 8-in. machine previously built. They are built massive, but simple, and have all necessary mechanical refinements required to readily obtain the various speeds and adjustments. The wheel slide is a heavy casting, and has flat- and V-ways to assure proper alignment at all times. These bearing surfaces are large and protected from grit and dirt. Another feature that adds greatly to the rigidity is the belt drive, which is so arranged that the downward pull of the belt tends to hold the wheel slide firmly in place.

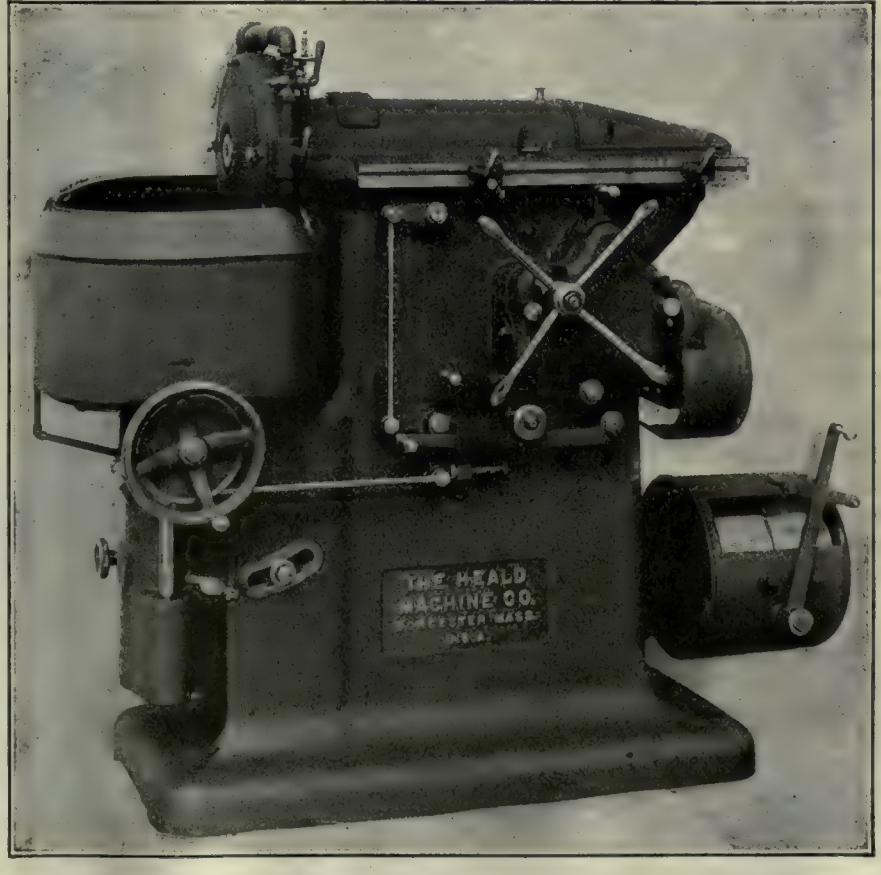


FIG. 1. FRONT VIEW OF THE NEW HEALD ROTARY SURFACE-GRINDING MACHINE

The large wheel spindle is made of chrome-nickel steel and is mounted in a straight, plain, adjustable bronze bearing at the rear. The front bearing is adjustable and can be reached through a hole in the top of the wheel slide, provided for that purpose. The front bearing is lubricated by a sight-feed oiler placed at the right of the wheel guard. Both automatic and hand feeds are provided for the wheel slide through an automatic box of a very simple and rigid design. The main drive bracket is located at the right side of the machine, and receives its power on tight and loose pulleys directly from the main lineshaft. From this bracket the power is transmitted by belt to the main feed box, wheel spindle and pump. The guard over the tight and loose pulleys is adjustable so that the openings can be lined up to suit the belt on any particular drive. The shifting lever can be reached from the operator's position, and is arranged with a spring plunger that locks it in place in either the on or off position. The main speed box is locat-

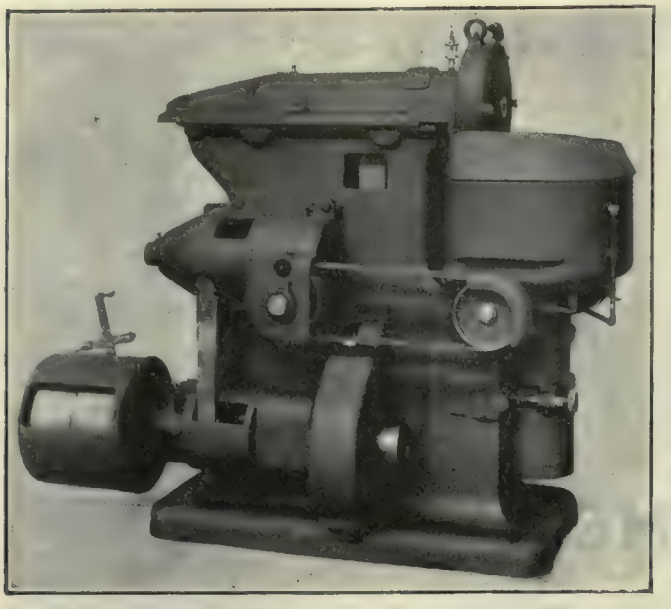


FIG. 2. A REAR VIEW OF THE MACHINE SHOWING VARIOUS FEATURES OF THE DRIVING MECHANISM

Specifications for 8-in. machine: Diameter of magnetic holding surface of standard chuck, 8 in.; face diameter of chuck, 9¼ in.; grinding wheel, 10 in. in diameter with 1 in. face and 3½ in. hole; maximum distance between top of chuck and center of wheel, 8½ in.; maximum distance between top of chuck and face of 10-in. wheel, 3½ in.; minimum diameter grinding wheel used, 6¾ in.; vertical adjustment of chuck, 5 in.; maximum swing inside of water pan, 13 in.; floor space for belt drive machine, 48 x 60 in.

Specifications for 12-in. machine: Diameter of magnetic holding surface of standard chuck, 12 in.; face diameter of chuck, 13¾ in.; grinding wheel, 12 in. in diameter with 1½ in. face and 5 in. hole; maximum distance between top of chuck and center of wheel, 10 in.; maximum distance between top of chuck and face of 12-in. wheel, 4 in.; minimum diameter of grinding wheel used, 7⅛ in.; vertical adjustment of chuck, 5 in.; maximum swing inside of water pan, 16 in.; floor space for belt drive machine, 48 x 70 in.

ed at the rear of the machine and furnishes power to the wheel slide through a set of three-step cone pulleys. It also transmits power to the chuck through a bank of gears giving three speeds. The speeds of the wheel slide and the chuck are independent in order that a great latitude in regard to speeds and feeds may be obtained. The speeds to the chuck are controlled by a pull rod at the front of the machine. A particular feature is that levers and adjustments for the operation of the machine are within easy reach of the operator while standing in the regular working position.

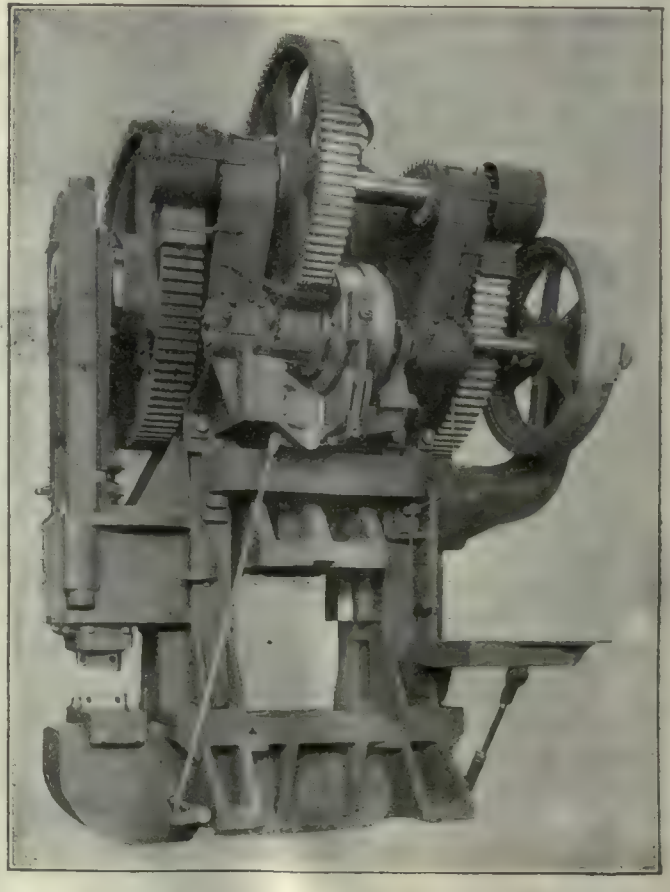
Magnetic chucks, an 8-in. for the No. 20 machine, and a 12-in. for the No. 22 machine are regular equipment, but three-jaw chucks or faceplates with special fixtures may be substituted in case these are more suitable for the work being handled. The chuck spindle is driven by spiral gears, one of which is mounted directly on the spindle, and the chuck bracket is adjustable to permit the grinding of concave or convex surfaces up to an angle of 10 deg. The chuck feed is by means of a handwheel, a vertical screw, and a nut on the spindle sleeve. The chuck spindle is mounted in ball bearings, while the vertical screw has a ball-thrust bearing to allow ease in the vertical adjustment. The machines are also equipped with an automatic vertical adjustment of the chuck that will feed it from 0.0005 to 0.003 in. at the end of each wheel traverse.

The water equipment includes pump, tank, water guard and necessary connections, all of which are furnished as regular equipment. The water guard projects well up over the top of the chuck, and is sloped inward so as to completely protect the operator from splash. The tank is of unusual capacity, giving a large volume of water, while a swivel joint in the distributing nozzle enables the operator to direct the flow to any position.

The machine is entirely self-contained, and requires but a single belt from the main lineshaft or motor.

Toledo Straight-Column Single-Crank Trimming Press

The Toledo Machine and Tool Co., Toledo, Ohio, has just placed on the market what is believed to be the largest single-crank trimming press that has ever been built. The machine weighs approximately 185,000 lb. Not only is the press of unusual size, but it is operated by twin gears on the main shaft. The frame is of four-piece steel tie-rod construction, and consists of a base, two uprights and a crown held together by four steel tie bolts that are heated and shrunk into place, and serve to take the stress when the press is in operation. The uprights are made heavy to withstand any lateral stress that would occur with the slide unevenly loaded. Particular attention is called to the design of the outer shearing-off slide that is operated by an eccentric shaft that extends through the bearing in an auxiliary housing secured to the outside housing by steel tie rods. The clutch is supported on a shaft, and held by a bracket bolted to the frame. This construction affords compactness and rigidity, and does away with the outboard bearing allowing a free space all around the press for access and the handling of material. Lubrication is provided by a forced-feed system permitting operator to lubricate all the important bearings from the floor.

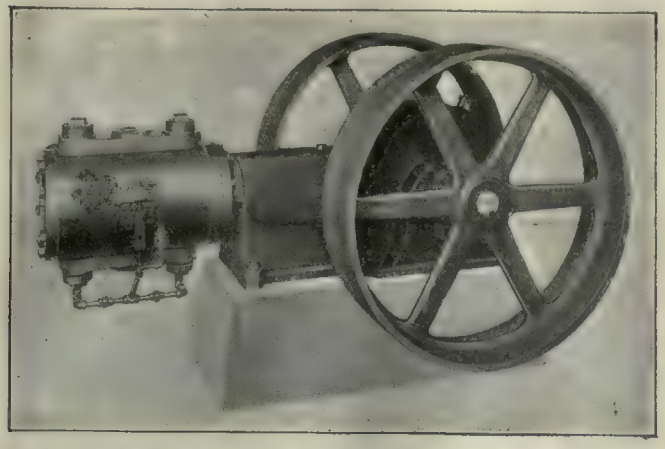


TOLEDO STRAIGHT-COLUMN TRIMMNG PRESS

Stroke, 16 in.; slide flange, 68 in. front to back, 40 in. from right to left; area of bed, 72 in. front to back, 48 in. from right to left; weight, 185,000 lb.

Stratton & Bragg Air Compressors

The illustration shows one of a line of air compressors that has recently been placed on the market by the Stratton & Bragg Co. Petersburg, Va. The compressors are of the single-stage, straight-line center-crank. belt-driven type, moving parts being oiled by the

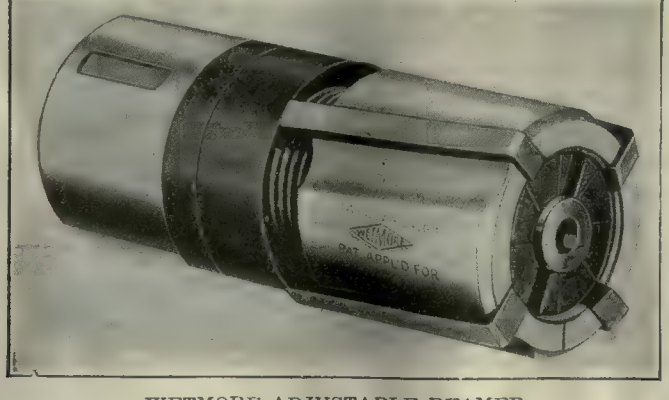


STRATTON & BRAGG AIR COMPRESSOR

splash system. The base of frame is a one-piece casting, to insure rigidity. The main bearings are lined with babbitt hammered and bored to size, and are adjustable. The crankshaft is made of a solid forging of open-hearth steel. The crosshead is of the box type with adjustable brass shoes to take up wear, and the connecting-rod is of openhearth steel. The cylinder is of cast iron, both heads being water-cooled and equipped with automatic valves. An unloading valve is connected with the receiving tank, so that when the desired pressure is attained, this valve acts automatically, holding the intake valves open and relieving the compressor.

Wetmore Expanding Reamers

The outstanding feature of this new line of reamers recently placed on the market by the Wetmore Reamer Co., 210 Syracuse St., Milwaukee, Wis., is the left-hand, spiral cutting angle of the blades, which is stated to have been found particularly well adapted to work where speed and accuracy are required. By means of a wrench provided, a graduated screw collar that is counterbored in the front end of the reamer body may be manipulated to adjust the reamer to the proper size, each graduation on the screw collar indicating the change of 0.001 in. in diameter. No shims, screwdrivers, calipers or other tools are needed for adjustment. The body is solid,

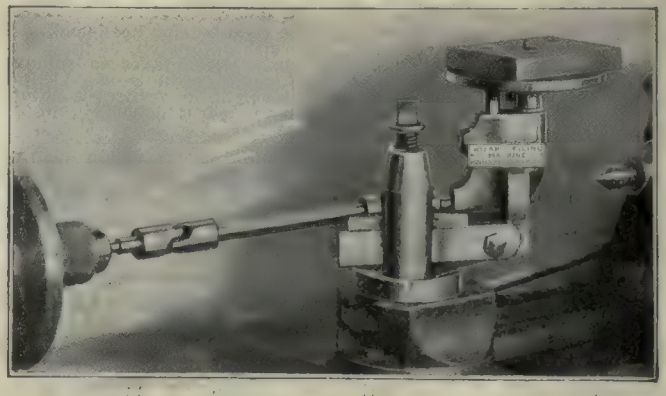


WETMORE ADJUSTABLE REAMER

and it may be attached to any arbor, although arbors are usually furnished; straight-type arbors for lathe reaming, Morse taper arbors for drill-press reaming and floating arbors for turret-lathe reaming. Blades are put up in sets of four or six, depending on the size of the reamer. The reamers are now made in diameters from 1 to 4½ in., four blades being used on sizes up to 3 in. and six blades on the sizes from 3 to 4½ inches.

Boston Rotary Die-Filing Machine

The rotary die-filing device illustrated can be attached to a drilling machine, bench or engine lathe, or can be driven by an independent electric motor, or from a countershaft. It is a product of the Boston Tool and Manufacturing Co., Inc., 262 to 280 Dover St., Boston, Mass., and is intended especially for making dies, tools



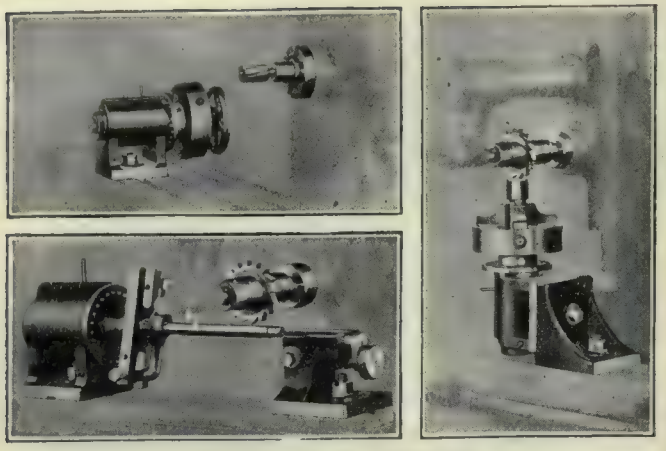
BOSTON ROTARY DIE-FILING MACHINE

Capacity, files and cutters from pin point to ⅜ in. in diameter; thickness of dies finished, up to 1½ in.; working surface of table, 5 to 8 in. in diameter; height from bench over all, 7 in.; chuck, for files or cutters with ¼-in. shanks.

and other work of this character. The machine may also be used for lapping. The device is designed to be held in the toolpost of the lathe or fastened to the table of the drill press, the power being transmitted to the file through a shaft with universal joints. The files can be run at high speed, and needle points can be used as well as larger ones. The table is generally set so that the file just comes through the work and as the chips are drawn down by the motion of the file, the layout is clear and in plain view at all times. Another advantage is that there is no overhead mechanism, and a magnifying glass can be used to advantage.

"Brandt" No. 1 Indexer

Meigs, Miller & Co., Inc., 129 Mill St., Rochester, N. Y., is now marketing the "Brandt" No. 1 indexer shown in the illustration. The features claimed for the device are simplicity, speed of operation, compactness of design, and the rapidity with which angular set-ups with precision can be made. It has positive stops for locating the work, a ball-thrust bearing on the spindle, and a line of fixed angle plates and taper tables. The spindle nose is short to obviate overhang and vibration, and the index plates are interchangeable. It is intended that a special index plate be used for each quantity job, each plate having only the required number of holes. Index plates are furnished up to 25 holes, spaced evenly or unevenly, to suit the needs of any particular job. It is stated that the compactness of the design permits a greater range of work than with the ordinary centers. The special adjustable



BRANDT NO. 1 INDEXER

Swing on centers, 7 in.; table space required for headstock and tailstock, 4 x 4 in.; distance between centers on 36-in. slide, 24 in.; diameter of spindle, 25/32 in.; Morse taper in spindle, No. 3; weight of headstock, 14 lb.; weight of tailstock, 21 lb.; height in horizontal position, 5¾ in.; height in vertical position, 7¾ in.; distance cutter must be raised to clear tailstock, $\frac{1}{16}$ in.

positive work stops enable work to be chucked inside of or through the head to a certain stop, this feature speeding up the insertion of work of this class. The base fits a line of fixed angle plates, and by the use of these any single or combination angular setting can be secured. The plunger for the index plate is actuated by a spring and disengaged by a small lever. The plunger is tapered so that it bottoms in the index hole automatically. The tailstock adjusting screw is a standard screw, two turns of the knob being sufficient to remove the work. The illustrations show how the device may be set in line with the spindle or turned to a vertical position through an angle of 90 deg., by means of the angle plate.

Grinding Attachments for the Potter Precision Bench Lathe

New grinding attachments for the bench lathe have recently been brought out by the S. A. Potter Machine and Tool Works, 79 East 130th St., New York City, which while primarily intended as an addition to the equipment of the Potter precision bench lathe, can be used on any lathe provided with a drum countershaft for driving them. Both external and internal grinding attachments are made to be used on the slide rest and are provided with rockers to allow vertical adjustment. Details of this rocker are shown in Fig. 1.

The attachment for external grinding is also shown in Fig. 1. The spindle runs on ball bearings, and is fitted with caps and felt washers to exclude dust. Adjustment is provided to compensate for wear. It will swing wheels from ¾ in. in diameter up.

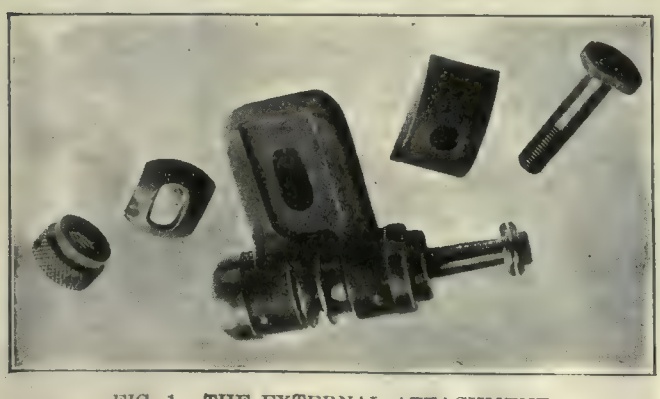


FIG. 1. THE EXTERNAL ATTACHMENT

The attachment for internal grinding, Fig. 2, while it is to be fastened to the slide rest in the same manner as the other, is not dependent upon it for movement, but has an independently sliding spindle with a movement of about 4 inches.

Owing to the extremely high speed at which the spindle is required to run it was not considered advisable to mount it on ball bearings. All wearing parts of this attachment are of tool steel, hardened and ground. The outer shell forms the bearing for a steel sleeve extending through it, having a tapered journal at the front end, and adjusting locknuts at both ends. The driving pulley is permanently attached to this sleeve at the rear end.



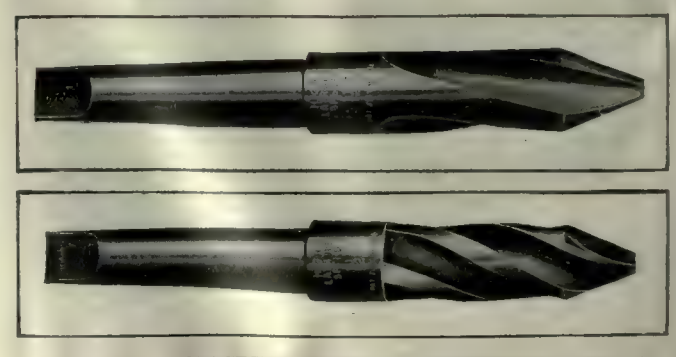
FIG. 2. THE INTERNAL ATTACHMENT

The sleeve has ample bearing surface, and there is an oil chamber at the center which insures proper distribution of lubricant. Brass caps and felt washers exclude dust and abrasive from the bearings.

The wheel spindle slides through the bearing sleeve and is splined to it. On the outer end of the spindle there is a loose wooden knob by which the operator may move the spindle back and forth while grinding.

Latrobe High-Speed Countersink Drills

The Latrobe Tool Co., Latrobe, Penn., is now marketing high-speed steel countersink drills with either three or four flutes, as shown in the illustration. The body of the countersink is made of high-speed steel, and is screwed and solidly brazed into the taper tool-steel shank with the patented Latrobe connection. In this connection the body of the tool is made with a taper-threaded shoulder, and this is screwed and brazed in a taper hole in the shank. The countersinks are made in various sizes, and with points of 15, 37, 45 and 60 deg., included angle.



LATROBE HIGH-SPEED-STEEL COUNTERSINK DRILLS

Why the Railroads Should Be Returned

The President's statement that the railroads were to be returned to their owners has attracted attention to the probable consequences of such a step and various more or less sane predictions have been made as to the outcome. This article is an abstract of a statement by Interstate Commerce Commissioner McChord and gives his personal views on the subject. It should not be taken as an official opinion of the commission which has not as yet committed itself.

THE importance of adequate and efficient transportation systems in this country cannot well be overestimated. The framing of laws that shall give expression to a National policy of regulation of railroad and water transportation for the future involves questions which affect immense property interests, as well as the welfare of the people as a whole.

It is apparent that some of the so-called problems have been needlessly magnified. After all, this is not entirely a new or novel phase of legislative action. For more than 30 years the common carriers of the country by railroad have been operating under more or less effective Federal and state control. The record has been made and is available for use and guidance at this time. Many of the propositions that will be presented should no longer be subject to controversy. They have become settled through court construction, or through recognition of their efficacy by carriers, shippers and the public. There is a disposition upon the part of some people to tear up by the roots the existing system of regulation, and to call for the framing of an entirely new statute, based largely upon new and untried theories. This would be a long step backward and no warrant can be found for such a radical change, judging from the results that have sprung from the regulation we have had. The good in existing laws should be preserved, and where necessary they should be bolstered and reinforced by amendment or addition. Not less, but more efficient regulation is the demand that experience dictates. In order that the public should realize the best results from consistent and just regulation, and in order that common carriers may be in a situation to secure the benefits of such regulation, the railroads, as determined by the President, should be returned to their owners by Jan. 1, 1920.

It has been repeatedly stated by officials high in railway councils, that if the railroad managers were left to themselves they could and would demonstrate their ability to handle and transport the commerce of the country in an efficient and satisfactory manner. When the officials return to duty the roads will have full opportunity to demonstrate their ability to perform as they promise.

I am not an unalterable opponent of government ownership if that becomes necessary and is safeguarded by proper legislation. There might be greater evils attendant upon the settlement of the railroad problem than government ownership. That alternative we can resort to if in the future it becomes imperative. What I do believe is that just now is a very inopportune time to enter upon so stupendous an undertaking. I read that the indebtedness of this country, as a result of the war, will approximate $30,000,000,000. The value of the railroads of the country is about $18,000,000,000. Add to this what the Government is now obligated to pay the railroads under the Federal Control Act in order that they shall be restored to their owners in as good physical and financial condition as when taken over, and a conservative estimate is that the total cost of the transportation systems of the country would not be less than $20,000,000,000. An issue of bonds to pay for the railroads in that sum would increase the National debt to about $50,000,000,000. No one should at such a time as this, when the business and industrial interests are endeavoring to resume business and production on a peace basis, advocate National expenditures on so stupendous a scale. Of course, the Government would operate the roads with no purpose of securing a profit, else the real incentive to such ownership would disappear. Under government ownership the public must pay the bills the same as under private ownership.

Our traditional policy with respect to our railroads has invited the investment of private capital. It is claimed by some that under the impulse of public demand, mingled with the speculative element of the American mind, many railroads were constructed that ought not to have been constructed. Some railroads were improvidently built, resulting in excessive cost; many were the victims of inexcusable and vicious financial manipulation; and many are not so located as to yield any warrant for the conclusion that they can in the immediate future earn a return upon the money invested in them.

In this connection it is well to state that many of the so-called weak roads are either branch lines of great systems, separately operated, or are largely owned by the latter. From reports to the Interstate Commerce Commission for the calendar year, 1917, it appears that railroad companies are among the largest stockholders of railroads. It is true that there are many small roads, and some large weak roads, which are not now in a position to meet a large decrease in revenue that may result from a decrease in business due to transition from a war to a peace basis. But they would be in no worse condition than they would have been had there been no taking over by the Government, except only disorganized management and increased cost of labor and materials.

If we enter upon government ownership now we cannot separate the sheep from the goats and purchase only the former. No railroad is so poor that it does not reach some people who have a right to demand a continuation of service. Many poorly located or poorly managed, or mismanaged railroads, have never earned a return on the money invested in them. If they continue to operate the deficit must be borne by someone. Government ownership is a means of shifting the burden from the owners, where it belongs, to the general public, where it does not belong. Under wise and effective regulation many of the so-called "weak sisters" in the railroad world may be fed and nurtured so as to restore them to some sort of transportation strength. If the protecting hand of the Government is placed on them they will make little effort to better their situation, but will settle down to a condition where they will be a continual drain upon the public treasury. I have never been convinced that government ownership of a losing railroad proposition will transform it into a gainful one. Remove from all the transportation systems of the country the individual initiative, reduce the management to the dead level of one system of management, and we will soon find that the country will have only such service as is absolutely necessary, with no incentive in any particular railroad to excel in any direction. The effort is to make a success of the whole without necessary attention to the success of the parts. The attempt to initiate all rules, regulations and practices, with respect to the operation of individual roads from Washington by one controlling head, could not in the very nature of things result in the most efficient or economical operation. A traffic manager or operating official on the ground, in touch with the situation with first-hand information, is in a far better position to adjust operating problems as they constantly arise. There has not been, and there cannot really be, any denial that the present arrangement is an expensive manner of controlling the transportation systems of the country. The longer it is continued the greater the expense. The longer it is continued the less readily may the railroads be returned to their owners with assurance that they can resume their normal functions with efficiency. There can be no question that physically the sooner the railroads are placed in the hands of their owners the better for them, and the better for the country as a whole.

A representative of substantially all the railroads under Federal control has publicly announced that Federal control and operation of the railroads has destroyed their credit, and that to return them to their private owners without at the same time providing for some sort of Governmental guarantee of earnings would result in disaster. Let us examine this contention.

When the railroads were taken over by the Government they were more prosperous than they had been in the past. To substantiate this, reference may be had to the return made by the railroads themselves to the Interstate Commerce Commission, the results of which have been collected in Table I.

From this table it appears that, considered from the viewpoint of dividend payments, operating income to asserted cost, or surplus accumulations, the railroads were in a more prosperous condition from 1910 to January 1, 1918, than before that period. Under the act passed by Congress the railroads of the country which were taken over by the Government are guaranteed earnings equal to the average operating income for the fiscal years ended June 30, 1915, 1916 and 1917. Thus there is insured to the railroads during the period of Federal control the largest net return as a three-year average ever received by them.

TABLE I. FINANCIAL CONDITION OF THE RAILROADS

	Average Income per Mile of Line	Dividend Rate	Ratio of Income Cost to Cost per Mile of Line	Surplus Accumulations
1900	2,479	5.23	4.53	
1901	2,592	5.26	4.69	
1902	2,776	5.55	5.02	
1903	2,852	5.70	5.19	
1904	2,707	6.09	4.23	
1905	2,896	5.78	5.10	
1906	3,212	6.03	5.58	
1907	3,343	6.23	6.61	
1908	2,841	8.07	4.78	
1909	3,145	6.53	5.34	
1910	3,487	7.50	6.73	$1,371,107,759
1911	3,156	8.03	4.87	1,541,991,152
1912	3,044	7.17	6.62	1,583,032,034
1913	3,420	6.37	6.12	1,767,320,318
1914	2,869	7.97	4.19	1,648,596,111
1915	2,840	6.29	4.09	1,556,787,176
1916	4,050	6.48	6.82	1,935,019,191
1916*	4,277	6.75	6.17	2,159,768,716
1917*	3,811	6.81	5.27	2,628,638,922

*Calendar year.

And it is difficult to understand how there is in this situation anything that can form the basis for a claim that railroad credit has been destroyed by reason of Federal operation.

A guarantee of minimum earnings and a limitation of the amount of earnings have all the evils of government ownership with none of the benefits. If we are to guarantee earnings we might as well enter upon government ownership at once, and repeat the experiences of the government of France. The guarantee system in that country has resulted in a steadily increasing demand on the public treasury. In a recently published statement respecting the guarantee to French railroads F. H. Fayant, assistant to the chairman of the Association of Railway Executives, said:

"But the results of the French guarantee system have been disappointing. There has been no profit-sharing. The Western, after 44 years' continuous appeal to the state on account of its guaranty, became so hopelessly involved in the treasury finances that the state in 1908 was compelled to exercise its purchase option. Incidentally it has become a greater burden to the treasury under state operation than it was under private operation. The Midi (Southern), in the half century prior to the war, was able in only a dozen years to meet its interest and dividends out of earnings. The Paris-Orleans, which at one time had some hopes of becoming self-supporting, was just before the war making large appeals to the treasury. The Est (Eastern) was self-supporting before the war. The Nord (Northern) and the Paris-Lyon-Mediterranean have always been prosperous and had no need of a guaranty.

'State aid in the pioneer days of railroad building in France was of great assistance in providing the capital needed for these enterprises and in bridging the companies over the early lean years, but in later years the guaranty has only served to entangle the weaker roads in politics and public finance. It has been a handicap to progress and has stunted private initiative.

"If we are to retain the advantages of private initiative, and save our transportation system and all our machinery of production from the deadening blight of political meddling, we ought to consider well the dangers involved in any proposal for a financial partnership between the railroads and the Government. While before the war our system of public control had its obvious faults, under it was developed the most perfect transportation machine in the world. The best railroads of Europe are many years behind ours in engineering development and operating efficiency."

It is said that the wages of employees of railroads have been raised to such an extent as to absorb the increased rates initiated by the Director General, and that unless there is some guaranty of increased rates on their return they will not be able to earn the same net income as they were earning when taken over. The figures submitted to the Commission do not show that the carriers are suffering from lack of gross income. In January, 1919, the gross receipts of class 1 railroads exceeded by $111,427,193 the receipts of the same month in 1918. In February, 1919, they exceeded by $61,924,937 those of February, 1918. It does appear that there has been a decline in operating income. This decline is no doubt due in part to increased operating expenses. How much of the increase is due to the fact that there has been a revolution of management and operation cannot be determined with accuracy. Doubtless this change has an important bearing on the matter. The removal of individual supervision and direction from the operation of the railroads of the country has resulted in large increases in operating expenses. The expression of a fear that more effective regulation will deprive the railroads of the country of a just return for service rendered is but a reassertion of the old fear that was given voice before the taking over. The people of this country have ever been, and they are now, ready and willing to pay to the railroads such rates of freight, passenger fares, and other charges for service rendered as shall be just and reasonable. There is no good reason for not believing that just and reasonable rates will be provided for the future. If wages and cost of materials are such as to demand higher freight rates and other charges in order that the railroads shall render adequate and efficient transportation service, the regulating body on being shown the facts can be depended upon to deal justly with the situation.

It is asserted that the carriers of the country during January, February and March of this year did not earn the Government guarantee by some $200,000,000. This assertion is on the assumption of an equal monthly accrual of the annual compensation which the Government must pay the roads. The early months of any year, however, are not equal in earning power to the average per month for the year.

The fallacy of estimating the operating income of any one year by the operating income of the first three months, January, February and March, is graphically illustrated in Table II, which refers to reports of class 1 roads only:

TABLE II. RELATIVE OPERATING INCOMES

Year	Railway Operating Income for First Three Months	Railway Operating Income for 12 Months Based on the First Three Months	Actual Railway Operating Income for Twelve Months	
1912	$137,779,550	$551,118,200	$736,466,326,	Fiscal
1913	152,023,732	608,094,928	816,510,793	Fiscal
1914	89,822,685	359,290,740	692,330,572	Fiscal
1915	133,783,495	535,133,980	716,476,186	Fiscal
1916	213,957,378	855,829,512	1,081,556,496	Calendar
1917	189,282,143	757,128,572	970,197,438	Calendar
1918	81,343,850	325,375,460	719,159,540	Calendar

If a comparison is made between the railway-operating income of January, February and March, 1919, and the corresponding months of the test period 1915, 1916 and 1917, it will be found that the income for the first quarter of 1919 was 131 millions less than for the corresponding part of the test period, and for the first quarter of 1918, 98 millions less, or 114 millions as the average of the first quarter of the years 1918 and 1919, and not about 200 million as asserted.

In his statement in a communication addressed to the Secretary of the Treasury made public May 25, the Direc-

tor General, in explaining the deficits for the years 1918 and 1919 in operating revenue under that of the guaranteed return for the first quarter of those years, said:

"The operating deficit for the year 1918 was due largely to two facts: First, the winter of 1918 was unprecedented in its severity and in its costly effect on railroad operations, and. second, the increases in passenger and freight rates, averaging about 25 per cent., were in effect for only a few days in excess of six months, while heavily increased expenses due to war conditions were effective on an ascending scale throughout the 12 months.

"The operating deficit for the first four months of 1919 is due in part to the cumulative high levels of cost brought about by the war, for labor and materials and in part to the sudden and abnormal falling off of business as a result of the cessation of war activities, the sudden drop in the demand for fuel and for other basic commodities and the general state of hesitancy due to the transition from war conditions to peace conditions."

In giving the figures and making the comparisons I must not be understood as taking the position that the railroads of the country have earned as much or more than they should have earned or were entitled to earn. My sole effort has been to give the facts as I find them, in order that the situation may be looked squarely in the face, and to ascertain whether there is a foundation for the statement that our railroads will be confronted with bankruptcy should they be restored to their owners.

What is there in the situation that the carriers will occupy on January 1, 1920, that warrants the claim that their being turned back would mean bankruptcy to them? It is said that the outlook is bad, and that the railroads cannot now stand alone. The claim is made that business is at low ebb; that wages and expenses are at high tide; and that to meet that condition there must be a radical reorganization of our transportation systems that shall involve some sort of a guaranty upon the part of the Government that net incomes of all carriers shall never be less than a return on property investment that shall be as great as, or greater than, the average return for the years 1915, 1916 and 1917, without regard to the location of particular lines or their previous financial history.

In the *Railway Age* of May 9, 1919, the following discussion of traffic conditions appears:

"It is true there has been a decline of traffic; and some refer to the business which has been handled thus far this year as abnormally small. It is smaller than that of 1918 or 1917; but conditions in 1917 and 1918 were not normal, and the traffic handled in those years showed a vast increase largely due to war conditions. Let us go back to the first three months of 1916. In that year the railways had the largest increase of traffic that ever occurred in any single year. They made the largest operating income ever made in one year. Every one remembers this. Doubtless, consequently, most people assume that because of the recent decline in traffic the business which has been moved thus far this year has been much less than in the remarkable year 1916. It is somewhat disconcerting, therefore, to find that in the first three months of 1919 the freight traffic of the railways was 85,000,000,000 ton-miles, while in the first three months of 1916 it was only 80,000,000,000 ton-miles, an increase in 1919 over 1916 of over 6 per cent. Furthermore, the traffic handled in the first three months of this year was only 10 per cent. less than that moved in the corresponding three months of 1917 and 1918. The railways moved less freight in February and March of this year than in the same months of 1917 and 1918, but they moved more in January than in either of those years."

There always have been and there will be, periods of business depression. No law that can be conceived or enacted and no tribunal that may be appointed, can control the yield ot crops or the production and sale of the industries of the country. Rates of freight or other charges for transportation cannot be so made that they will rise and fall in response to the volume of production from season to season. If the carriers of the country may not be safely returned on January 1, 1920, when in receipt of the guarantee for the preceding two years, it may be asserted with confidence that they never will be in condition to be so returned.

It is a fact that operating expenses have increased during Federal control, due to wage increases, increased cost of materials and supplies, and to unavoidably expensive operation and changed operating and financial management during the war. Unless it is to be assumed that war conditions are to continue indefinitely in times of peace there is bound to be a decrease in operating costs. As pointed out by the Director General in a recent statement, the organization of the carriers is now equipped to handle a much larger business than is offered for transportation. If the railroads are returned there is little doubt that decreases in operating costs can be effected.

It has also been proposed that the Congress should provide for the consolidation or merger of all railroads in a given territory under a Federal charter; all such merged roads to be operated as one. This is only a difference in degree from the National consolidation which now exists as a war necessity. We should go slow in the way of permitting or requiring the consolidation of the railroads of the country. The inevitable tendency in such consolidations is to level down the best in order to level up the poorest. The country had some experience with consolidation in the New York, New Haven & Hartford attempt to consolidate and control all the transportation systems of New England. When the scheme originated the New York, New Haven & Hartford was regarded as one of the best managed and operated railroad systems in the country. Its stocks and bonds were recognized as securities of the highest standard. A citizen who died and was able to leave his family a substantial block of New Haven securities did so with confidence that they were amply protected. Someone devised the consolidation. It was inevitable that one of two things was bound to happen, either that the New Haven bring its consolidated interests up to its high level or that it go down to the lower levels of the others. The latter happened and we see the New Haven's present difficulties.

Slippage of Slushing Oils on Vertical Polished Surfaces

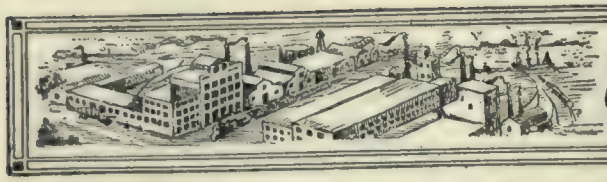
By C. A. Briggs

To a toolman, rust is about as welcome as a toothache. Like the toothache, rust cannot be eliminated, but we have to continue our efforts to alleviate it and to reduce the cause as much as possible.

Some observations made on slushing oils will be of interest to those who have to consider this matter. In experimenting it was found, that when certain specimens of oil were applied to polished metal plates, which were then stood on edge, in a few days' time the coat of oil would slip down, leaving exposed patches of metal surface which were free of any trace of oil and as susceptible to corrosion as though no oil or grease had been applied.

This property of slushing oils and greases is not so rare as might be thought, but has been found in samples from different sources. This characteristic of some oils appears to explain the experience in arsenals where, in the case of guns and machinery covered with slushing oils to prevent corrosion, rust has frequently been found on the top and sides, while the bottom was found in good condition. On account of the top and sides being more or less exposed, the rusting was generally attributed to the oil being rubbed off in some way and the matter was let go at that.

As a result of this discovery, it has been suggested that one of the requirements for slushing oils is that they should pass a test in which they are applied to a polished metal plate and held in a vertical position at any temperature between 15 and 35 deg. C for five days without the slushing oil sliding from the top edge of the plate or leaving any portion of the surface.



Sparks from the

War Taxes Held Due From Makers of Shell Parts

Circuit Court of Appeals Decides that War-Time Tax on Profits of Munition Manufacturers Must Be Paid by Those Who Produced Only Parts of Shells

The policy of the Government involving many millions of dollars in revenue already collected, or in course of collection, was sustained by the Circuit Court of Appeals in Philadelphia on June 9 in a decision holding that the war-time tax on profits of munition manufacturers must be paid by those who produced only parts of shells. The contention was raised by the latter that the impost was intended to apply only to completed articles.

In a group of three decisions the court held that any participant in the abnormal profits of munition making must submit himself to taxation laid upon this class of income. Opposite action by the court would have necessitated legislation to make up the consequent deficit in Federal receipts.

The decisions, written by Judge Buffington and affirmed by Judges Woolley and Haight, who sat with him, sustained the judges of the first and third Pennsylvania districts, who denied claims of the Carbon Steel Co. and the Worth Brothers Co., seeking to recover from the Government, taxes paid under the excise tax law of Sept. 8, 1916, and reversed the justice in the twenty-third district, who allowed a similar claim by the Forged Steel Wheel Co.

Judge Buffington's opinion held that the purpose of Congress was to tax persons who manufactured the whole or any part of a shell, overruling the manufacturers' contention that the legislative intent was confined to the production of the completed shell or a completed part. Its effect is to make munition contractors liable for their profits, regardless of sub-contracts, and to place a similar liability upon all subcontractors doing any part of the work of producing a shell, whether loaded or unloaded.

In general the opinion advanced the rule that where any article which is fitted for general commercial use is taken from that field and segregated for utilization as a war munition, the person carrying out the segregation becomes a manufacturer of war material and as such is liable to the tax.

The opinion also held that decisions of the Federal courts on customs cases, cited by the manufacturers to show that uncompleted parts of manufactured articles were not subject to taxation, did not apply to the act in question, which was declared to be purely a revenue measure, incident to the support of the Government during the war. Judge Buffington pointed out that the customs laws were enacted not primarily for revenue, but to encourage American manufacturers, and where importation of parts of articles to be assembled or manufactured in this country was not in competition with American industry exemptions or reductions of impost duties were proper.

The tax which induced the litigation is "an annual levy of 12½ per cent. upon the entire net profits actually received or accrued from the sale or disposition of such articles (munitions) manufactured within the United States." The impost is in addition to the income tax.

* * *

Source and Distribution of Power

The following power statistics based on the Thirteenth U. S. Census Report will be of interest. The power used in transportation is not included:

Year	Total Horsepower per Each 1,000,000 of Population	Percentage of Distribution of the Total Power Through Internal Combustion: Steam	Water	Gas	Electric Motors
1915	482,392	61.2	24.4	14.3	51.0
1909	203,163	76.0	9.8	4.0	25.8
1904	160,760	80.3	12.2	2.1	11.8
1899	132,875	80.6	14.4	1.3	4.9
1889	94,832	77.1	21.1	0.15	0.26
1879	68,182	64.1	35.9	....	....
1869	60,846	51.8	48.2	....	....

The following table giving the percentage of increase of the various prime movers and electric motors during ten-year periods is taken directly from the Thirteenth U. S. Census Report:

Period	Total Hp.	Steam	Water	Gas	Electric Motors
*1915–1909	162.3	111.2	557.7	831.9	5032.0
1909–1899	84.9	74.4	25.4	181.1	877.2
1899–1889	70.0	77.7	15.9	214.5	3066.1
1889–1870	74.1	109.6	2.4	.....	.....
1879–1869	45.4	79.8	8.4	.....	.....

* Six years—(Rushmore).

Below is an estimate of the distribution of power in 1915, as made by Mr. D. B. Rushmore:

	Horsepower	
Horse and mules	25,000,000	
Automobiles	25,000,000	
Steam and naval vessels	5,000,000	
Steam railways	50,000,000	
		105,000,000
Irrigation	500,000	
Mines and quarries	6,000,000	
Flour, grist and saw mills	1,250,000	
Manufactories	25,000,000	
Central stations	8,000,000	
Isolated plants	4,250,000	
Electric railways	4,000,000	
		49,000,000
		154,000,000

The figures 482,392 total horsepower per one million of population in 1915, given in the first table of power statistics, is the sum of the last seven items of the above list divided by 101,577,000, the total continental population in 1915. All other items in the two tables are taken directly from the Census Report.

The Eleventh Annual Convention of the Master Boilermakers' Association

The eleventh annual convention of the Master Boilermakers' Association was held in Chicago, May 26 to 29, 1919, at the Hotel Sherman. The officers in charge of the affairs of this convention were D. A. Lucus, president; John B. Tate, first vice president; Harry D. Vought, secretary, and Frank Gray, treasurer.

The meetings were devoted to lengthy discussions on practical topics presented by a series of special committees which had been created for this purpose. Among the topics discussed were "The Proper Method of Threading Radial Stays and Tapping Holes for Same;" Best Method of Threading and Drilling of Tell-Tale Holes;" and other subjects devoted solely to locomotive design and maintenance. One committee favorably reported the use of the oxy-acetylene gas torch for cutting off staybolt ends instead of using chisels or special nippers for this purpose. Chisel tools are liable to damage the threads while the nippers do not leave a square end, which necessitates dressing up the ends after they have been cut.

The new officers elected for the ensuing year are: John B. Tate, president; Charles P. Patrick, first vice president; Harry D. Vought, secretary, and W. H. Laughridge, treasurer. The location of the next annual convention will be determined some time during the year by the executive board.

* * *

A National Trade-Mark

A bill was introduced in the House recently by Congressman Sims which provides for a trade-mark to be selected by the Secretary of Commerce and which will be known as "The National Trade-Mark." It is to be registered in the Patent Office in the name of the United States of America, without limitation of time and covering all classes of goods which are recognized under trade-mark laws.

The Secretary of Commerce is authorized to issue licenses for the use of the trade-mark under certain rules and regulations to any Amercian manufacturer or producer. He is also given the right to institute and maintain proceedings when the rights of the trade-mark have been infringed upon.

The bill provides for the sum of $25,000 to be used in the expense of carrying the provisions of the act into effect, and has penalties for using any trade-mark similar enough to deceive purchasers into believing it to be the national trade-mark.

World's Industrial Forge

By E.C.Porter, News Editor

Meeting of the Material Handling Machinery Manufacturers' Association

The semi-annual meeting of the Material Handling Machinery Manufacturers' Association was held on June 10 and 11 at the Hotel Astor, New York City. Addresses of unusual interest covering the entire field of equipment suitable for the loading and unloading of ships and for the improvement of docking facilities were given. The keynote of the meetings, however, seemed to be along the lines of establishing cooperation between employers and labor. Several phases of this work were covered by Francis Holly, Director, Bureau of Commercial Economics, Washington, D. C., who, in his address on "Educating the World Masses on Industrial Methods by Moving Pictures Shown all Over the World," told how labor and society as a whole can be educated and informed of manufacturing and business methods by means of motion pictures.

In the open forum session, the discussion was led by David B. Bushnell of the General Electric Co., and many interesting details of problems of trucking and the mechanical handling of materials in manufacturing plants were discussed.

* * *

Advantages of Electric Furnaces in Steel Foundries Discussed

At a recent convention of the American Electro-Chemical Society in New York a discussion was made of the advantages of the electric furnace in the steel foundry, particularly in comparison with the small openhearth and the small converter. W. E. Moore, president of W. E. Moore & Co., engineers, Pittsburgh, in a paper "The Electric Furnace: Its Introduction Into Foundry Practice," made the following comparisons of the physical properties of the three grades of steel together with data as to costs, after a general portrayal of the various operating and metallurgical advantages of the electric furnace:

Electric-furnace steel, when made to the same chemical specification, is always better than other steel. Usually such steel will run 15 per cent. or better in tensile strength or in ductility, depending upon its heat-treatment. It is easier to control the composition, and consequently, electric steel can be made to more accurate specifications than other steel.

The following comparative physical properties of electric furnace versus openhearth steel made to the American Electric Railway "Axle Steel Specifications" is shown by the tests of a prominent metallurgical engineering firm for a large city street-railway line. These steels, after forging, were held one hour at a temperature of 1450 to 1460 deg. F. (785-793 deg. C.), then quenched in 65-deg. oil, then drawn back at 1185 deg. F. (640 deg. C.) and cooled slowly in the furnace.

	A.E.R.A. Standard Specifications	Open-Hearth	Electric Steel
Elastic limit (lb. per sq. in.)	55,000	41,060	64,850
Yield point (lb. per sq. in.)	.....	41,060	64,850
Tensile strength (lb. per sq.in.)	90,000	89,100	105,140
Elongation in 2 in. (per cent.)	22	21.5	22.0
Reduction in area (per cent.)	45	31.74	52.37
Character of fracture	.....	.....	silky cup
Elastic torsion	.....	16,750	33,700
Shearing strength	.....	62,400	76,000

The following is the estimate of operating cost per ton of liquid steel, produced by Pittsburgh 3-ton type electric foundry furnace, in continuous operation, melting heavy steel turnings and superheating the steel to a fluidity suitable for small steel castings:

MELTING STOCK	
1 ton heavy steel turnings—axle turnings	$12.00
1/20 ton (5 per cent.) loss in melting axle turnings	.60
Electric power, 550 kw.-hr. at 1c	5.50
Electrodes, carbon, 20 lb. at 9c. (ante bellum price 4½c.)	1.80
33 lb. of mill scale (used as a decarboniser)	.09
ADDITIONS	
8 lb. 70 per cent. ferromanganese at 10c.	.80
5 lb. ferrosilicon at 5c. (Note that spiegel and 20 per cent. ferrosilicon may be substituted at lower cost.)	.50
½ lb. aluminum	.17
LABOR AND MAINTENANCE	
Wear and tear on refractory roofs and linings at 40c. per ton (some of our users average 20c. per ton)	.40
Furnace labor	1.00
Total cost of liquid steel in the ladle (per ton)	$22.86

* * *

Exhibitors at Lyons Fair

According to the figures furnished by the Lyons fair officials, French exhibitors led the list with 2994 displays, those from the United States coming second with 618. Great Britain had 415, Italy 154, Switzerland 149, Spain 72, and Canada 44. The 4700 total exhibits for this year compared with 3176 for last year, 2614 for 1917, and 1342 for 1916, the initial year, show the rapid growth of the institution.

* * *

Providing for Welfare Work

Home Cotton Mills, 2400 South 2nd St., St. Louis, Mo., a branch of the Bemis Bros. Bag Co., is organizing and installing a large and complete service department to take care of the welfare work being undertaken in the interest of their employees. A complete system of lockers, rest rooms and reading rooms for men and women, also a kitchen and dining room, will be provided for them.

Trade Currents From Western Cities

Holidays in Chicago Cause a Slackening Effect in Machine-Tool Trade—Cleveland Reports the Placing of Large Orders for Equipment

CHICAGO

The holiday at the end of May, coupled with three near holidays on the occasion of the return of large contingents of fighting men, had a decidedly slackening effect on business the first few days in June, which was felt by the machine-tool trade as heavily as at any other time. The recovery which occurred after the first few days of the month was very pronounced, dealers stating that indications point to business in June being as good if not better than in May.

There have been no new large want lists made public, the large corporations, in the main, staying out of the market. Orders for from one to several tools from various small and medium-sized concerns are being booked with surprising regularity.

One feature that works to a good market is the fact that most dealers are able to effect delivery of practically any item that may be called for, their stocks being in excellent condition. If the existing steady demand over a wide range of machines continues for long, however, delivery troubles may again be looked for. One large dealer, even now, complains that calls for tools for immediate shipment have been so heavy that he has been unable to maintain a demonstration shop.

Punch presses and grinding machines seem to be most in demand, although milling machines, boring mills, shaping and planing machines and all sizes of lathes are moving freely. A couple of fairly large air-compressor machines were also sold. Several houses are taking advantage of conditions to put on additional salesmen.

CLEVELAND

The most significant development of the week in this market for machinery and machine tools is the placing of several orders for various equipment ranging from $10,000 to $15,000 each. This is the first week since the armistice was signed that so much business in bulk has been placed here. The orders call for grinding machines, radial drilling machines, milling machines, gear cutting machines, screw machines and planing machines, and are being taken mostly by automobile and automobile-parts makers, rubber and tire manufacturing plants and gear-mold makers. The business has been placed

by firms within a radius of 200 miles of Cleveland. This business is considered unusual for this time of year, but is taken to indicate the prosperous trend in the machinery field which has been looked for since last fall.

The balance of business now being placed here is by various concerns seeking a miscellaneous assortment of material and equipment with which to round out their plants. With the larger orders being placed the trade as a whole is in agreement that the situation here is not quite normal. It is now expected that the coming summer will see a larger amount of "fill-in" business placed than formerly during the hot weather.

A good deal of new business coming forward and being absorbed by local firms is attributed to the fact that consumers are better acquainted with the equipment handled by each individual firm, and in this respect fewer inquiries go unfilled in this district than formerly.

Business Items

The U. S. Tractor and Machinery Co., manufacturers of "Uncle Sam" tractors, governor pulleys and machinery, Menasha, Wis., has completed the first units of its new factory and administration building. The unit completed is 60 x 125 ft., and practically all the equipment has been purchased.

The Hydraulic Press Manufacturing Co., home office and factory Mount Gilead, Ohio, has opened a branch office at Pittsburgh, Penn., in the Union Bank Building. J. E. Holveck is the manager.

The Rome Universal Export Co., Inc., has recently been chartered by the State Department to manufacture machinery, machine tools, etc. The directors are Samuel B. Stevens, Charles E. Simpson and H. J. Hayes, all of Rome, N. Y.

The Chicago offices of the International Oxygen Co. have been removed from 223 Railway Exchange Building to 817-820 Chicago Stock Exchange Building, 30 North La Salle St., Chicago. This office is in charge of Philip G. Wesley.

The pattern shop and general offices of the Wunsch & Washburn Co., mechanical engineers, has been moved to 302-304 McDougal St., Brooklyn, N. Y. The engineering offices of the company are located at 487 Broadway, New York.

The Borden Co., Warren, Ohio, manufacturer of Beaver easy-working die stocks and square-end pipe cutters, has just purchased an Oldsmobile roadster for its representative, George D. Clewell, who covers the New England states, Cleveland and Detroit. Mr. Clewell expects to work his entire territory with the car and in this manner will be able to keep in closer contact with the small towns.

Personals

A. Borsuk, for the last two years superintendent of the Presto Machine Works, Inc., Brooklyn, N. Y., now acts in a similar capacity for the Presto Phono Parts Corp., an allied interest, of which he has been elected vice president.

W. G. Balph has been appointed manager of the safety-switch section of the Westinghouse Krantz Factory, Brooklyn, N. Y. As head of this section, Mr. Balph will have entire responsibility of the sale of all Krantz products. Prior to working as salesman in the New York office, Mr. Balph was head of the fan-motor division with offices at Pittsburgh, Penn.

H. L. Garbutt, formerly manager of the line-material section of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has been appointed manager of the supply division of the Westinghouse San Francisco office.

Albert Brunt, who for the last four years has been engineer in charge of the direct-current machine design section of the industrial engineering department of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has resigned to return to Holland. Mr. Brunt was an active member of the A. I. E. E. and has prepared a number of interesting articles for technical papers on direct-current motors.

L. S. Devos, 24 Stone St., New York City, is export manager for the following concerns: Becker Milling Machine Co., Hyde Park, Boston, Mass.; Reed-Prentice Co., Worcester, Mass., and Whitcomb-Blaisdell Co., Worcester, Mass.

John T. Swift, president of the Swift Manufacturing Co., has become vice president and financial manager of the Williams Galloway Co., Waterloo, Iowa, manufacturers of gasoline engines, tractors, etc. The company is being reorganized. It was organized in 1906 and now employs 500 men. Plans are being worked out, it is reported, that will give employment to 700 men exclusive of the tractor plant.

George Ostendorf, formerly with the Tropical Paint and Oil Co., Cleveland, Ohio, has become associated with the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y. Mr. Ostendorf will make his headquarters at Cleveland and will look after both the manufacturing and the jobbing trade in northern Ohio.

Charles A. Greene, Chicago representative for the Borden Co., manufacturers of Beaver pipe tools, has opened up a downtown office at Room 501, No. 549 West Washington Boulevard, Chicago. Mr. Greene can be reached promptly by mail or phone at his new headquarters.

H. E. Sewell, Philadelphia, Penn., has been made salesman for organizing the open territory of the eastern states for the new Hart-Parr tractor. Mr. Sewell will make his headquarters in Philadelphia and will appoint distributors for the New England states, New York and Pennsylvania.

R. S. Carter, sales manager for the Whitman & Barnes Manufacturing Co., sailed from Halifax aboard the steamship Aquitania, on June 2, for Southampton, from which place he will proceed on a tour of European countries, visiting manufacturers, dealers and jobbers in England, Denmark, Norway, Sweden, Belgium and France. Provided conditions are settled, Mr. Carter plans to go to Petrograd.

A. H. Bauman, formerly general foreman of the 1.55-millimeter gun shop at Erie, Penn., has been appointed to a position with the sales department of the Cleveland-Duplex Machinery Co., Cleveland, Ohio, and will have city territory.

Forthcoming Meetings

The thirty-first annual convention of the American Boiler Manufacturers' Association will be held at Lafayette Hotel, Buffalo, N. Y., on Monday and Tuesday, June 23 and 24.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association. Annual convention will be held June 23, 24 and 25, 1919, at Marquette Hotel, St. Louis, Mo. The officers of the association are: President, W. J. Moffatt; first vice president, G. B. Hosford; second vice president, W. W. Nash; third vice president, T. E. Holderby; secretary-treasurer, Otto E. Schlinck, 485 W. 5th St., Peru, Ind.

The American Society of Marine Draftsmen will hold its eight annual convention at the Hotel Brunswick, Boston, Mass., on June 20 and 21. B. G. Barnes, 1596 North Ave., Bridgeport, Conn., is the secretary.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., N. Y.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On June 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

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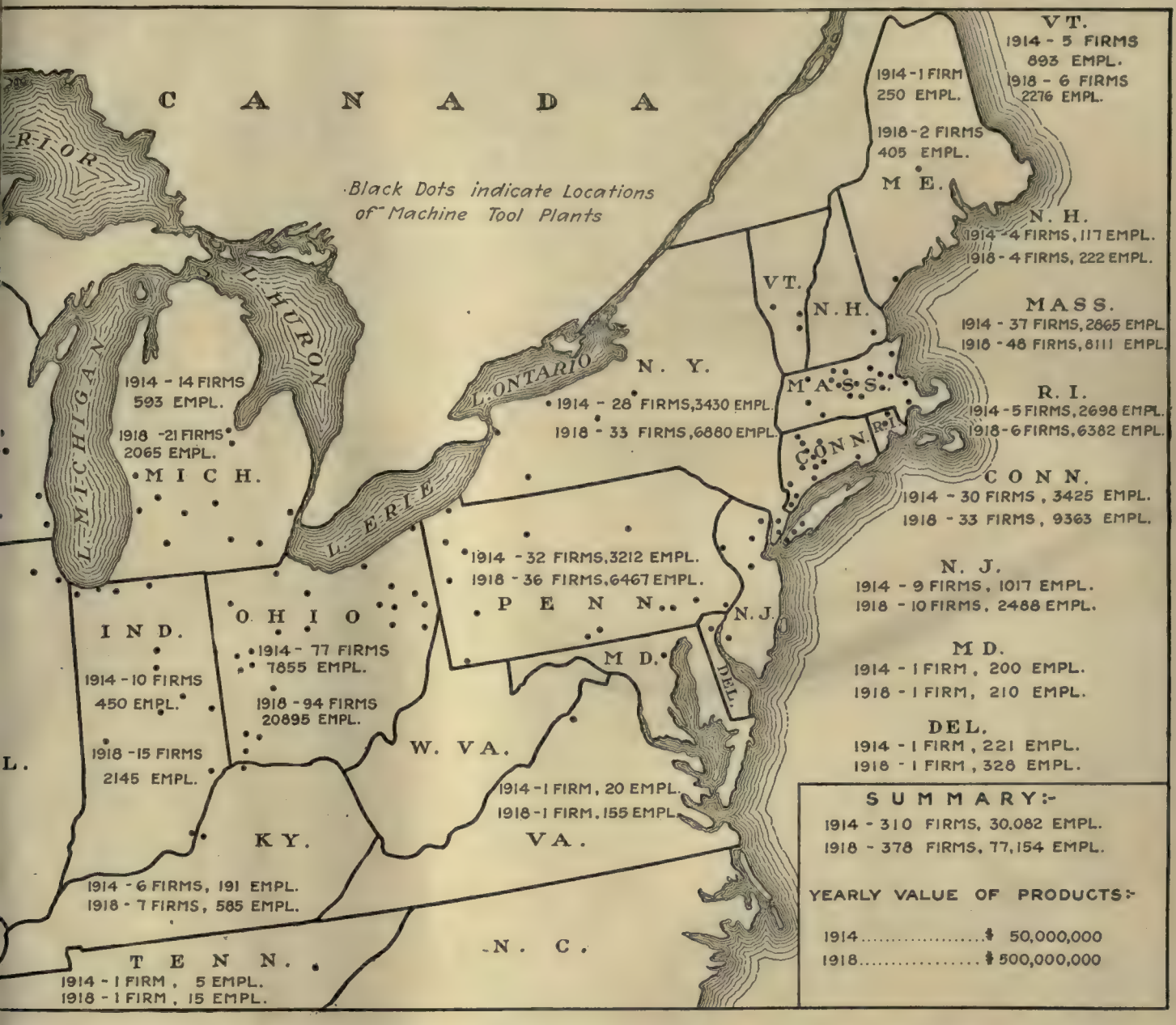
Machine-Tool Building in the United States

This map shows the distribution of the machine-tool building shops of the United States as shown by the statistics of the Machine-Tool Section of the War Industries Board. The location of machine-tool towns is shown by the dots in the various states while a summary of the industry in each state is also shown as nearly as possible to the state itself. Details as to the towns, the number of firms and the number of employees in each are given in the accompanying tables. These show the shifting of the geographical centers of the industry and are of especial interest as indicating the growth of the industry in the Middle West.

In order to adhere strictly to geographic lines, four firms using Cincinnati as a postal address but with their shops across the river in Kentucky, are classified as being in Kentucky instead of Ohio. This reduces the number employed in Ohio by 429, but still leaves Cincinnati with more employees than the whole state of Massachusetts, which comes next to Ohio. The figures as a whole are of great interest to all who are identified with the machine-tool industry in any way.



City	State	No. Firms 1914, July	No. Firms 1918, Oct.	No. Emp. 1914, July.	No. Emp. 1918, Oct.
Los Angeles	Calif.	0	1	0	30
Bridgeport	Conn.	9	9	669	2090
Bristol	Conn.	1	1	40	75
Danbury	Conn.	1	1	33	92
Hartford	Conn.	9	9	1344	4072
Meriden	Conn.	1	1	6	3
Middletown	Conn.	0	1	0	29
New Britain	Conn.	1	1	515	1497
New Haven	Conn.	2	3	20	99
New London	Conn.	2	2	251	357
Norwalk	Conn.	0	1	0	65
Torrington	Conn.	1	1	452	875
Waterbury	Conn.	2	2	77	86
Winsted	Conn.	1	1	18	23
Total		30	33	3425	9363
Wilmington	Del.	1	1	221	328
Chicago	Ill.	9	13	439	1431
Edwardsville	Ill.	1	1	39	50
Elgin	Ill.	1	1	21	34
Freeport	Ill.	1	1	37	80
La Salle	Ill.	1	1	14	44
Moline	Ill.	2	4	226	536
Rockford	Ill.	11	12	788	2026
Total		26	33	1564	4201
Aurora	Ind.	1	1	42	56
Brazil	Ind.	1	1	7	70
Elkhart	Ind.	2	2	36	401
Hammond	Ind.	0	1	0	75
Indianapolis	Ind.	1	3	63	332
Kokomo	Ind.	1	1	71	182
New Albany	Ind.	1	1	33	75
New Castle	Ind.	0	1	0	80
Peru	Ind.	0	1	0	50
Richmond	Ind.	1	1	37	250
South Bend	Ind.	2	2	161	574
Total		10	15	450	2145
Davenport	Iowa	1	2	12	270
Dubuque	Iowa	1	1	50	158
Marshalltown	Iowa	1	1	6	20
Total		3	4	68	448
Covington	Ky.	5	6	164	505
Louisville	Ky.	1	1	27	80
Total		6	7	191	585
Dexter	Maine	1	1	250	335
Portland	Maine	0	1	0	70
Total		1	2	250	405
Baltimore	Md.	1	1	200	210
Braintree	Mass.	1	1	11	27
Barre	Mass.	1	1	20	63
Beverly	Mass.	0	1	0	25
Boston	Mass.	4	5	497	1164
Cambridge	Mass.	1	1	51	148
Everett	Mass.	1	1	30	40
Fitchburg	Mass.	4	5	389	1441
Greenfield	Mass.	2	3	42	162
Hatfield	Mass.	0	1	0	27
Hudson	Mass.	2	2	92	315
New Bedford	Mass.	1	1	10	35
Springfield	Mass.	3	3	234	683
South Sudbury	Mass.	1	1	20	24
Waltham	Mass.	4	4	105	198
Westboro	Mass.	0	1	0	65
Winchendon	Mass.	0	1	0	153
Worcester	Mass.	12	16	1364	3521
Total		37	48	2865	8111
Adrian	Mich.	0	1	0	38
Bay City	Mich.	0	1	0	80
Detroit	Mich.	2	3	15	125
Grand Rapids	Mich.	3	5	101	503
Hastings	Mich.	1	1	80	261
Holland	Mich.	1	1	18	115
Jackson	Mich.	3	4	146	381
Kalamazoo	Mich.	1	1	9	30
Lansing	Mich.	0	1	0	20
Muskegon	Mich.	1	1	68	100
Saginaw	Mich.	2	2	156	412
Total		14	21	593	2065
St. Louis	Missouri	3	3	58	140
Lakeport	New Hampshire	1	1	4	11
Nashua	New Hampshire	3	3	113	211
Total		4	4	117	222
Bridgeton	New Jersey	1	1	118	128
Garwood	New Jersey	0	1	0	20
Newark	New Jersey	6	6	660	1260
Paterson	New Jersey	1	1	1	101
Plainfield	New Jersey	1	1	238	979
Total		9	10	1017	2488
Alfred	New York	1	1	2	29
Astoria	New York	1	1	30	50
Brooklyn	New York	5	5	1108	1840
Buffalo	New York	4	5	912	1289
Glendale	New York	1	1	57	88



City	State	No. Firms 1914 July	No. Firms 1918 Oct.	No. Emp. 1914, July.	No. Emp. 1918, Oct.
New York, New York		5	6	443	975
Rochester, New York		6	8	587	1873
Seneca Falls, New York		1	1	93	239
Syracuse, New York		3	4	113	417
Yonkers, New York		1	1	85	80
Total		28	33	3430	6880
Alliance, Ohio		1	1	34	38
Batavia, Ohio		1	1	30	56
Barberton, Ohio		0	1	0	15
Canton, Ohio		1	1	100	110
Cincinnati, Ohio		37	39	3214	9150
Cleveland, Ohio		14	21	2117	6227
Conneaut, Ohio		1	1	21	46
Defiance, Ohio		0	1	0	75
Hamilton, Ohio		3	5	717	2173
Ironton, Ohio		1	1	9	25
Kenton, Ohio		1	1	40	100
Massillon, Ohio		2	2	63	138
Minster, Ohio		0	1	0	65
Mt Gilead, Ohio		1	1	92	150
New Bremen, Ohio		1	1	20	46
New Phila., Ohio		0	1	0	15
Salem, Ohio		1	1	125	120
St. Mary's, Ohio		1	1	15	150
Sidney, Ohio		1	3	54	528
Springfield, Ohio		3	3	142	211
Tiffin, Ohio		1	1	162	202
Toledo, Ohio		5	5	883	1216
Zenia, Ohio		1	1	17	39
Total		77	94	7855	20895
Braddock, Penn		1	1	36	120
Chambersburg, Penn		1	1	147	399
Columbia, Penn		1	1	20	42
Elwood City, Penn		1	1	25	50
Erie, Penn		5	5	397	877
Franklin, Penn		1	1	71	275
Lancaster, Penn		0	1	0	10
Meadville, Penn		2	2	29	47
Philadelphia, Penn		15	15	1569	2494
Pittsburgh, Penn		1	3	178	454
Ridgway, Penn		1	1	64	189
Royersford, Penn		1	1	15	125
Waynesboro, Penn		2	2	661	1325
Williamsport, Penn		0	1	0	60
Total		32	36	3212	6467
Pawtucket, Rhode Island		2	2	710	735
Providence, Rhode Island		3	4	1988	5647
Total		5	6	2698	6382
Knoxville, Tennessee		1	1	5	15
Springfield, Vermont		3	3	553	1188
Rutland, Vermont		1	1	0	200
Windsor, Vermont		1	2	340	888
Total		5	6	893	2276
Covington, Virginia		1	1	20	155
Albany, Wisconsin		1	1	3	3
Beloit, Wisconsin		2	3	91	135
Eau Claire, Wisconsin		1	1	25	25
Fond du Lac, Wisconsin		1	1	90	340
Janesville, Wisconsin		2	2	44	55
Madison, Wisconsin		2	2	388	1430
Milwaukee, Wisconsin		3	4	237	1230
Oshkosh, Wisconsin		1	1	6	19
Racine, Wisconsin		3	3	66	146
Total		16	18	950	3383

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Casting

Grand Rapids Grinding Machine Co., Grand Rapids, Mich.

"American Machinist," May 29, 1919



For use in the foundry or machine shop for the grinding of gates, sprues, fins, rough places, etc. or for the grinding of the surface of castings preparatory to filling and painting. The base casting has three feet in order that it may be mounted on rough flooring, and carries the main spindle in ring oiled bearings. The spindle is of the hollow type in the form of a heavy steel sleeve. The key extends through from the pulley into a long feathered keyway on the internal shaft which slides longitudinally inside of this hollow spindle. To the outer end of this spindle shaft is fitted a universal joint and to this joint in turn is fastened the long, rigid shaft which carries the grinding wheel. The machine regularly carries a 12-in. grinding wheel with 1¼-in. face, but smaller wheels can be quickly fitted.

Knee, Toolmakers'

Taft-Pierce Manufacturing Co., Woonsocket, R. I.

"American Machinist," May 29, 1919



In the new device a second measuring plug has been substituted for the hole in the table, the distance between the two measuring plugs being 5 in. The outer measuring plug, instead of being inserted in the edge of the table, is mounted in an adjustable plate held in position by two dowel pins. This construction is used so that in case it is ever necessary to repair the knee the plate can be readjusted and redoweled without undue trouble. The base of the knee is finished on two right-angle faces which permit it to be set at any angle from zero to 90 deg. and yet make the measurement on an angle of 45 deg. or less, which gives the greatest degree of accuracy in observation. Another feature of the knee is the location of one of the measuring plugs in the center of rotation. Is also made with a vernier reading angles of 5 min. in place of the buttons.

Indicator, "True"

Osberg & Johanson, 206 Boston St., Dorchester, Mass.

"American Machinist," May 29, 1919

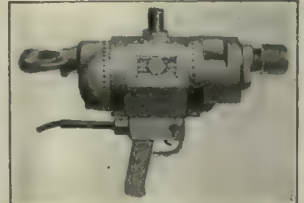


This device requires no elaborate setting up on account of its simple construction, and has no delicate springs, levers or other small parts to get out of order. The outfit consists of a set of two centers and a scale that can be used for indicating motions of the pointer; this scale being held in an ordinary surface gage when in use. The device can be used for truing up center marks in work to be bored out, for testing lathe centers, aligning the headstocks and tailstocks of lathes, and other similar center jobs.

Drill, Electric

Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md.

"American Machinist," June 5, 1919



The machine is shown in the illustration, and has a capacity up to ⅞ in. in steel, and is provided with a No. 1 Morse taper socket. It is stated the machine will drill a ⅞-in. hole through machine steel at the rate of 1½ in. per minute without overloading the motor. The machine weighs 21 lb., has a no-load speed of 600 r.p.m. and is supplied with interchangeable spade handle and breastplate, as well as electric connecting cable.

Lathe, Foot Power, "Sterling"

Shepard Lathe Co., Canal and Jackson Sts., Cincinnati, Ohio

"American Machinist," May 29, 1919

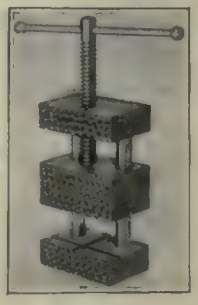


Can also be furnished with countershaft for power drive if desired. The headstock is provided with a hollow spindle of high-carbon steel, running in white-bronze bearings, the front bearing being tapered to allow adjustment for wear. The back gearing is of the planetary type and is located on the inside of the cone pulley. This construction allows the spindle to be thrown in direct or back gear without stopping the spindle, the movement being accomplished by means of the clutch handle located near the front spindle bearing. Actual swing over bed, 11¼ in.; hole through spindle, ⅞ in.; spindle nose, 1½ in. in diameter threaded, 19 pitch; front spindle bearing, 1¾ x 2½ in.; rear spindle bearing, 1¼ x 2½ in.; ratio of back gears, 4 to 1; distance between centers, 24 and 36 in. with 4- and 5-ft. beds respectively; net weight, 500 lb.

Vise, Drilling

Acme Tool Co., 143 West Water St., Milwaukee, Wis.

"American Machinist," May 29, 1919



This device is of open-work construction so that holes may be drilled completely through a piece of work, and two V-grooves are placed in one of the jaws so that cylindrical work can be conveniently held. The tool is made of semi-steel and the sides and edges are made at right angles so that after a piece of work is once clamped holes can be conveniently drilled at right angles without moving the work in the vise. The screw is 1 in. in diameter with an Acme thread. The vise is 5½ in. wide, 3⅜ in. high and 10½ in. long, having a maximum opening between the jaws of 4⅛ in. The sliding jaw moves on two cylindrical ways that are securely fastened at the ends to the stationary jaw and the block carrying the screw, these ways being of suitable size to give rigidity.

Angle Fixture, Universal

Nelson Tool and Machine Co., 253 Norfolk St., Newark, N. J.

"American Machinist," May 29, 1919



This universal angle fixture is made in three sizes. The smallest size, 3 x 3⅜ in., is made with a plain base only, while the two larger sizes, 6 x 9 and 9 x 12 in., are made with either plain or swivel bases as desired. The swivel-base fixture illustrated can be adjusted to any angle horizontally and can be adjusted to 90 deg. in a vertical direction without the necessity of resetting the work being held. Adjustments in the vertical plane are made by a gear and pinion wrench that has a sufficiently large ratio to permit fine adjustment. After being adjusted to the desired position the table can be securely clamped. The swivel head is locked to the base by two bolts that prevent any possibility of lifting. Another feature is the construction of the top plate, which has three T-slots in the top and one on the edge, this being said to be advantageous where work of L-shape, such as the work shown clamped in position, is being handled.

Die Head, Automatic

Landis Machine Co., Waynesboro, Penn.

"American Machinist," June 5, 1919



This automatic die head is made of steel to insure a long life of hard service. The head is opened automatically by retarding the forward motion of the carriage, and is closed by hand. It is locked by the operating handle which contains a latch having a tongue milled on the lower end. To adjust the head for either roughing or finishing cuts merely requires a half turn of the latch to suitable graduations. The head is graduated for all sizes of bolts and pipe, both right- and left-hand within its range. It is adjusted to size by means of a screw which engages the head body. This head is applicable to practically all makes of screw machines and turret lathes which have sufficient space to swing heads of these diameters.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$29.80
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	25.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅜-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Near Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.37	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.27	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.22	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.17	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.05	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 1/12, 3/32, 1/8, 7/32, 1/4 No. 8, 5/16 and No. 10	25.50 to 33.00	3/16 by 12 in. long	14.00
5/16		1/4 by 19 in. long	12.00
No. 12		5/16 by 19 in. long	10.00
3/8, No. 14 and 7/16		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/16	33.00
		1/8	30.00
		5/32	8.00

Domestic 20c. for 1/16, 15c. for 1/8 to 7/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	1/8 to 1 1/4	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	1/8 to 1 1/4	39½%	24½%
1/2	51½%	39%			
3/4 to 1 1/4	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	47%	31%	46½%	31%	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	16.75	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	91.00
Lead	5.20	5.25	7.25
Spelter	6.50	6.5	7.62½
ST. LOUIS			
Lead	4.95	5.00	7.12½
Spelter	6.15	6.20	7.31½

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	25.50	22.50	31.50–33	24.50	35.00	26.00	31.50
Copper wire (carload lots)	23.00	23.00–28	32.00	24.00	34.00	22.00	31.00
Brass sheets	20.50	23.75–28	30.75	24.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	31.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	43.00	41.25	39.00	55.00

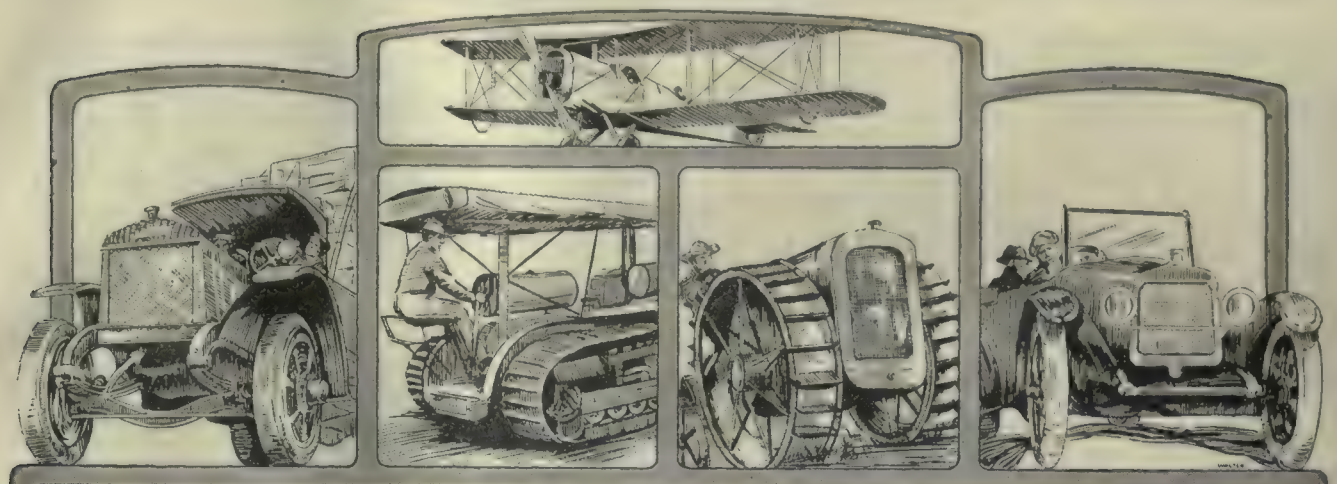
Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00½	$25.25
New York	19.50	26.25
Cleveland	23.00	30.00
Chicago	24.00	28.00

June 26, 1919 American Machinist Vol. 50, No. 26

1213



AUTOMOTIVE CONSTRUCTION

The Hispano-Suiza Airplane Engine—I

By H. O. C. ISENBERG
Works manager Wright-Martin Aircraft Corporation, New Brunswick (N. J.) plant.

One often hears the expressions "Built like a watch," "As accurate as a watch," implying that the article referred to is extremely accurate. As a matter of fact, if a watch were built to a degree of accuracy proportionate to the accuracy of the Hispano-Suiza airplane motor, it would be so very accurate that it would not function at all.

TO COVER the entire manufacture of the Hispano-Suiza motor would be a gigantic task and would probably not be worth publishing in the columns of the *American Machinist*. However, many puzzling problems have been solved at the Wright-Martin plant and as a large percentage of these are applicable to other lines of manufacture a description of them should be of value. It is therefore the intention in this series of articles to select for special mention only those high spots in manufacture which are considered of specific interest to the readers of this paper. However, before going into the manufacturing methods, a brief description of the plant and its facilities may be in order. The Wright-Martin Aircraft Corporation, New Brunswick plant, is located at the west end of the town on Jersey Avenue. It is divided into two sections, the northerly and southerly, and has a total area of approximately 18 acres. The number of employees is about 8123.

There are two railroad sidings on the property. The plant is easily accessible by motor vehicles and trucks in all seasons of the year, and two electric-railroad lines have terminals nearby. There are in all 37 buildings on the property, as shown in Fig. 1.

Weight is of prime importance in an airplane motor; further, within a very slight tolerance one motor must weigh the same as another motor of the same make and size. To attain this object all the components that go to the making of the motor must be incessantly watched during the process of manufacture.

With parts made from bar stock a slight variation in the density of the material or a slight variation in dimensions will cause wide variation in the weights of finished parts. The latter is of course eliminated by the inspection system while the former is not so easily detected. In castings uniform weight of the work requires careful watching; but perhaps, instead of indulging in platitudes, it will be better to give an outline of how work on a new airplane engine is started. After the tentative design is passed by the engineers in charge of the design, tracings and blueprints are made and copies of these are sent to the wood-pattern shop. In work such as this, the writer finds it obligatory to make a very accurate layout. Usually, in the pattern shop the layout is made on a board; in this shop sheet aluminum is used. This is coated with patternmakers' ordinary black shellac. After it is dry the layout is made full size with *single* shrinkage allowance, for it must be remembered that this first set of patterns is an experimental set to provide the castings for the experimental motor which will determine the wisdom of the engineer who designed the engine.

In the Wright-Martin plant layouts are made by men who are not only first-class draftsmen but efficient patternmakers as well. With the necessary tools and a sharp scriber the lines are scratched through the black-shellac surface so that they stand out clear white on the black background. When the layouts for the various parts are finished they are carefully inspected and checked to see that no errors have been made. The layouts then go to the patternmakers assigned to do the work. In this plant the wood patternmakers are obliged to work to a tolerance of 0.015 in. Usually for all wooden patterns and coreboxes high-grade mahogany is used.

AUTOMOTIVE CONSTRUCTION

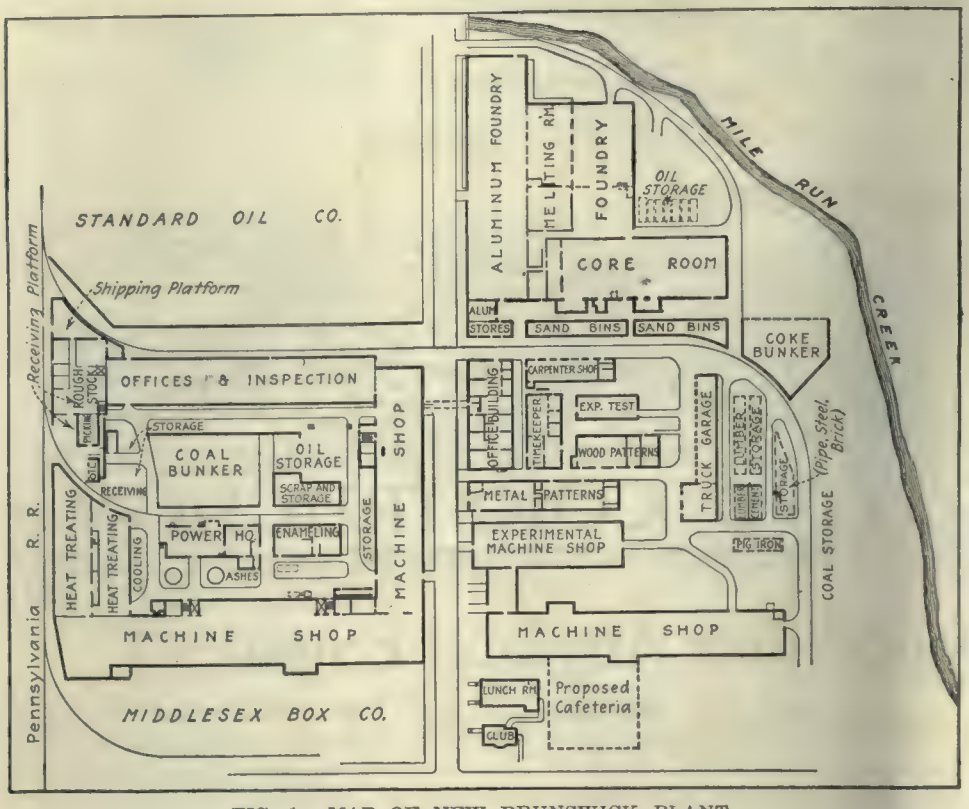


FIG. 1. MAP OF NEW BRUNSWICK PLANT

Mention may be made here that Detroit and Cleveland seem to have a mortgage on a large proportion of the men who are capable of turning out the grade of pattern work demanded in the production of airplane-motor castings. The reason for this is obvious, except for the refinements necessary in airplane work, as the cylinders, crank case and other castings used in high-grade automobiles are very similar. Therefore, many patternmakers were imported from these cities.

The Hispano-Suiza engine passed through the experimental stage a good many months ago. However, an experimental set of patterns is, at this writing, going through the pattern shop, and while it is not for an airplane engine it will serve to illustrate, as it is just as accurately and nicely made as it would have been had it been for that purpose.

In Fig. 2 is shown the cylinder-block pattern made of high-grade mahogany. To the right the outside of the pattern is shown, while to the left is the parting face of the pattern. Four dowel pins are used with a single rapping and drawing plate in the center. In Fig. 3 the corebox for the barrel cores is shown. This also is made of mahogany and, except for its accuracy, is about the same as any other corebox for a barrel core.

In Fig. 4 is shown the corebox for the water-jacket core. This is somewhat more complicated. The core is supported in the mold by the print projections *A*, Fig. 4, resting in the depressions in the mold left by the prints *A*, Fig. 2. The projections *B* also enter the depressions left by the prints *B*, Fig. 4. There are six loose pieces in this corebox; two of them are shown at *C* and *D*. They fit at *E* when the coremaker is ready to make up a core. Similar pieces for the other side of the corebox are shown in place at *F* and *G*. The part *H* fits in the dovetails *I* and the part *J* forms the walls of the cylinders. The work on the patterns and coreboxes referred to amounts to about 200 hours.

In Figs. 5 and 6 are shown some smaller and simpler patterns and coreboxes. There is nothing remarkable about these except the extreme accuracy previously referred to. The machines and tools in this pattern shop are similar to those of any other well-equipped shop for work of a like nature.

In Fig. 7 are shown three wood-turning tools used in the shop. At *A* is the ordinary rough-turning tool, at *B* a finish-turning tool that is not so well known, and at *C* a parting tool that is still less well known. The two projecting points at each side shave the sides of the parting cut and leave a nice smooth surface.

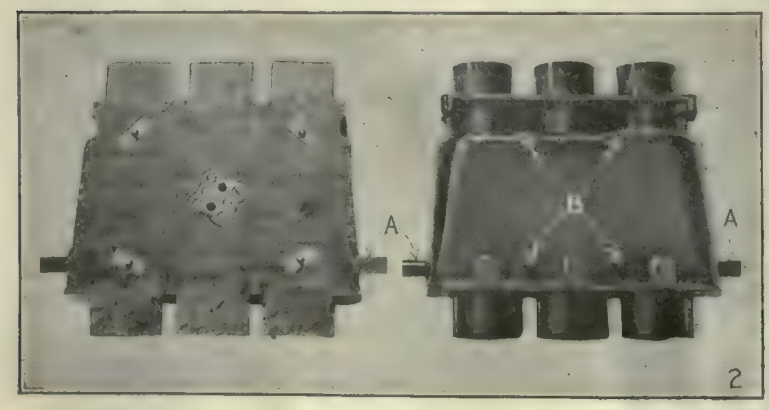


FIG. 2. EXPERIMENTAL CYLINDER-BLOCK PATTERN

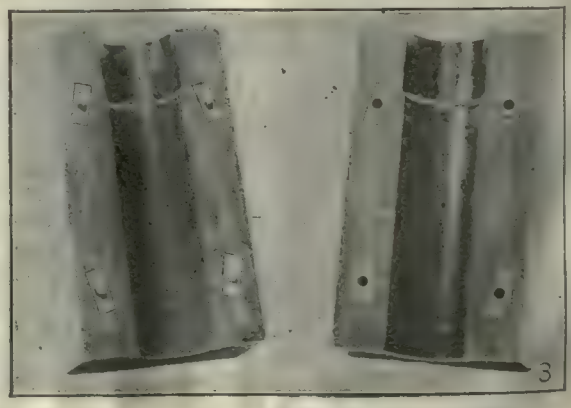
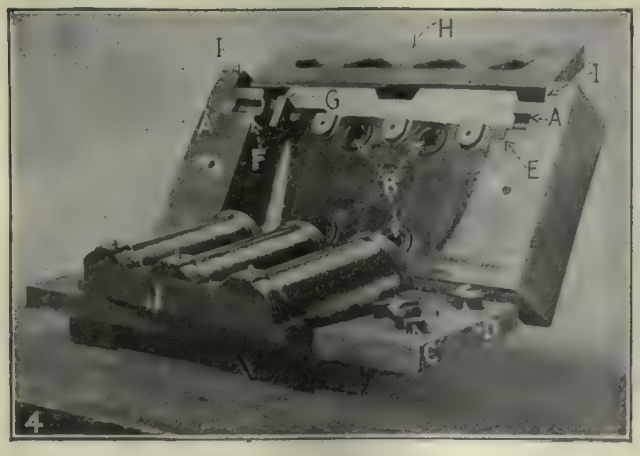
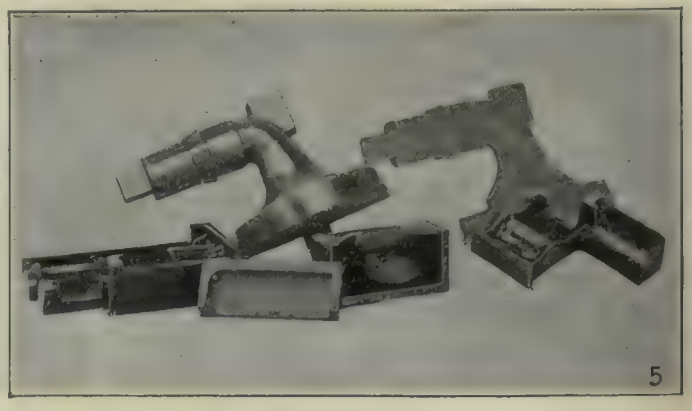


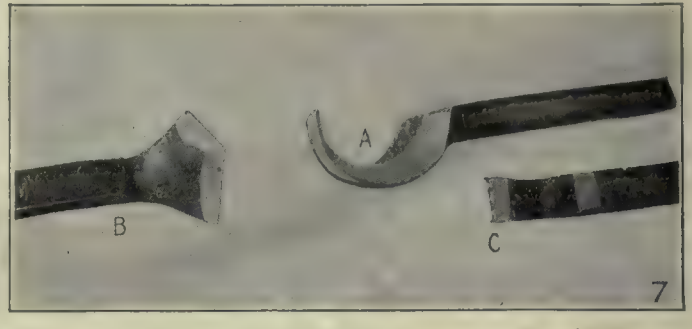
FIG. 3. COREBOX FOR BARREL CORES

AUTOMOTIVE CONSTRUCTION









FIGS. 4 TO 7. COREBOXES, PATTERN AND WOOD-TURNING TOOLS

Fig. 4—Water-jacket corebox. Fig. 5—Pattern for centrifugal pump. Fig. 6—Small coreboxes. Fig. 7—Turning tools for wood

After the experimental patterns are finished they are first rigidly inspected in the pattern shop for size and finish after which they go to the general-works inspector and by him are thoroughly inspected before being passed. Having passed this inspection they go to the foundry where a trial set of castings are made. These are again sent to the shop inspector who so far as possible checks all the dimensions to see that they agree with the design. The castings are then sawed in sections to see that the desired metal thicknesses have been obtained.

The castings being satisfactory or the patterns having been altered to make them so, sets of castings are made and sent through the shop; the engine built and given

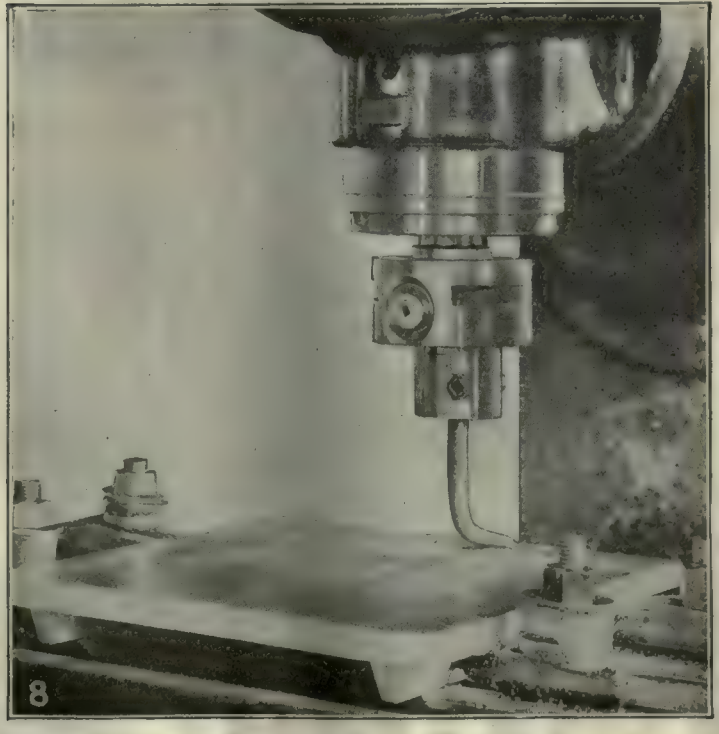


FIG. 8. ROUGH-SURFACING ALUMINUM PLATES

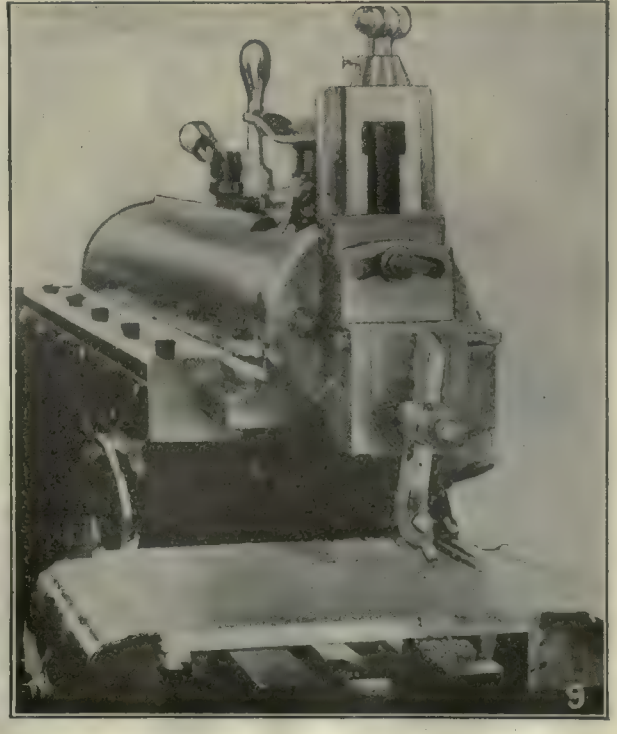


FIG. 9. FINISHING PLATES ON SHAPING MACHINE

AUTOMOTIVE CONSTRUCTION

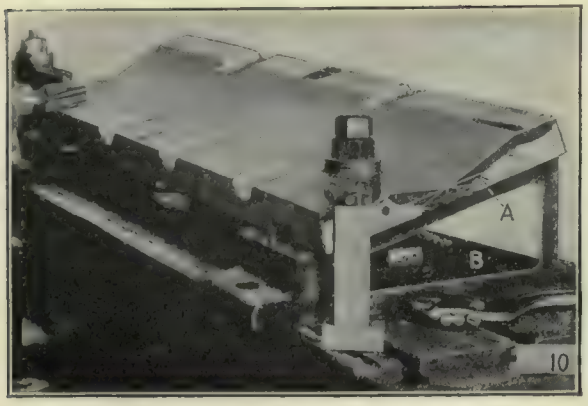


FIG. 10. DRIER FOR HEAD CORE

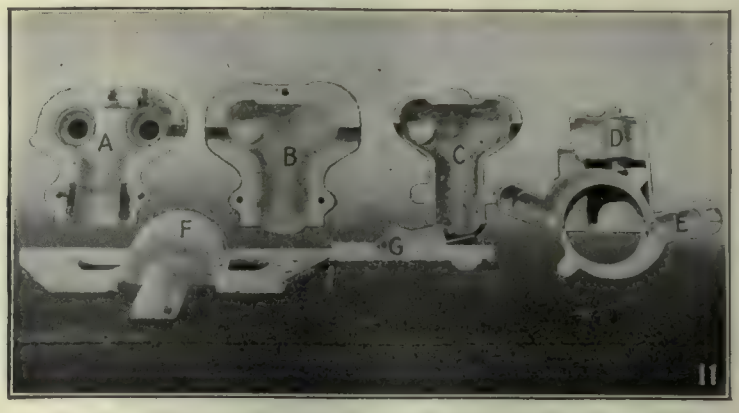


FIG. 11. SMALL METAL COREBOXES AND DRIERS

a thorough tryout. When the performance of the experimental engine has been pronounced satisfactory, work is begun on a set of master patterns. These also are made of wood, but with double shrinkage, as the working patterns are made from them.

The Metal Pattern Shop

The metal pattern-shop equipment for work of this character more nearly approximates the equipment for a toolroom than it does that of the ordinary metal pattern shop. We have all the toolroom equipment, lathes, planing machines, plain universal and vertical milling machines, with all the attachments which go with them, shaping machines, sensitive and radial drilling machines and a fairly large hardening furnace. The tolerance on the work from the metal pattern makers is 0.005 in. The bulk of the metal patterns are made from aluminum alloy as are also the plates to which plate patterns are attached.

In Fig. 8 is shown a roughing operation on aluminum plates, being done on a Cincinnati universal milling machine with the vertical attachment. The sweep tool is driven by a Marvin and Casler boring head. In Fig. 9 these same plates are shown being finished on a shaping machine. There is nothing out of the ordinary about the job except that it shows the metal shaping machine used in patternmaking. Fig. 10 shows the drier for a head core being machined on the milling machine. Each corebox is provided with a number of drier plates. They must be machined so as to retain the shape of the cores. When preparing metal patterns for machining they are varnished with ordinary black shellac and after drying the work is carefully laid out. This black surface with the scribed lines on it can be readily seen at *A* in Fig. 10. In the pattern shop a number of special angle plates are employed for producing the patterns. A pair of these special angles *B* are shown supporting each end of the drier. In this case the angle is 15 deg. and their use is of great assistance in assuring the interchangeability of the work, for it must be borne in mind that the drier plates may be used with any one of say half a dozen similar coreboxes in use at the same time in the coreroom.

The use of the driers will be shown later in connection with the description of the coreroom.

The Smaller Core Driers

In Fig. 11 are shown a number of smaller core driers. At *A* in this figure is one-half of a corebox for the intake port; at *B* is the other half of the corebox. At *C* is one of the driers for this core. As an operator can make a large number of these cores with one box a large number of driers must be provided with each corebox. *D*, *E*, *F* and *G* are also driers; the one at *E* is for a centrifugal pump for the cooling water for the engine. The reader can readily see that a core such as this must be very carefully handled while it is still moist and soft.

In Fig. 12 is shown a job set up on the faceplate of an engine lathe. The two halves of the corebox have been planed and fitted and the face next to the faceplate has also been surfaced so that it can be used

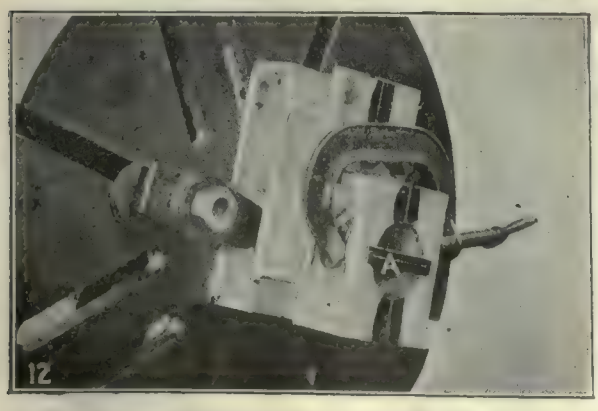


FIG. 12. COREBOX SET UP ON FACEPLATE

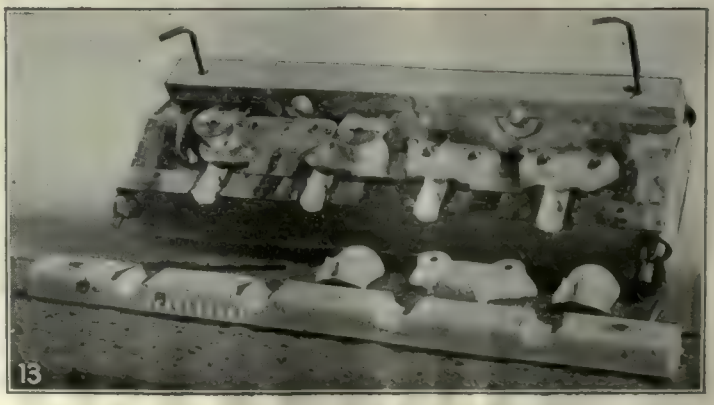


FIG. 13. BOX FOR HEAD CORE

AUTOMOTIVE CONSTRUCTION

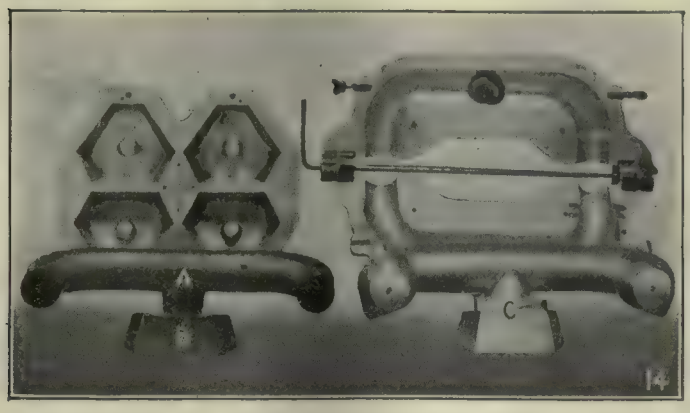


FIG. 14. PATTERN AND COREBOXES FOR INTAKE MANIFOLD

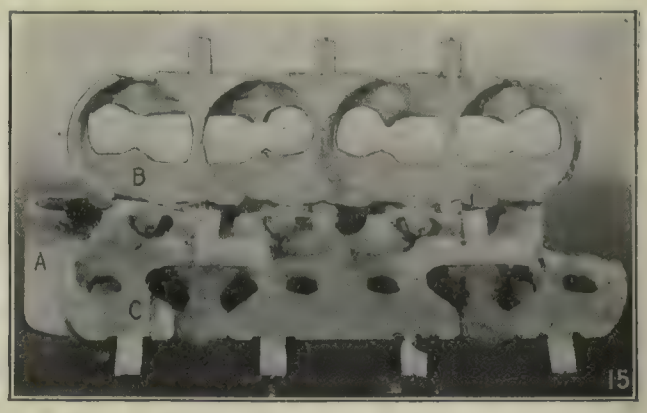


FIG. 15. PLASTER CASTS OF THE WATER-JACKET CORES

to locate for boring the hole at *A*. The job is clamped to the faceplate just as it might be clamped were it a toolmaker's job instead of one for the patternmaker.

In Fig. 13 is shown a box for a head core. One half of the box is shown with the loose pieces in place and the other half with them removed. As previously stated all the metal patterns and coreboxes are made of aluminum alloy. Aluminum is a very soft metal and core sand very abrasive in its action. For this reason all the faces of the patterns and coreboxes that are exposed to sand erosion are faced either with hard brass or as in this instance with steel. This is ordinary steel plate about $\frac{1}{8}$ in. thick. In the majority of cases it is attached to the face of the pattern with countersunk screws and when securely located in place, the surfaces and slots of the screwheads are made flush with the surrounding steel or brass plate by filling in with solder. But even with this protective sheet of steel the abrasive action of the sand soon shows itself, especially so in the case of coreboxes. This is due to the fact that a large percentage of sharp silica sand is used in the core mixture.

Description of the Pattern and Coreboxes For Intake Manifold

In Fig. 14 is shown the pattern and coreboxes for an intake manifold. Note how the corebox is hinged together and provided with swing bolts and thumb nuts to facilitate the work of the coremaker. On completion of a corebox the pattern-shop inspector takes a plaster cast of the core. This plaster cast is shown in Fig. 14 at *A*. In this case the core consists of two parts, the irregular hexagon *B* and the curved cylinder *A*, the hexagonal part fitting the print *C* at the center of the length of the manifold.

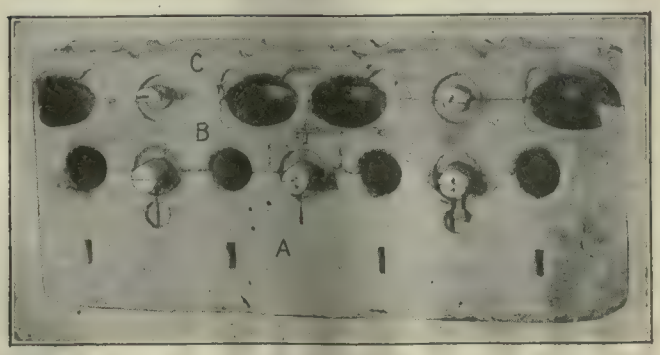


FIG. 16. PARTS OF FIG. 15 ASSEMBLED

In Figs. 15 and 16 are shown plaster casts of the water-jacket cores for the cylinder block. In Fig. 15 are shown the three parts *A*, *B*, *C*, that go to make up the complete water-jacket core shown in Fig. 16. In both these illustrations similar reference letters are used to indicate similar parts.

The Time-Study Man or Rate-Setter

By D. C. Cook

Gaylord G. Thompson, in his article on page 939 of the *American Machinist*, seems to be worrying over the correct designation for a time-study man or rate-setter.

But why worry over official designations when in the last analysis they are details of organization? Titles in modern business remind me of a certain kitchen utensil which is known as a frying pan, a skillet or a spider, according to the section of the country in which you live.

Payment of wages is based on certain time factors which are determined by making observations of various sorts with a view, primarily, toward obtaining maximum output in a minimum period of time. The success of this undertaking depends upon the personality of the individual making the observations and his method of using the stop watch. A stop watch is a dangerous tool and when conspicuously used, together with the impossible rates which are based on the reading of the split second hand rather than on sound judgment, will stir up more labor unrest than any other cause. The article also states that the time-study man has "thus far escaped the literary barrage laid down by the long- and short-range pens of various authorities." True, but has this individual escaped the scorn and hatred of shop men who have suffered through his inconsistencies?

Instead of endeavoring to determine their correct designation, I would suggest that more time-study men cultivate those personal characteristics that gain co-operation, rather than opposition, of shop men. The point of position, title and salary, as well as the adequacy of piece rates, will take care of themselves.

Flatness Tests at Bureau of Standards

By R. L. RANKIN

It is not so long ago that the scientist and his methods were looked upon with kindly condescension by the practical men of the shop. Fortunately, this attitude has been changed to a large extent by the valuable contributions of the laboratory to mechanical operations, among the best of them being those in the field of precise measurement. A quick and extremely accurate method of determining the degree of flatness of gage surfaces is here described.

SINCE the organization of the Gage Section of the Bureau of Standards in 1917 there have been frequent calls for tests of flatness of various steel surfaces, notably the contacts of measuring instruments. While the methods used by the Gage Section for such tests have long been known and utilized many manufacturers who have visited the bureau have expressed their surprise at the rapidity of this work which is accurate to one millionth of an inch.

The tests are made by means of the well-known principle of the interference of light. When light is reflected from two flat surfaces there is interference under certain conditions between the two sets of reflected light waves. The result is a series of light and dark bands known as interference fringes. Newton's rings formed by light reflected from the upper and lower surfaces of thin films of oil are interference fringes.

Another simple method of obtaining these fringes is by means of two glass true planes, or flats, as they are sometimes called. These true planes usually consist of a round piece of glass ground flat on one surface. When one of these true planes is placed on another the fringes referred to are seen by looking through the upper true plane. When monochromatic light—that is, light of one color—is used these fringes consist simply of light and dark bands. Thus with a sodium flame bright yellow and very dark bands are produced. The fringes may be seen clearly in ordinary daylight, however, in which case the various colors composing white light are separated into small rainbows in which the red and the green fringes are the most prominent. It is not necessary that both surfaces be of glass in order to obtain these results. While one glass flat is necessary the surface to be tested may be lapped steel. In any case there are two ways of using the true plane—it may be placed flat upon the surface to be tested or it may be placed in contact with this surface at one edge only, leaving a thin wedge of air between them. The latter method is preferable for testing flat surfaces or surfaces that are nearly flat.

If the surface being tested is really flat and the true plane is placed flat on this surface either all color is eliminated or else a uniform color spreads across the whole surface, depending on how close the two surfaces are pressed together. But if the true plane is held in such a way as to form a thin wedge of air between the two surfaces the interference fringes appear as straight lines. Fig. 1 shows such interference bands with flat surfaces. In one part of this figure the bands are widely separated because the taper of the wedge is reduced almost to the point at which a single color will appear across the whole surface.

When the true plane is placed flat on a surface which is not flat curved lines are seen instead of a sheet of color (unless the surface is perfectly cylindrical). Fig. 2 shows the appearance of the circular fringes produced when the surface tested is spherical. There are different methods of determining whether a surface of this kind is convex or concave. The simplest perhaps is to form a wedge of air between the two surfaces, as was done with the flat surfaces illustrated in Fig. 1. The fringes then become arcs of a circle the center of which moves farther and farther away as the taper of the wedge is increased. Fig. 3 shows such fringes. If the surface is convex the ends of these fringes curve toward the small part of the wedge; if the surface is concave the ends of the fringes bend away from the small part of the wedge. The small part of the wedge

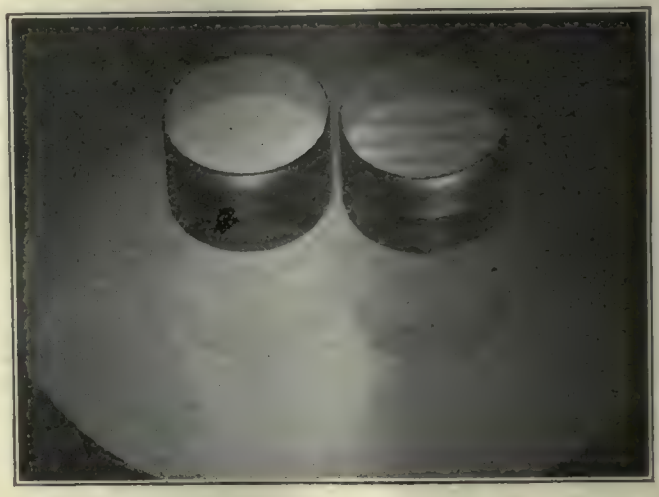


FIG. 1. INTERFERENCE FRINGES ON FLAT PLATE

in Fig. 3 is in the foreground and the ends of the lines turn in this direction. There the surface being tested is convex.

When a true plane is placed flat on a cylindrical surface, straight fringes appear that cannot be eliminated, as was done with the flat surfaces. When the wedge is formed the lines appear straight or curved, depending on the location of the closed part of the wedge. When the surface tested is the shape of a piece of egg shell, as is frequently the case with micrometer anvils, the fringes form ellipses when the plane is placed flat on the surface and are curved when the wedge is formed.

The convexity or concavity of any surface may be determined just as it was done with a spherical surface. In order to make sure of the shape of a surface this test with the wedge should always be made, and furthermcre the small end of the wedge should be formed at two different points 90 deg. apart. Consider, for instance, a cylindrical surface and a flat surface with a burr on one edge. In both cases, with the true plane flat on the surface, straight lines appear that cannot be eliminated by pressing down on the true plane. Thus the wedge must be formed, and since a cylindrical sur-

face shows straight lines for one position of the wedge straight lines running perpendicular to each other must be formed in order to make sure that a surface is flat. This is shown in Fig. 1.

The shape of any kind of an irregular surface can be determined readily by means of the three settings already described; this is, with the true plane flat on the surface to be tested and in contact at each of two points that are 90 deg. apart. In every case, except when there is a burr on the surface tested, the true plane flat on this surface shows fringes that are contour lines of the surface, corresponding exactly to the contour lines that show the elevation of land on a map. The contour interval of the interference lines is 0.00001 inch.

After the determination of the general character of the surface being tested it is a simple matter to measure the exact amount that the surface is out of flat, no matter whether the true plane is placed flat on this

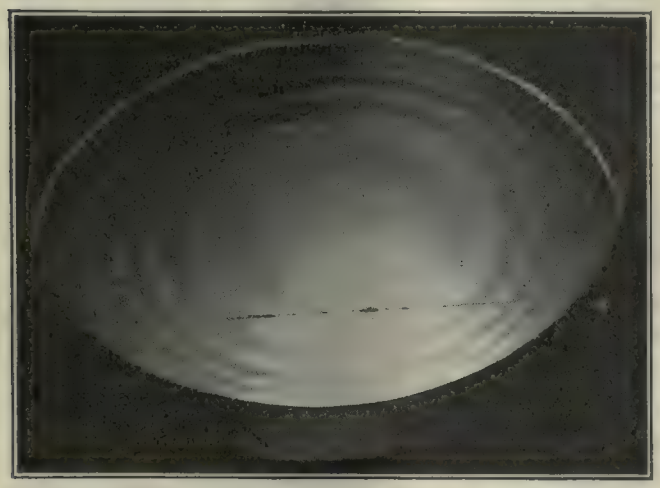


FIG. 2. INTERFERENCE FRINGES ON SPHERICAL SURFACE

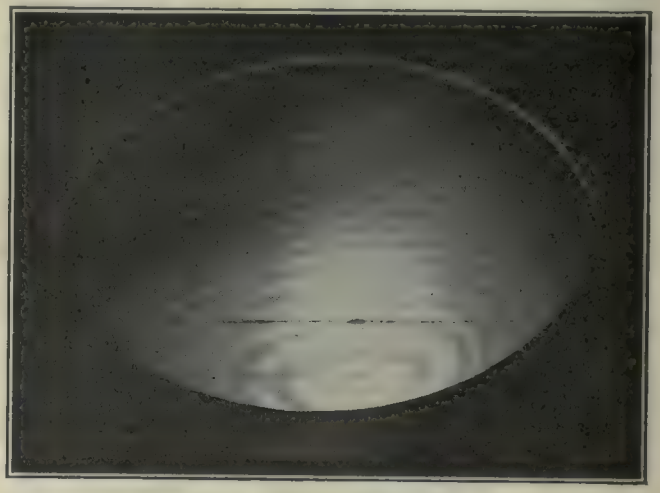


FIG. 3. SPHERICAL SURFACE WITH WEDGE OF AIR INCLUDED

surface or whether pressure is brought against one edge of the true plane in order to form a wedge of air between them. In the former case the number of circular fringes is counted from the center out to the edge. In the latter case a line is drawn tangent to one of the curved fringes and the number of other fringes which this tangent cuts will be the same as the number of circles counted before. Each of these circles or fringes cut by the tangent line represents an error of 0.00001 in. in the flatness of the surface. The exact value of a fringe depends upon the color, that is, the wave length, of the light used, but since these variations are of the order of only a few millionths of an inch, 0.00001 in. is an accurate enough figure to use for commercial work. For very precise work a good true plane is used, the color of the light is considered and readings accurate to 0.000001 in. are obtained by estimating to one-tenth of the distance between fringes.

In flatness tests made in the Gage Section the value reported gives the difference between the height of the surface in the middle and near the edge. If the surface is good and flat except around the very edge it is usually not necessary to consider the rounded edge when making a report. The surface shown in Figs. 2 and 3 is about 0.00006 in. out of flat. A tangent line is shown in Fig. 3, which may be used to determine the number of fringes cut, although this line should be across the center of the surface. It is not necessary to have the tangent line cut on the true plane at all; the edge of a piece of paper may be used. and with a little practice it is possible to count with the unaided eye the number of fringes cut.

A manufacturer who has any need for testing the flatness of surfaces should get a glass true plane for his own use. Tests may be made on any surface that is reasonably flat, such as the lapped surfaces of gages, straight-edges, the ends of flat-end standards, micrometer anvils and spindles and in fact practically any contact surface used in making measurements. Anyone can obtain very accurate results with a little practice. Care should be exercised not to scratch the true plane by rubbing it against surfaces that are not entirely free from grit, but the tests will be found very simple, even though the explanation of them may not appear so. Results are obtained with considerable rapidity. A micrometer manufacturer recently visited the Gage Section in order to have the results of his lapping inspected. The test took about as many minutes as the trip took days.

TABLE OF INTERFERENCE FRINGES

I. Surface	II. With True Plane Flat	III. With Wedge of Air	IV. Wedge Revolved 90°
Flat	No bands	Straight lines	Straight lines
Spherical	Circles	Arcs of circle	Arcs of circle
Cylindrical	Straight lines	Straight lines	Arcs of circle
Ellipsoidal	Ellipses	Curved lines	Sharply curved lines
Irregular	Figures formed by broken lines and curves	Broken lines and curves	Broken lines and curves
Flat with turned-up Edge	Straight lines	Straight lines	Straight lines

True planes flat within 0.00001 in. are sufficiently accurate for commercial work and should not be expensive. Manufacturers may make arrangements by writing to the director of the Bureau of Standards, for obtaining such true planes from the Bureau of Standards Optical Shop where those in use by the Gage Section were made. F. C. Weaver is in charge of this shop, which grinds the glass flat to 0.00001 in. or, when temperature conditions are good, to considerably better than that amount. For precise work Mr. Clacey, also of the Bureau of Standards, finishes the work by hand until it is flat to about one-tenth of that amount. Three true planes are tested one against the other, as is done with surface plates, to make sure that the surfaces are not spherical.

The table shows the kind of interference fringes given by different surfaces, as described above.

To obtain first the kind of lines shown in column III and then those shown in column IV (when these lines differ) there are of course certain positions at which the first wedge must be formed. Otherwise the order may be reversed or a combination of the two kinds of lines may be seen at the first trial, as described in the beginning of this article telling of a method for determining whether a surface is convex or concave.

The Detroit Institute of Technology

By A. R. Davis

Even before the entrance of the United States into the war the manufacturing industries of the country had begun to feel a scarcity of trained mechanics and this scarcity quickly grew to alarming proportions following the declaration of war.

Men from every walk of life had been drawn into shops and factories, most of them to begin at the bottom as unskilled workers. Many, however, by reason of previous training in other lines, advanced rapidly to the better-paying jobs, but manufacturers, realizing the expense and delay of breaking in unskilled labor, were quick to welcome the development of outside training courses that could send them men properly instructed and trained in shop practice and methods.

In Detroit, where the shortage of machine men mounted into the thousands, national attention was attracted to the work being done by the Detroit Institute of Technology, the department of education of the Detroit Y. M. C. A. At the head of this work as chancellor of the Detroit Institute of Technology was Benjamin D. Edwards, a man keenly alive to changing conditions and the educational needs of the times, under whose direction and guidance the annual enrollment of the Detroit Tech had grown to over 3000 students.

His foresight had been largely responsible for the favorable action of the board of trustees, which resulted in the construction and equipment of a shop and laboratory building representing a cost of approximately $300,000. This building, thoroughly modern and planned particularly for technical instruction, was ready early in the spring of 1917. Hardly had the war started when steps were taken to offer a complete course in machine-shop practice. A full equipment of new standard machines was installed and competent instructors engaged.

In the working out of the course of instruction the advice and coöperation of production managers of many of the leading Detroit industries were easily secured, with the result that students completing the course found immediate and desirable employment in places they were best fitted to fill. As the course grew in popularity additional equipment had to be secured, and for this the institute found it easy to obtain Government priority orders, which in effect amounted to official recognition of the importance of the work being done.

The equipment consisted of 27 lathes, 3 shaping machines, 4 milling machines, 2 drilling machines, 3 tool- and 1 cutter-grinding machines, all installed in a light, well-ventilated room 40 x 90 ft. in dimensions. A view of the shop is presented herewith.

Eight Weeks' Course

The complete machine-shop course extended over a period of eight weeks, eight hours a day, five and one-half days a week. It gave thorough instruction in the use of all the above-mentioned machines as well as bench work, tempering and hardening of tools, instruction in shop mathematics and the reading of drawings.

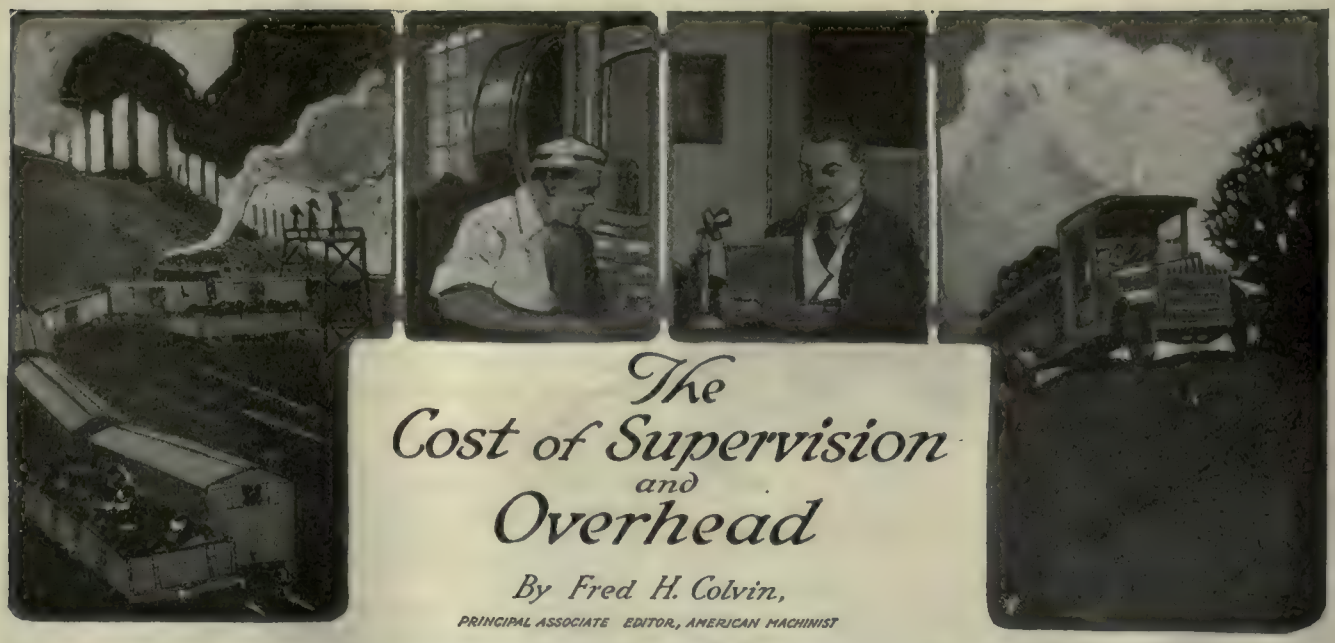
The time on the machines is charted and the record shows better than 90 per cent. efficiency for both day and evening. In a little less than 18 months over 750 men were graduated.

A course in toolmaking was opened to skilled machinists and to graduates of the machine-shop course. The growth and development of the work soon justified the belief that this department had an assured future.

Among the other activities of the Detroit Tech, which have contributed to the work of training men for useful service, might be mentioned the complete courses in automobile, motor truck and tractor, electrical and mechanical engineering, pharmacy and chemistry, and radio-telegraphy.



MACHINE SHOP OF DETROIT INSTITUTE OF TECHNOLOGY



The Cost of Supervision and Overhead

By Fred H. Colvin,
PRINCIPAL ASSOCIATE EDITOR, AMERICAN MACHINIST

Misunderstandings are probably at the bottom of more racial, domestic and labor troubles than anything else. These are aided by suspicions and jealousies of various kinds, and if left with no attempt at explanation or reconciliation, may easily lead to disaster. Exaggerated ideas of profits come from a lack of knowledge concerning the cost of supervision and other overhead expenses. Hence this summary of numerous inquiries which contain many suggestions.

IN THE days of the small shop there were fewer problems of every kind than face us today. The owner very often worked in the shop and the cost of supervision was almost negligible, as everyone but the apprentice could handle any job and usually needed neither instruction nor watching. The overhead cost could practically be summed up as shop rent and taxes, and these were as well known to the men in the shop as to the proprietor. Every man felt a proprietary interest in his machine and in his job, just as did the locomotive engineer of 40 years ago.

The growth of the industry changed all this. The element of personality disappeared and the absentee board of directors, like the absentee landlord, neither understood the problems of the men nor had their sympathy in any way. The old-time loyalty is almost impossible under such circumstances.

The newer type of manager, who had never been in direct contact with the shop, evidently did not appreciate the interest of the older men in their work. These managers adopted the attitude that as long as the men were paid regularly and at the prevailing rate, they had no interest in anything beyond; in fact, that nothing else was any of their business. Coupled with this attitude came the advent of the huge combinations of business, many of them with capital stock full of water, of ostentatious display of wealth and other apparent evidences of huge profits.



The men in the shop knew the cost of materials and of labor. Few of them, however, had reason to understand and to appreciate the increase in overhead expenses due to the changed shop conditions. The advent of the unskilled man on sub-operation work added new problems in supervision and also added much to the overhead expense, and in this way offset, to some extent, the decreased cost of production due to the newer method. No attempt was made, however, to show this change in cost distribution to the men in the shop, and they naturally failed to grasp the great increase in the cost of supervision.

While these huge combinations did not invade the machine-tool industry to any great extent, the influence has naturally been reflected in the minds of the men, so that many believe that it has become advisable for all manufacturers to explain matters to their employees and to show the various costs which go toward making up a modern business.

The change in selling methods, due to the necessity of keeping the huge plants going as steadily as is possible, made another addition to overhead expenses which was unknown in the old days. Then the work came to the shop as it was needed. But the marketing of huge modern production requires a sales force which costs more than was formerly dreamed of. Yet, without it, the huge shop could not keep its production up to an economical point.

Had these changes been pointed out in heart-to-heart talks with the men, they would never have obtained the exaggerated ideas of profit which have existed in many cases. Many misunderstandings could have been prevented and much greater harmony would have resulted.

There are grave questions as to how much overhead expense a business can carry legitimately, or when the cost of doing business becomes too great to warrant its continuance. There are some cases where the office in New York or Chicago employs as many people and costs more to run than the shop in which the products they sell are produced. In cases of this kind it is not surprising that the men who are actually making the product should question the kind of management or the kind of business which makes such a proportion necessary.

Much of the misunderstanding can be traced back to

the teachings of the public schools, where, all unintentionally to be sure, children receive an entirely erroneous impression as regards costs and profits. This has been very clearly pointed out in a letter from a well-known manufacturer, who cites a well-known school example, which often reads about as follows:



"If a grocer buys a dozen oranges at 30 cents a dozen and sells them at 60 cents a dozen, what percentage of profit does he make?" The answer is, of course, 100 per cent. The damage is done by the incorrect use of the word "profit," and the child unconsciously absorbs the idea that the entire difference between cost and selling price is profit. Every business manager knows how incorrect this is.

It is to correct such impressions as these, as well as to assist managers themselves in determining the various costs which enter into the supervision of a business, that we have secured expressions of opinion on this subject from a large number of machine builders. These are for the most part given without identification, at the request of the writers, and in the hope of securing further helpful data from others. It is the growing belief of many managers that if proper methods of putting information of this kind in the hands of the men in the shop can be found, it will aid in the establishment of a better understanding, which means more harmonious relationships between the men and the management.

Where the Money Goes

In order to get something of an idea of the many items which go to make up the expenses of a manufacturing business, perhaps the outline submitted by a well-known machine tool company, of the Middle West, gives the most complete and at the same time most concise list. This divides the expenses into a number of headings as shown, and shows very clearly how the various expenses are distributed. By this method they figure the burden or factory expense as being equal to the total of the material and labor cost on a complete machine; in other words, 100 per cent.



Factory expense is divided into two parts, as shown under the heading of Supervision and Shop Management. The first division includes that of supervision and other items which are quite different in character from those in the second group under the same head. This second group includes what might be called the material things which go into the machines being built.

Fixed Charges

Taxes, buildings and real estate, material and equipment, corporation tax, capital stock, street and sewer.
Insurance.
Depreciation on equipment.
Depreciation on buildings.
Interest on investment.

Office Expense

Executive and clerical.
Depreciation on furniture and fixtures.
Heat and light.
Bonus and wage distribution.
Interest on borrowed money.
Discount charges on customers' notes.
Interest paid on notes to creditors.
Supplies—printing, stationery, etc.
Donations—charity.

Supervision and Shop Management

Factory Expense

Executive: Superintendent, production department, cost and factory clerks.
Purchasing department.
Watchmen.
Hospital.
Garage and trucks.
Discarded parts—old style.
Toolroom—manufacturing special tools and jigs; storing and distributing same.
Castings storage; receiving, storing and issuing to factory.
Blacksmith, dressing and hardening tools.
Stockroom—storing finished parts and issuing same to factory.
Steel stock storage; receiving, storing and issuing to factory.
Shipping and boxing.
Drawing room.
Pattern shop.
Inspection department.
Millwrights and carpenters.

The foregoing departments each include the following expense items:

Fixed charges.
Power, heat and light.
Labor.
Charges by other departments.
Defective workmanship.
Repairs.
Bonus and wage distribution.

The monthly total of the entire general expense is distributed on a productive-hour basis and charged as such to each productive department.

The productive departments are classified as follows:

Boring and chucking.
Lathes.
Grinding.
Polishing.
Large erecting.
Drilling.
Milling.
Planing.
Painting.
Small lathe erecting.
Milling-machine erecting.
Automatic screw machines.
Rack-cutting and keyseating.
Cutter grinder assembling.
Countershaft assembling.
Boring mills.
Gear cutters.
Repair department.
Unit assembling.

The above include the following expense items:

Fixed charges.
Power, heat and light.
Nonproductive labor—foreman and assistants.
Charges by other departments.
Defective workmanship.
Supplies.
Repairs.
Bonus and wage distribution.

Total department expense is distributed on a department productive-hour basis, and by adding the general factory expense hourly rate we have the complete hourly burden rate.

Selling Expense

Fixed charges.
Executive and clerical.
Bonus and wage distribution.
Discount allowed customers.
Collection charges on discounted notes and checks.
Entertaining.
Club dues.
Traveling expense.
Publications.
Catalogs and circulars.
Freight and drayage.

Selling expense is added to the total cost. The burden (or factory expense) on a complete machine is equal to the total material and labor cost on same.

In addition, the manufacturer pays, this year, an excess-profits tax which in large concerns is about 75 per cent.

Taxes Make Overhead 200 Per Cent.

The second concern reports, according to figures recently compiled for 1918 operations, "Our overhead was almost double the average hourly rate of shop employees. This, of course, was largely due to the tremendous income tax which the form of our organization imposed on us last year."



Firm No. 3 writes as follows: "We figure the cost of supervision in shop management as two separate burdens; one called the manufacturing expense and the other the commercial and sales burden. The kind of accounts that are carried under each of these heads would be those naturally suggested by the titles.

"The total manufacturing expense for the month is divided by the total number of productive hours for a month and the results given as a productive hourly burden rate.

"We do not consider this necessarily the best or most accurate method, inasmuch as it throws the cost of handling of raw material into the productive operation. It is, however, the method which was instituted here some time ago and we continue it for the sake of comparisons with past records, and it works out very satisfactorily. The sales and commercial burden is estimated as a percentage of the cost of sales. Both of these burdens are subject to considerable fluctuation and for the sake of obtaining more practical comparisons, we are in the habit of establishing a fixed burden for a period of six months and then adjusting it to take care of an excess or deficiency which may have accrued."

Need of Understanding

No. 4 says: "I quite agree that the question of management and supervision is perhaps the one phase which is least understood by the average worker. I also believe that a certain amount of educational work along these lines would prove interesting and helpful, for I cannot help feel that if the average worker really understood more fully and definitely the many and varied business perplexities which daily confront the manufacturer, it could not fail to have a beneficial effect on their relations. It is a fact that very few workers have the slightest conception of what the word 'overhead' means when applied to the cost of manufacturing, and it is also to be deplored that so many manufacturers seem to have so little idea as to what does or what should constitute their overhead.

"In the old days, 'overhead' was not a very common term. In fact, 'operating' expenses or 'running' expenses were the terms employed. But after the so-called efficiency engineers began to permeate the country, a good many new terms and phrases (both English and profane) seemed to come into being, and overhead was one of the more expressive, which has in too many cases been badly overworked.

Cost of Departmental Supervision

"Naturally, the cost of supervision is but one item that goes to make up what is known as overhead. In the matter of supervision, it is our practice to handle the cost in such a way that the expense of supervision of one department does not add to or detract from the expense of any other department. Of course, in the final analysis the cost of supervision goes in the general item of operating expenses. To this is added all items of general expense, such as insurance, taxes, interest on capital, advertising, and all nonproductive labor that is not directly or indirectly associated with the factory cost of production.



"In the old days it was considered almost a crime if the factory superintendent did nothing but superintend. He was expected, not only by his men but by the management as well, to turn out a full day's work, and the superintendent was usually recognizable from his over-soiled appearance, being always the dirtiest one of the bunch. It was, however, finally discovered that a superintendent could greatly increase production by spending all of his time in directing the operations of others and by using his brains instead of his hands in the direction of better methods for production.

"It was later found desirable to divide the work into departments, to analyze the cost of production in each department, and in fact, to systematize methods, and, through efficient department foremen, carry on a system of continuous study for betterment in all directions toward an increased production of better quality. In every case where modern methods of shop supervision have been introduced, production has been bettered and increased, while the overhead has been very greatly reduced as compared with the proportionate increase of production.

Advantage of Better Working Conditions

"In line with an increased production comes the matter of better working conditions and the welfare of the worker, for we cannot fail to recognize that we can all accomplish more and better work under proper conditions of light, cleanliness and order. Consequently, we endeavor to maintain the most sanitary, light and healthful atmosphere in and about our works and offices. The maintenance of such conditions adds to the over-

head, but we find that it helps to produce a better product and stimulates production to a degree that more than compensates for the expense.

"I have known manufacturers who inventoried their plant year after year as a constant factor. Every machine was inventoried at its original cost, regardless of its years of service, no depreciation being figured. Their yearly sales, with cash on hand or deposit added to the inventory, constituted their gross worth. By deducting their running expenses, which included supervision, taxes and insurance, it produced their net worth, and their year's profit was figured as the amount of money on deposit over and above what was on hand at the same period in the previous year.



"These manufacturers still have 'working foremen' and are unable to understand how a superintendent or foreman who does not produce with his hands can be of any real service. Of course, in such firms the general manager always does the shipping and invoicing in order to earn his wages and to insure that no mistakes are made! Fortunately, these firms are growing less in number, but the real overhead of these firms is considerably in excess of that of a modernized works with proper supervision.

Relieve Workers of Clerical Duties

"It is our practice to relieve the worker from all clerical work so that each man's time and attention can be devoted to production without having to disturb himself several times each day in trying to figure out whether he put in three hours on the last job and an hour and a half on the job before. We issue work tickets from our factory office by means of a pneumatic tube system connected with each department, and by which work 'move' tickets and all other departmental instructions are issued, so that the worker is enabled to keep his mind on production.

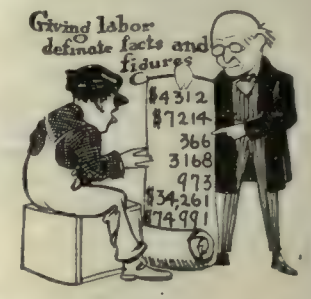
"This, of course, adds to the overhead, but not in proportion to the time that it saves the workers and the increased production effected thereby. Anything that will save time, add to the betterment of working conditions, remove complication and detail, is a factor in the contentment of the worker. It adds to his efficiency, insures a better product and an increased production in a measure beyond the extra burden to the overhead which such betterment incurs.

"As to the cost of supervision, we divide up our overhead under four different items. These are Factory Burden, Commercial Burden, Direct Labor, and Material. These for the past year show about as follows: Factory Burden, 45.8 per cent.; Commercial Burden, 6.3 per cent.; Direct Labor, 17.4 per cent., and Material 30.5 per cent."

Believes in Giving Facts and Figures

No. 5 writes: "We hope that managers and executives will realize the necessity of carrying on educational work among their own employees so as to give labor in general some definite facts and figures regarding the cost of doing business.

"The writer believes that a considerable amount of the present unrest in the industrial situation is caused by ignorance on the part of the average shop worker regarding the cost of supervision and other necessary expenses, these expenses being always necessary to hold an organization together and to procure work for which wages may be paid.



"As a general proposition, we believe that almost any management will be benefited by taking the workers into their confidence and explaining the items making up the cost of overhead. If this is done in some simple form so that the workers will at least grasp the fundamental principles, we believe that they will clearly understand that all between the cost of material plus direct labor and selling price is not profit.

"The writer has even met intelligent foremen who did not have any clear conception of overhead expense or of the way in which this expense must be taken care of, so that a profit can be insured for the capital invested. We believe also that some additional benefit would be derived in letting the workers know about the actual cost of the materials they use or waste, and the first cost and subsequent expense for repairs of the equipment which is provided for them. For without this they would be unable to exercise their skill and thus secure any income."

Where Labor Cost Is High

No. 6 is from a shop building small machine tools, and says: "As the machinery we build is of small size, the labor cost is by far the largest item. As our men are all paid on the hourly basis, we have taken the productive hour as the basis of all our overhead charges. In other words, we have recorded the number of hours that our productive men have charged in during the past year and have then divided the factory burden, which includes the non-productive labor, all supplies used in the manufacture of the machines but which do not enter into their construction, depreciation on buildings, machinery, tools, patterns, and drawings, insurance, light, power, heat, repairs and renewals to the buildings, cartage, freight, express and taxes. This, we find, amounts to 13½ cents per hour.



"In addition to this, we have figured the sales expense, including in it the general and office expense, advertising, commissions, and items of a like nature. This amounts to 6½ cents per hour and makes a total of 20 cents to be added to each hour of productive labor required in the manufacture of a machine. We consider that this 20 cents multiplied by the number of hours used in producing a machine, added to the actual wages paid to the men and to the cost of materials, represents the total cost, and that this is the least which must be obtained for the machine to insure against actual loss.

"The profit on the transaction should include the interest on the capital invested and the salaries of the proprietors if they are actively engaged. In order to

allow for expansion of the business, a larger profit than this must be allowed for."

High Wages but Lower Labor Costs

Among the most interesting figures are those obtained in letter No. 7, which, after indorsing the plan for the distribution of real knowledge concerning costs of production, gave an excellent summary of their own distribution of costs during the years 1913, 1914, 1917 and 1918. These are shown in the following table and should be extremely valuable as a means of comparison, as this is a modern shop and one which is recognized as being well managed.

COST OF PRODUCT IN PERCENTAGE

	1913	1914	1917	1918
Material	0.2512	0.1695	0.3847	0.3471
Productive labor	0.2233	0.1735	0.1937	0.1649
Burden or shop overhead	0.4086	0.4781	0.3708	0.3615
Commercial cost	0.1167	0.1781	0.0507	0.1264

It is particularly interesting to note the difference in the percentages of the various items during the different years. Material, mostly cast iron in this case, fell from approximately 25 per cent. of the total cost in 1913 to 17 per cent. in 1914, but jumped to over 38 per cent. in 1917. This was during the time of $55 pig iron. When the price was controlled by the War Industries Board the cost of material dropped to less than 35 per cent.

Productive labor was less in 1914 than in 1913, and though it increased slightly in 1917, the lowest cost is in 1918, when wages were higher than at any other time. This speaks particularly well for the productive methods and probably for the coöperation secured in the shop. It is also interesting to note that the burden or overhead expense was lower than at any previous time, this being particularly high in 1914. Commercial or selling costs were extremely low in 1917, due to practically the entire product being absorbed or at least allocated by the Governmental activities.



Firm No. 8 expresses its approval of the publication of facts concerning the amount of overhead, saying: "The average workman has no appreciation of the cost of doing business and also an exaggerated notion as to profits. We believe that if the returns of corporations, which are open to the public in Massachusetts and other states, were carefully studied, they would show that for a long term of years profits did not average nearly as much as was popularly supposed.

"Our own cost-account system is very common. We keep the total of the productive hours in each department, find out weekly the total of the various items of overhead expenses, and divide this by the number of productive hours, then distribute the cost of the overhead to the various jobs in accordance with the number of productive hours on that chart. The cents per hour will, of course, vary according to the number of productive hours at which the shop is running. Our present figures are somewhat over the normal, due to the fact that we have been doing an unusual amount of repairing which we have charged to this account.

"Having established our manufacturing costs, we keep the cost of selling and of general administrative expense for each group of the articles we manufacture. This total we distribute as a percentage on sales in the corresponding department.

"Certain fixed items as, for example, a requisite return for capital, are somewhat beyond the control of the men. For without a return of say 6 per cent. on the investment, there would be no capital for expansion or extension of the business.

"The matter of taxation is one in which all workmen have a part, and it is a matter of good citizenship for every voter to see that the money raised in taxes is properly spent. City taxes in our case amount to about ½ cent an hour on productive labor, state taxes perhaps ¼ cent, and the Federal taxes about 2 cents per productive hour. This should make it evident that any extravagance in government leaves less money for the development of the business or to be distributed between those who invest and those who directly produce the work of the shop.

"We believe that there should be a frank understanding as to the costs of doing business and that an effort should be made to have the men realize that the responsibility for results is partly theirs. Anything which can bring about a better understanding of the problems on both sides cannot fail to make for more harmonious relations and better returns to all concerned."

These firms represent a wide variety of machine manufacture and the figures given may be considered to give a fair average for present conditions. It is almost universally suggested that the facts about shop costs should be made clear to the workmen. Clearly written bulletins or posters may be the best method of doing this.

An Easily Made Sine Bar

By E. Amos

On page 1097 of the *American Machinist*, J. B. Gray describes his way of making a sine bar and criticizes John Teckeer's method, outlined on page 260, of making the same tool on the ground that difficulty would be experienced in attaining the high degree of accuracy necessary in such a tool.

It would seem to me that there is little choice between the two in that respect. As Mr. Gray says of his design the surfaces *A* and *B* must be ground at the same setting in order that they may be parallel; but a great deal more than grinding at the same setting is necessary to insure parallelism to within 0.001 in. It is also necessary that the surface upon which the buttons rest shall be parallel with its opposite face and that both be absolutely square with *A* and *B*.

It is necessary also that the ends of the buttons be square with their surfaces, which condition is by no means assured by the fact that the buttons are bought at a hardware store.

Then, too, while it is possible to get the buttons in contact with surface *B* and keep them there while tightening the little screws that hold them, it is likewise possible and even easy to move them 0.0001 in. or more either in tightening them or subsequently.

I believe in sines myself, but I realize the necessity of keeping close tabs on them to see that they do not play tricks on me. It is not pleasant after finishing a job with dimensions to the fourth decimal place to have a hard-hearted inspector come around and tell you that your sine bar is 'steen millionths out of whack according to the meridian of Greenwich.

The Riddle of Dependency—II

By CHESLA C. SHERLOCK

AS WAS pointed out in the previous discussion, there are in this country two classes of dependents; those conclusively presumed by law to have been dependent upon the earnings of the deceased workman for support, and those who must establish their dependency as a matter of fact. In treating of the subject of who are dependent, we will first consider those who are generally conclusively presumed to be dependents, or those who are specifically enumerated in the statutes as being entitled to compensation as dependents.

What are Dependents?

According to our compensation acts there are certain persons whose dependency is "conclusively presumed" and who have only to establish their relationship to the deceased workman to obtain compensation. Others must prove their dependency in order to recover. Do you know into which class any particular case would fall?

It might be noted here, however, that since the American acts have attempted to classify dependents in the statute itself, any person who is mentioned in such classification is not entitled to compensation as a dependent. Do not misunderstand this statement, for the acts are generally very thorough in the classification, not only classifying those who are conclusively presumed to be dependents, but also those who may be partial or total dependents upon a finding of fact to that effect. Where the acts specifically set out the persons entitled to compensation, either upon a presumption of law or upon the establishment of fact, and practically all of the acts do, it is obligatory upon the employer to consult that act in ascertaining who are dependents.

We will, however, discuss the matter in connection with the decisions which have already been rendered by the proper authorities under the classifications of relationship usually found in the statutes.

The New Jersey court has said that proof that the deceased workman gave his earnings to his father up to and prior to the time of his death, and that the father had no other means of support or income, was sufficient to justify a finding that the father was a dependent of the son.

In Ohio, it was held that an invalid father was wholly dependent upon the earnings of the deceased son.

It has been held in a number of cases that a father may be found to have been dependent upon a deceased son but that such findings cannot be made as a matter of law, but must depend upon the facts in each case. The mere fact that there was a moral obligation to support, or that the deceased intended to furnish support shortly, is not sufficient establishment of the status of dependency.

In other cases, the point has been brought out that it is not necessary for the father to show that he is under or was under absolute necessity for his son's earnings in order to live. It is not necessary that actual necessity for the son's contributions be shown, but the mere fact that such contributions were made and were used in supporting the father will generally be deemed sufficient.

In other cases, it has been held that a showing of the fact that the father received money from the deceased son and spent it is not sufficient to establish dependency; this is a point worth remembering. If such money, when received, was used for purposes other than buying the necessities of life or in the actual support of the father, no dependency has been established. Again if the money received is insufficient in amount to show dependency, even in a partial way, then no case has been established and the employer will not be required to pay compensation to the father as a dependent.

In a Massachusetts case, it has been held that where a minor son contributes all of his earnings to his father, the extent of the father's dependency is not diminished by the fact that the father pays for the son's support. In other words, the employer is not entitled to deduct the amount of the son's support from the amount of wages contributed to the father. This rule, doubtless, would be the exact opposite in cases where the son was not a minor, and indeed it has so been held in a number of instances.

In an English case, it was shown that a minor son contributed his wages to his father, but that the wages were not more than the value of the son's support; that in addition the son rendered services to his father in his spare time which had some value. The court held that the value of such services should be taken into consideration together with the cost of his maintenance.

In another English case, it was shown that the deceased son had contributed largely to the support of his father, paying the house rent and also a large portion of the other expenses, but that the father who had an irregular earning capacity had been supporting, in addition, another brother who was crippled. At the death of the workman he was unable to continue his house. The court held that the father was at least partly dependent upon his son regardless of the fact that he, himself, was supporting another person.

It has also been held in an English case that one cannot be deemed the dependent of an illegitimate son of the wife. It was shown that the claimant had married the mother of an illegitimate son, he not being the putative father, and that all three had lived together, the son contributing his wages toward the expenses of the household. The court held that the husband was not a dependent of such an illegitimate son within the meaning of the English compensation act. A similar ruling would doubtless obtain in this country.

The effect of the decisions, then, is to show that there is nothing to prevent a father of the deceased workman obtaining compensation as a dependent, provided such dependency actually existed at the time of the accident.

It is quite generally provided in the various statutes that the mother of a deceased workman shall recover compensation, either as a partial or total dependent, according to the degree of dependency as brought out by the evidence. The real question involved in regard

to the mother of the decedent is generally found not to be as to whether dependency existed, but as to the degree thereof, it usually being fairly well presumed that some sort of a dependency exists in such a relationship.

It was held, in an Illinois case, that where it is shown that the mother had no property and that the deceased and his sisters had taken care of her, all keeping house together, there was sufficient evidence to show dependency.

In an Illinois case, it was contended that such contributions as the son had made to his mother were not in the nature of contributions for support, but merely holiday or birthday gifts. The court ruled, however, that in the absence of an express showing involving the intent of the deceased in making the gifts, that they would be presumed to have been made for support, and that dependency would therefore be established to the extent of the contributions.

Another Ohio Case

In another Ohio case, there was evidence to show that a deceased daughter had been turning over the greater portion of her wages to her mother, as did other wage-earning members of the family, and that the mother then used the money to meet the household expenses. It was held by the Industrial Commission that this was sufficient to show that the mother was at least a partial dependent of the deceased daughter.

In an English case, it was shown that a workman had been in the habit of sending weekly contributions to his mother and that for a certain length of time he had sent a certain amount regularly. Upon changing his employment he sustained an accident causing death. It was shown that up to the time of his death he had made no contribution to his mother. The court, however, held that the evidence was sufficient to establish dependency, leading one to presume that he would have continued such contributions had he lived.

In this connection, it might be well for employers to note that a mere change of employment will not relieve an employer of the liability of paying compensation to dependents, provided compensation would have been due to the injured workman himself had he lived. The employer who is employing the man at the time of accident is liable, and the present behavior of the workman is not the true criterion of dependency liability, but the past record of the deceased governs.

The Wisconsin commission has held, in conformity with a decision mentioned in connection with the dependency of a father, that where a minor son contributes his earnings to a mother who supports him out of those earnings as well as herself, that the extent of dependency cannot be ascertained by first deducting the value of that support, but that the extent of the dependency is based upon the total earnings of the deceased. In other words, it is not permissible for employers to deduct the value of the support of minor children from the compensation which they are to pay dependent parents, the law presuming that the extent of dependency is the same as the full value of the contributions made by the deceased.

The mere fact that a son leaves a widow does not ordinarily affect the dependency claim of a mother who is an actual dependent upon him. Most of the statutes provide the amount of compensation which a parent may recover in such cases, and in New Jersey it is fixed at 25 per cent. The court of that state sustained an award in that amount to a dependent mother, saying that the payment should be made without regard to whether the son left a widow or not.

In another New Jersey case, it was urged that since the law made no mention of such a case, where a deceased workman left a mother, but no widow, the mother could not recover any compensation.

What the Court Said

Said the court: "It would be absurd to construe the act, which by its very language secures compensation to actual dependents in such a way as to give that compensation to more remote relatives and not to near relatives. We can think of no reason that would justify such an exclusion. That it was not intended is indicated by the fact that express provision is made for the father or mother where there is a widow. The legislature cannot have meant to provide compensation where the decedent was under the double obligation to wife and parent and to deny it when he was only under the single obligation to father or mother."

In Illinois, it was held that where the deceased workman left a dependent mother and nondependent brothers and sisters that the compensation was payable to the mother alone and not to the brothers and sisters also.

In this connection it is well to note that a stepmother may receive compensation as the dependent of a deceased workman the same as his actual mother might, the sole question going to the facts in the case. The test in dependency is never a test of relationship, as it might be if dependents stood in the same position as beneficiaries, but the test is the fact of actual dependency, either in whole or part, and where the facts establish such actual dependency, a stepmother will have as much right to the compensation as an actual mother in the same circumstances would have. Of course, there is no test to apply where the statute establishes a legal presumption of dependency in the case of a mother, such dependency being established by relationship in that instance.

The wife is generally conclusively presumed by the statutes to be a dependent on the husband, provided they were living together at the time of the accident causing the husband's death. It is seldom that the dependency of the wife rests upon a question of fact, unless it be as to whether the parties were "living together" within the meaning of the statute.

In Wisconsin, it has been held that this question is one of fact to be determined by the Industrial Commission, as are all other questions of fact.

In a Massachusetts case, it was held that where the wife and children of the deceased were living apart from him at the time of his death, there is no conclusive presumption that they were dependent upon him for support, but that it is a question of fact to be decided by the evidence in the case.

The greatest disagreement in the case of dependency of the wife arises where she was living apart from the husband at the time of the accident. As to where there has been a separation of the parties, many questions of interest and profit to employers arise. If the separation is the fault of the husband and he has been compelled by court order to contribute toward the support of the wife, compensation will be payable to her as a dependent.

In a Scottish case, it was held that where the separa-

tion was due to the wife, where she had voluntarily withdrawn from the husband's household more than 12 years before his death and had supported herself from her own earnings, that it could not be held that she was the dependent wife of such workman and compensation was denied her.

In an English case, it was shown that the wife had voluntarily separated herself and her children from the husband and had never received any support whatever from the husband, although it was shown that he had repeatedly offered to aid in their support, but such offer had been refused. The court said that in view of these circumstances there was no dependency and that no compensation should be paid by the employer.

In still another case, it was shown that the husband and wife had voluntarily agreed to separate, the wife being supported by an illegitimate son. It has shown that this separation occurred more than 11 years prior to the death of the husband and that during that time they had met only casually, three times in all, but that on each occasion the wife had received small sums of money from the husband. It was held that these contributions established no evidence of dependency.

The mere fact that the parties are separated at the time of the death of the workman is not sufficient to deny the wife compensation as a dependent even under the wording of the American compensation acts.

(To be continued)

Necessity for Keeping Grinding Wheels In Perfect Balance

By John H. Peckham
The Norton Grinding Co.

This brief paper is written with the idea of reaching users of grinding wheels and machines that they may know the real necessity of having wheels in perfect balance at all times, to insure precision grinding and to produce highest quality of work and production at the minimum cost.

During 30 years' development in grinding machines engineers have spent unlimited time and money to perfect those of the present. They have realized and tried to impress upon their customers through untiring efforts that if they expect the machine to be a success the wheel must be in balance.

An unbalanced wheel causes chatter marks on the work, causes the wheel to pound, wear unevenly, and breaks up the face, making it wear very rapidly. It also requires frequent dressing and truing with the diamond, with the result that the diamond cost is excessive.

For example: An 18-in. diameter wheel 1 oz. out of balance, running 1360 r.p.m. on a 10 x 36-in. Norton cylindrical grinding machine, exerts a force of about 25 lb. every revolution, and will produce vibration in the machine, which is reproduced on the work. The continual pounding in the spindle boxes will in short time wear the boxes and spindle egg-shaped.

With these conditions existing the operator not only imperils his life as well as that of nearby fellow-workmen, but finally accomplishes the destruction of spindle boxes and gets unsatisfactory work.

Can you imagine standing before a grinding wheel running between 6000 and 6500 surface feet per minute and having the wheel break? To be sure, adequate safety hoods and guards are in vogue, but there is always danger. Of all evils mentioned heretofore this one alone should, for the protection of life and limb, be considered first.

Customers have in many instances believed that the gears in the headstock caused chatter marks, but in practice nine cases out of every ten have proved the wheel to be out of balance.

Never tighten spindle boxes to overcome chatter marks. The procedure may help the condition but it will never eliminate it. Put the grinding wheel in static balance from time to time. Note the Norton cast-iron balancing center, with lead inserts for putting the wheel in balance, shown in the cut.

Place the wheel on a balancing arbor and the arbor on a balancing stand having knife edges, making sure that the stand is accurately leveled in both directions

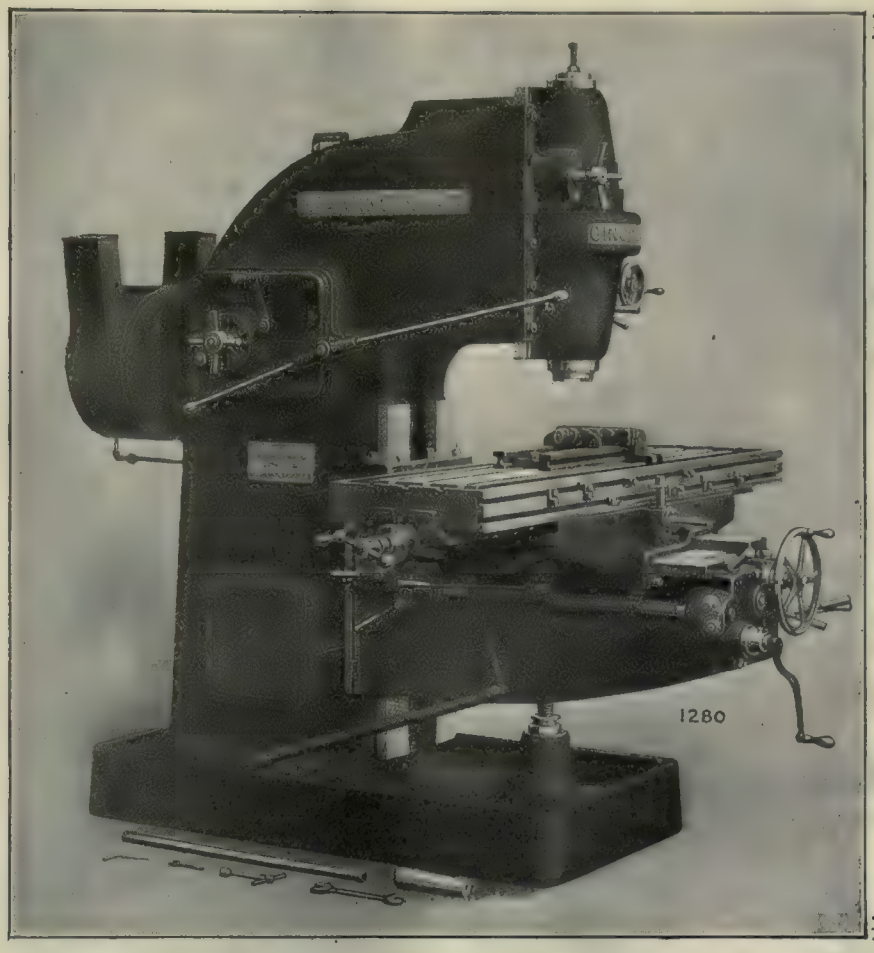


BALANCING A GRINDING WHEEL

to insure accuracy of balance. Proceed to move the lead inserts relative to each other, until the wheel can be placed at any point on the knife edges and balance itself.

The periphery of the wheel balanced with weights in proper places will produce good work until the wheel has been reduced by wear about 1 in. For example: When a wheel 18 in. in diameter has been reduced to 17 in., it should again be balanced. As the wheel is reduced in diameter from time to time the lead weights must be shifted in their relative positions to insure best results.

A wheel in balance at all times reduces the diamond consumption and wheel wear beyond conception, and the user of grinding machines and wheels will, by properly attending to this matter, secure four important results: Safety for the operator, accuracy, production and good work, while the time employed in balancing wheels will save many dollars worth of diamonds and wheels.



The No 4 Cincinnati Vertical High-Power Milling Machine

Special Correspondence

As a result of the success attained by the new No. 5 high-power horizontal type Cincinnati milling machine, described on page 971 of the "American Machinist," the Cincinnati Milling Machine Co., Cincinnati, Ohio, has placed on the market a heavy vertical machine of similar design, embodying some of the same features. This new machine is intended for extremely heavy work and is patterned after the No. 5 in all those elements which are common to both machines.

FOR die work, some classes of toolroom work and many manufacturing operations, the vertical-spindle milling machine has many obvious advantages over a machine of horizontal type. Chucking the work, in particular, is often simpler and the work is more accessible and very easily observed. Also, in combination with a rotary milling attachment the vertical-spindle machine becomes a continuous milling machine. The stresses set up by the cutter in the vertical machine, particularly when using the large-diameter face mills for which this machine is designed, are just as severe as those which must be taken by the horizontal machine of the same horsepower rating. However, horizontal machines are provided with braces for tying the upper part of the machine carrying the cutter, and the knee which carries the table and the work, together. There is no such provision on a vertical machine and the stresses must be absorbed by the knee and column and those parts must therefore be made very strong and solid to take heavy cuts at high rates of feed. The illustration, Fig. 1, will indicate that the column of this new machine has unusually great depth and width, the walls being thick and well ribbed.

The Construction of the Knee

The knee is the other member which must absorb these same stresses and also carry the entire load of the table, saddle, fixture and the work. It is shown in Fig. 2, which illustrates the size of this member as well as the thickness of its walls, and the extent to which it is ribbed. The openings are small and are placed as far as possible in the neutral sections. It is connected to the column by rectangular bearings with square gibs and narrow guides which, together with the rigid construction of the knee itself, provide ample strength for the maximum cuts and heaviest load this large machine is designed to carry.

The saddle is long and its extreme width provides an ample bearing for the table. Its bearings on the knee are again rectangular, square gibbed and with a narrow guide which provides good sliding conditions even when the table is heavily loaded, and at the end of its travel. This square gibbing also enables the incorporation of a very effective clamp for securing the saddle to the knee. This clamp is, in fact, so effective that no special stops or other facilities are required for holding the saddle in position when heavy irregular cuts are being taken. The saddle details are shown in Fig. 3, which also illustrates the liberal proportion of the feed gearing, the connection of the power quick-traverse transmission and also the connection for the drive for the circular milling attachment shown in Fig. 4. This circular attachment is also entirely new, designed in strength and general proportions to suit the machine. By using this arrangement the machine may be converted into a continuous milling machine, at the same time allowing the use of the table feed independent of the rotary feed. It also makes possible the use of the power quick traverse for both the machine table movement and for rotating the attachment table, the operator being relieved of all hand adjustments.

The table of the machine is 19 in. wide, has a working surface 68 in. long, with three T-slots ⅝ in. wide, providing ample clamping facilities. In order to resist as far as possible the warping effect of clamping bolts when holding the work for heavy cuts the table has been

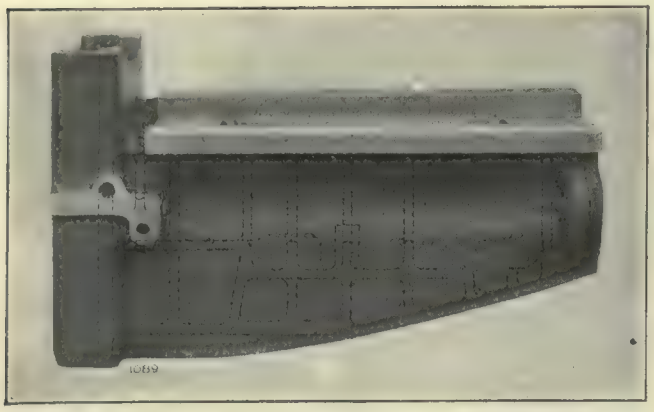


FIG. 2. VIEW SHOWING THE RUGGED CONSTRUCTION OF THE KNEE

made of unusual height, box section, and has a large number of ribs to give it added stiffness.

The main driving pulley runs on ball bearings and is mounted on a bracket fastened to the column, this method relieving the driving shaft of belt pull. It drives the machine through a large powerful friction clutch which is operated by the main starting lever from either the front or rear of the machine. When the clutch is released to stop the machine an automatic brake is engaged and stops the spindle almost instantaneously. A belt guard conforming with the modern safety laws is also provided. The main driving pulley runs at a fast speed which allows the use of a high-speed motor for either the belted or geared driving arrangements.

The Speed-Change Mechanism

The speed-changing mechanism is similar to that of the No. 5 machine except that the spindle and back gear shaft are turned to the vertical position. One of the novel features of this machine lies in the fact that this is accomplished by incorporating in the vertical machine the same large face gear and the same powerful mounting of the spindle as in the horizontal machine. The back gear shaft which is parallel with the spindle, and therefore also in a vertical position, is driven through a pair of bevel gears, and back of these the entire drive is the same as on the horizontal machine. The speed changes are made through selective sliding gears. There are no tumblers in the machine, and all shafts are hardened. The back gear shaft has four integral keys on which the back gears slide. This transfers the sliding feature from the spindle to the back gear shaft and eliminates the difficulty resulting from a construction that requires the spindle to slide through the gears.

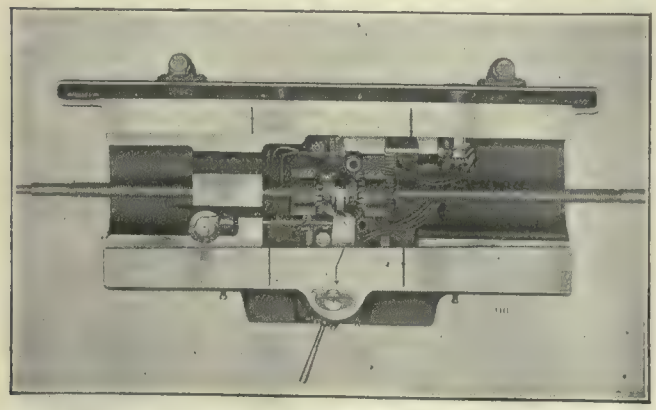


FIG. 3. DETAIL VIEW OF THE TOP OF THE SADDLE WITH THE TABLE REMOVED

The gears on the back gear shaft may be selectively brought into mesh with the gears of the spindle and no matter which set of gears is engaged, when the spindle is adjusted vertically they may slide along with the head and retain their driving engagement at all positions of the head The spindle itself has no gears on it but is surrounded by a sleeve, the lower end of which is slightly tapering and fits snugly on the spindle to which it is keyed at this point. This construction for all practical purposes makes the spindle and sleeve one piece, having the effect of merely enlarging the diameter of the spindle, and at the same time placing all stresses due to driving on the sleeve to which the face gear for the slow speeds and secondary gear for the higher series of speeds, are keyed. When the head is adjusted up and down, these gears are carried with it and there is a connection between the head and the driving gears on the back gear shaft which moves them up and down to correspond.

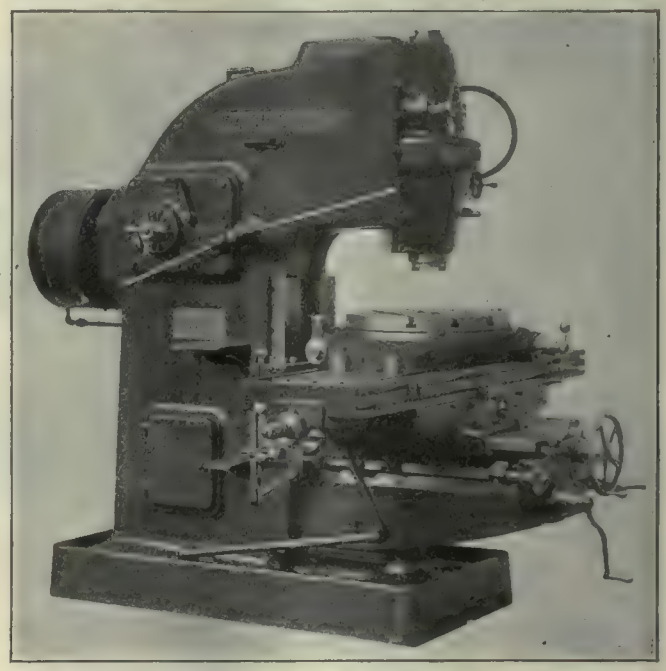


FIG. 4. MACHINE WITH THE SPINDLE HEAD LOWERED AND CIRCULAR MILLING ATTACHMENT IN PLACE

The Spindle Head

The spindle head is square gibbed to the column and carries both bearings of the spindle in fixed positions in relation to each other for all positions of the head. The quick head adjustment may be made through the pilot wheel at the right side of the column, one turn of which moves the head 6 in., the full adjustment. There is also a slow adjustment provided through a handwheel (worm and wormwheel) which is brought into engagement by means of a fine-tooth clutch operated by a knob in front of the pilot wheel. There is a micrometer stop and also a micrometer dial provided. The details of the head are shown in Fig. 5.

The feed mechanism is placed at the side of the knee and the feed changes are made through sliding gears by a single lever operated from the front. The changes may be made instantaneously from one feed to any other by merely shifting the position of this lever. Its location and the ease with which the feeds may be

changed also makes the fast feed of 30 in. per minute available as a quick traverse for cross and vertical adjustments. The standard feed range is ¾ in. to 30 in. A slower or a faster rate may be furnished.

The individual feed levers for table feed control, each of which starts, stops and reverses its corresponding feed, also at the same time indicates the direction of movement and these levers are duplicated at the rear of the machine so that the feeds can be controlled from a position behind the table when the size of the work makes this position desirable. The table feed lever has five positions controlling the starting, stopping and reversing of the table feed, and also the quick traverse of 100 in. per minute for the longitudinal movement in both directions. The trip mechanism is arranged for intermittent feed, this feature being made available by setting the necessary dogs to suit the work and the intermittent feature may be used for feeding in either direction. This feature saves much time on work in which the cut is intermittent, the fast and slow feeds being controlled entirely by dogs, automatically bringing the quick traverse into action at all times except when the feed rate is being used. This is one of the outstanding features of this new machine and is a great time saver.

One of the cycles of movement which is especially useful in the vertical machine is the continuous reciprocating cycle. The application of this cycle is as follows: Assume two pieces of work on the table some distance apart and assume the cutter in the space between the two pieces. The operator starts the machine; immediately the table moves quickly until one of the pieces has arrived at the cutter, when the dog trips to the feed rate; the work is fed under the cutter and then the table is reversed and is returned at the quick rate until the cutter arrives at the next piece, when a second dog trips to the feed rate. After this piece has been traversed the table is again reversed, and a piece which the operator has in the meantime chucked in the other fixture is again brought to the cutter and so on. This is continuous reciprocating milling, the operator chucking a piece in one fixture while the machine is milling the other, the entire operation of the machine being automatic.

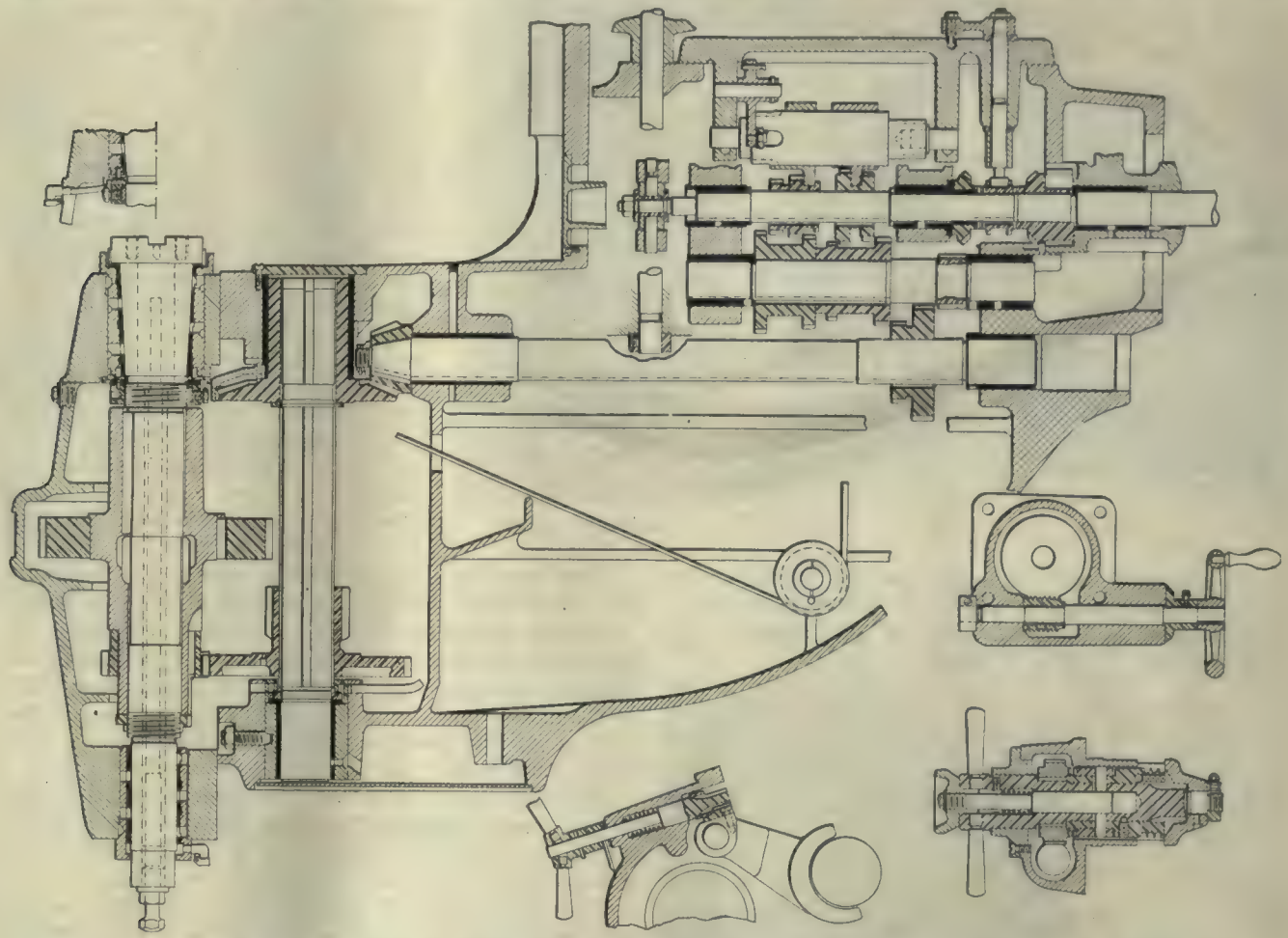


FIG. 5. A CROSS-SECTION OF THE MACHINE THROUGH THE CENTER LINE OF THE SPINDLE, TOGETHER WITH DETAILS OF THE OILING AND GEAR-SHIFTING MECHANISM

Table and Crossfeed Are Dog-Controlled

Another feature is that the table and crossfeed can be used consecutively, being dog-controlled. The design of the trip members is such that with the dog in the path of the trip-plunger, the power feed can be easily reversed and the table fed in the reverse direction, so that the work can be finished in a square or rectangular path in either direction.

A centrifugal lubricant pump with a capacity of 11 gal. per minute is supplied as regular equipment for cooling the cutters. A geared pump placed in the pulley bracket provides automatic lubrication of all mechanism in the column, and several centralized oiling stations

provide quick and convenient oiling facilities for the bearings in the knee, saddle and table. Another feature is that it is not necessary to set the table in a certain position for oiling the inside parts of the saddle and table and their bearings, as these parts may be oiled with the table in any position whatsoever.

Fig. 6 is the spindle head detached and shows the two main gears and the gear-shifting mechanism, as well as the method in which the gear assembly slides on the back gear shaft to allow for spindle-head adjustment.

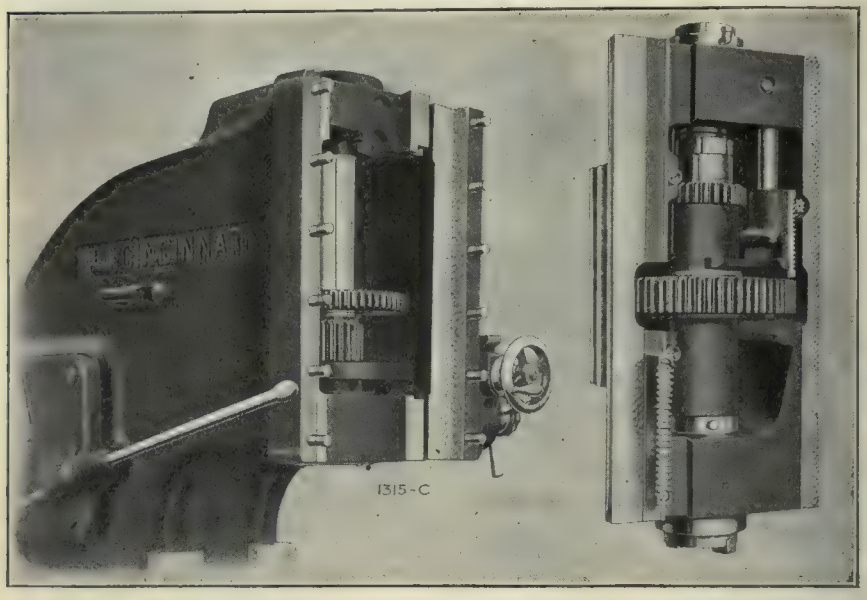


FIG. 6. SPINDLE HEAD REMOVED, SHOWING THE GEARED DRIVE

A view of the machine from the side opposite that given in Figs. 1 and 4, is shown in Fig. 7.

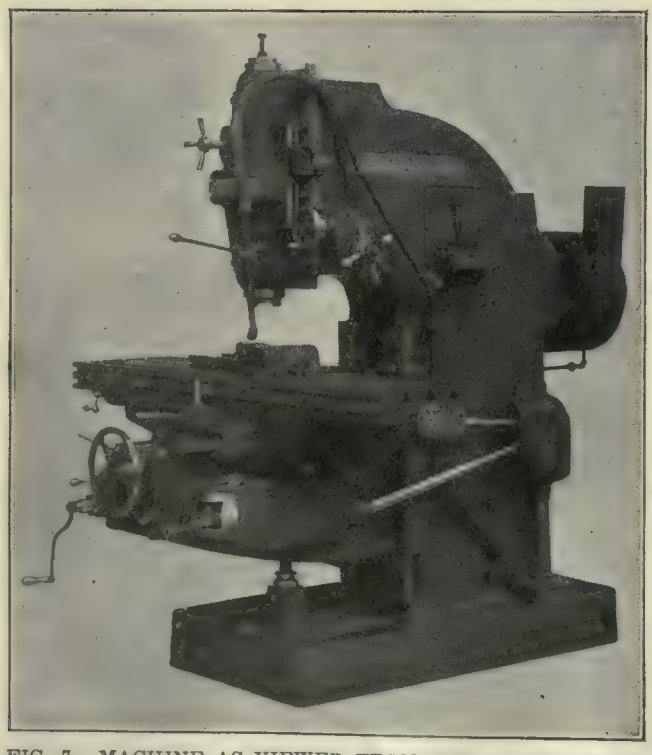


FIG. 7. MACHINE AS VIEWED FROM THE RIGHT FRONT

Size of table, 19 in. wide, 68 in. long, with three ¾-in. T-slots; driving pulley, 16 in. in diameter for 5-in. belt, running 600 r.p.m.; rapid traverse for cross and vertical adjustment, 30 in. per minute; rapid traverse of table feed, 100 in. per minute; capacity of centrifugal lubricant pump, 11 gal. per minute; weight, 9500 lb.

Centralized Compressor Plant Versus Independent Compressors

By E. L. Mills

I wish to take exception to the conclusions drawn by Frank Richards, under the above heading, on page 728 of *American Machinist*. He criticises the use of several compressors by the Winslow Bros. of Chicago, in their shell shop and shows the economy of a single unit which is ideal for a shop running 10 hr. a day and six days a week but not for a shell shop. The shell business was a 24-hr. day, seven days a week, job. Every minute of the time air had to be used for some purpose. Therefore the shut down of the single unit, for any reason would tie up the whole works. The best reason, however, for two or more compressors, was to provide a separate supply of air for the sandblast In every shop this was a comparatively unknown factor. The number of shells passing per hour would vary; perhaps a series would be condemned for bad varnish and they would be added to the regular run. The greatest variable, however, was the constant wear of the nozzles. I have frequently found them $\frac{5}{8}$ to $\frac{3}{4}$ in. in diameter, but this did not worry the operators.

Now consider a single system, very ample for average conditions: Suddenly a battery of oversize nozzle sandblast machines cuts in. The first intimation of trouble is that about half of the heavy bore chucks are slipping, entailing more or less loss in production. After a few such slips the beautiful cutting surface on the outside of the shell would enlarge the jaws so that they would have to be repaired or replaced.

It is easy to say "more air," "watch the nozzles," "use larger chuck cylinders," but the practical cure was a separation of the two systems which put the penalty for low air pressure where it belonged every time.

Shell shops were got together in the shortest possible time and could not afford to wait three or four months for a large compressor if several smaller ones could be purchased off the shelf. New uses were found for air every day; blowpipes seemed to sprout and grow overnight. The best of chuck cylinder connections and pistons used several times the figured amount of air. It was a constant struggle in the earlier shops to keep up with the demand for air. This was also due in a great measure to the rapid growth in production called for by the Government and the enormous advantage of compressed air in a shop of this kind.

The later shops, or those starting during the last two years, had the advantage of the first shops' experience and probably came closer to the mark in figuring their air requirements. One of the peculiarities of this work was that there were no secrets. All were working to the same end, and while no two shops were equipped or arranged alike, any shortcut method or process was open and free to all that were in the business or expected to be.

I feel sure that the Winslow separate compressor plant was right for the reasons stated here if for no others.

Load Characteristics of Radio-Thrust Bearing

By F. W. GURNEY

This article is practically a description of the chart for finding the capacities of ball bearings of the radio-thrust type. The principles underlying the construction of the bearing are discussed briefly and its history is outlined.

THE idea of making an annular ball bearing in which the balls have contact with their raceways at an angle suitable to take a definite combination of thrust with radial load came to the writer in 1908 or 1909. With this basic idea in mind the writer proceeded to figure what contact angles would be required to give to such bearings various thrust capacities. He figured what angle of contact would give to such a bearing a thrust capacity one-fourth the radial capacity, what angle would give 50 per cent. thrust capacity, what angle 75 per cent. thrust capacity, and so on up to double and treble the radial capacity. Bearings of these various kinds were constructed and numerous tests made. Formulas were developed for the securing of the desired angles of contact and methods devised for the production of bearings of this type. A very extensive

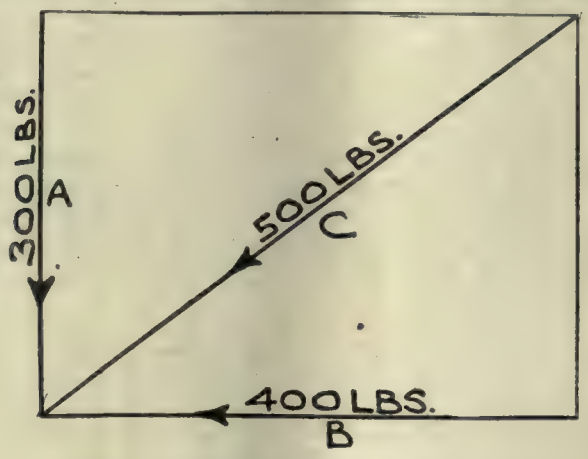


FIG. 1. PARALLELOGRAM OF FORCES

business has been built up on this type of bearing, which the writer christened the "radio-thrust bearing."

The radio-thrust bearing when first put upon the market some 10 years ago met with very general disapproval and even ridicule. The early pioneers in the development of the modern ball bearing had come to the conclusion that the proper way to take care of cases where there were loads of both a radial and an axial character was to use two types of bearings, a radial bearing to carry the radial load and a thrust bearing to carry the axial load. It was early found that the annular bearing as then developed was not at all suitable to take axial loads of any magnitude. Accordingly the dictum was soon laid down, and that with a good deal of emphasis and insistence, that where there were thrust loads of any considerable amount thrust bearings must be used. The experience of users of ball bearings amply justified this rule. With universal usage the practice solidified into a rule so rigid that no one thought of disregarding it.

When therefore the proposal was made to take a radial load and a large thrust load on one and the same bearing it was met with almost universal condemnation. It was directly counter to a rule based on universal experience and was accordingly rejected as rank heterodoxy. Some objected that we were undertaking the palpable absurdity of trying to make the balls roll two ways at once. So for some time the radio-thrust bearing got very scant consideration.

All this is now past and well-nigh forgotten history. It is not the first time that a rule firmly established by general practice has been incontinently swept aside by some innovation at first regarded as absurd. The first steamship that crossed the Atlantic carried a little book just off the press in which an English scientist proved by incontrovertible mathematics that a ship could not be built large enough to carry coal enough to generate power enough to drive the ship across the Atlantic. Doubtless his British complacency was unruffled by this circumstance. The bearing which the recognized authorities rejected as a palpable absurdity has become one of the most conspicuous successes in the bearing industry. Its sales have mounted up into the millions. It has begun to be somewhat generally suspected that the fundamental principles which the German doctrinaires laid down as the laws to which all ball-bearing practice must conform are after all not as the laws of the Medes and Persians. It might be something less than *lese majesty* to suggest that these principles were possibly incomplete.

In that highly specialized branch of mechanical engineering which has been developed along with the development of the ball-bearing industry there are two quite distinct sub-branches. There is a branch which investigates and analyzes the nature and characteristics of the loads that are to be borne on the bearings, and there is the constructive branch which designs and applies bearings appropriate to carry these loads most efficiently. When we come to analyze a mechanism to ascertain its bearing requirements we find loads of various magnitudes to be carried at various speeds. We find loads which are exerted in a direction perpendicular or at right angles to the rotating shaft, which we call radial loads. We find loads exerted in line or longitudinal with the shaft, which we call axial or more commonly thrust loads. And we find loads combining both radial and thrust elements. For example the loads coming from a spur gear are radial loads. The loads from a screw and from marine and aërial propellers are thrust loads. The loads from bevel gearing, from the various forms of helical or spiral gearing, from worm gearing, are a combination of both radial and thrust loads. The main spindles of most machine tools, such as lathes and milling machines, must carry both radial and thrust loads.

The bearing engineer who would make trustworthy mountings for taking care of such cases must make a correct analysis of the loads, must determine just what are the radial loads and just what are the thrust loads. When the ball-bearing engineer has made a correct analysis of the bearing loads of the mechanism under consideration and knows just what loads he has to take care of the very practical problem presents itself, How shall he most efficiently carry these loads? To clarify

the discussion let us take a very simple case. Let us suppose that the engineer has at a certain place a radial load of 300 lb. and a thrust load of 400 lb. Now there are two ways of taking care of this case. The old way is to provide a radial bearing to take the 300-lb. radial load and a thrust bearing to take the 400-lb. axial load. This, according to European authorities, whose word a few years ago was regarded as law and

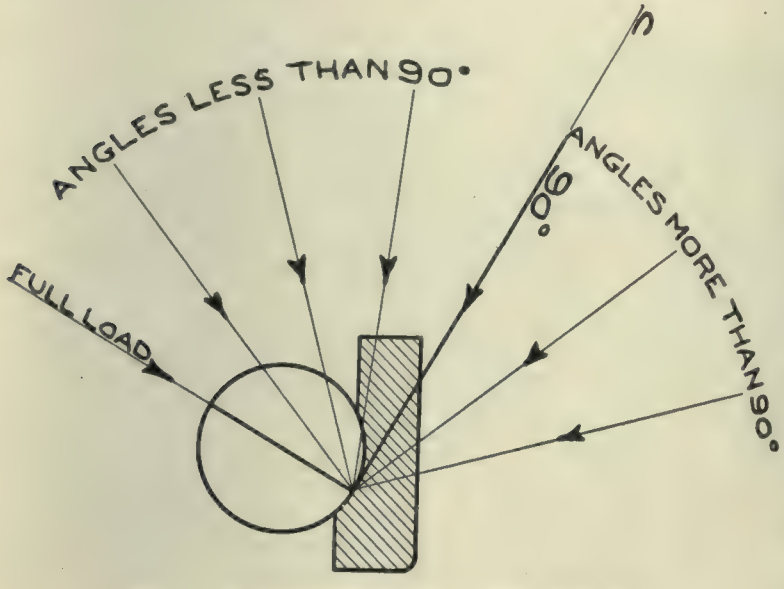


FIG. 2. DIRECTIONS OF LOAD UPON ONE BALL

not to be questioned, was the only proper way to take care of this case with ball bearings. The new way, the radio-thrust way, is to take the 300-lb. radial and the 400-lb. thrust load on one bearing.

Now there are one or two very significant differences to be observed in the actual load conditions as they exist in these two mountings. In the one case we are carrying 300 lb. on one bearing and 400 lb. on another. We are carrying on the two bearings a total load of 700 lb. In the other case we have a load of 300 lb. exerted radially and a load of 400 lb. exerted axially, or in a direction 90 deg. from the direction of the 300-lb. load. What is the total load in this case? It is not the sum of 300 and 400 lb. It is the resultant of 300 lb. and 400 lb. exerted at right angles. The actual load on this single radio-thrust bearing is only 500 pounds.

Everyone familiar with the most elementary principles of mechanics understands how the combination of two forces exerted in different directions is a simple and single force acting in one direction. This simple mechanical principle is usually shown graphically by the use of the parallelogram of forces (Fig. 1). The amount and direction of the two forces are represented by the vertical and horizontal sides of the parallelogram. The resultant force is shown, both in amount and direction, by the diagonal. Every lad in high school knows that the square on the diagonal is equal to the sum of the squares on the two sides. There is manifestly this very radical advantage in the single radio-thrust method of carrying combined radial and thrust loads; it effects a very material saving in the amount of the load that is actually borne on the bearings. With the use of a radial bearing and a thrust bearing, the bearings are actually loaded with the sum of the two loads, the full radial load, no less, carried on one bearing, and the full thrust load, no less, carried on the thrust bearing. With the loads combined on the one bearing the total load carried is not the sum but the resultant, the square root of the sum of the squares of the loads exerted at right angles to each other. ($C = \sqrt{A^2 + B^2}$.) In all cases the actual load borne is the resultant as shown by the parallelogram of forces.

Furthermore, there is not only this obvious large saving in bearing load effected by the radio-thrust method; there is great saving in the cost of bearings and their mounting. With the old method we must use two bearings and we must provide mountings and housings for them. By the new method we carry a materially reduced load on only one bearing requiring but the single mounting. The arguments from considerations of simplicity, efficiency and economy are all for the radio-thrust method.

Having now reduced these two loads, the 300-lb. radial, or vertical, and the 400-lb. thrust, or horzontal, to a single load of 500 lb. exerted in the diagonal or oblique direction shown by the graphic diagram of the parallelogram of forces, it remains to provide a suitable bearing to take this diagonal load.

Putting the case in this way we get a direct indication for a bearing of the radio-thrust type, a bearing in which the load line of the ball is inclined into the general direction of the line of force through which the actual load is received. In a limited or modified way the above phrase might be taken as a definition of the radio-thrust bearing. It needs, however, but little further consideration to develop the fact that a proper formula for the proper bearing to carry a diagonal load of a certain angular direction is not exactly one in which the load line of the ball, or the

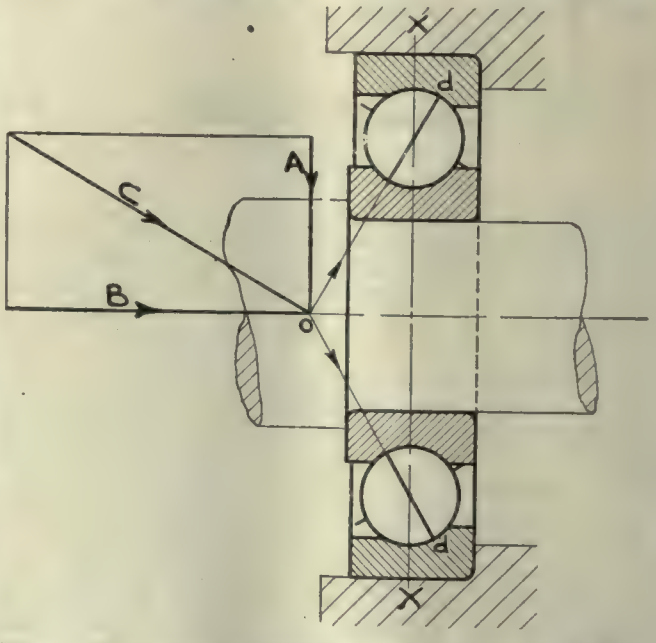


FIG. 3. RADIO-THRUST BEARING WITH LINES OF ACTION OF FORCES

Explanation: Radial load, a load exerted perpendicular to the shaft, as line A; thrust load, a load exerted longitudinally of the shaft, as line B; diagonal or resultant load line, actual direction in which combined load is exerted on bearing, as line C; load line of ball, a line diametrically through ball through the two spots of contact at right angles to the axis of rotation of ball as line *od*; angle of contact, angle between load line of ball and central plane $x - x$, of bearing.

line through the contact points of the ball, is coincident with the direction of the line of force through which the actual load is exerted. This would be the case if the load bore on only one ball. But when we consider that the load bears on a number of balls, and that the load line on each of these several balls extends in a different direction, the problem becomes somewhat complicated.

When the bearing is subject to a straight thrust load the load bears on all the balls, on each ball equally. When the bearing is subjected to a straight radial load the load bears, theoretically, on one-half the balls, on each ball in proportion to the cosine of the angle between the load line of the ball and the line of direction through which the load comes onto the bearing. To express this differently, a pure thrust load is borne equally around the whole circumference of the raceway. A pure radial load is borne on just 180 deg. of the raceway. (In this discussion we ignore complications due to compression or distortion of steel, bearing slack or lack of fit and similar irregularities.) As the direction of load varies from the vertical, or pure radial, to the longitudinal, or pure thrust, the amount of the raceway in load contact varies from the half to the whole. As the load inclines from the vertical or radial the amount of raceway under load increases from the 180 deg. As soon as the angle between the direction of load and the load line of the ball becomes less than 90 deg. the ball begins to take load. And this ball takes load in proportion to the cosine of such angle. The cosine of 90 deg. is 0. The cosines of angles less 90 deg. are positive quantities increasing as the angles become less until we get the cosine of the angle of 0 deg. which is 1, which means simply that when the ball comes under direct load it gets full load (Fig. 2).

Fig. 2 shows the manner in which the balls take loads coming from different directions. It represents the top ball in the bearing shown in Fig. 3. When the load comes upon the ball at an angle with the load line of the ball greater than 90 deg. the load tends to force the ball away from its contact with the raceway at *d* and of course the ball gets no load. This is the case when the direction of load varies from radial over to the line *C*, which is shown at an angle of 90 deg. from the load line of the ball. When the direction of the load passes the 90 deg. line *C* and the angle becomes less than 90 deg. the load begins to force the ball against the raceway, the pressure being in proportion to the cosine of the angle. As the direction of load swings around further the load becomes greater and greater as the angle becomes less and less until we get full load when the direction of load becomes coincident with the load line of the ball and the angle becomes 0. The cosine of 90 deg. is 0, the cosine of 0 deg. is 1.

The load lines of the balls converge at a common point 0. (Fig. 3.)

Now it is quite plain that when we have a bearing of the radio-thrust type, one in which the balls contact with the raceways at an angle rather than vertically

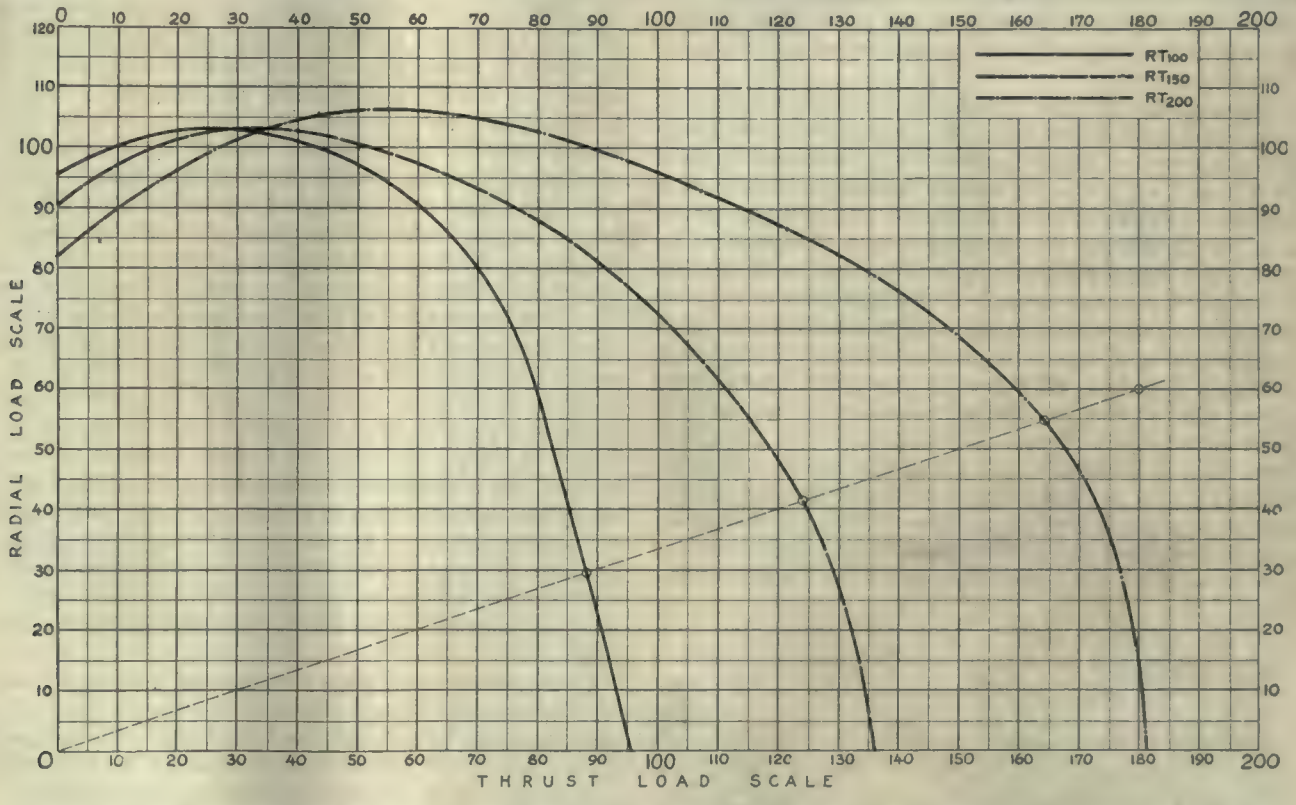


FIG. 4. CHART SHOWING STATIC CAPACITIES OF RADIO-THRUST BEARINGS UNDER DIFFERENT LOADS

These curves show the capacities of the radio-thrust bearings, in percentages of the regular rated loads, to carry various combinations of radial and thrust loads. On this chart the radial and the thrust components of a combination load may be laid off and the resultant load determined both in its direction and amount, the same as by the parallelogram of forces. By measuring the length of this resultant line to where it crosses a curve we get the capacity of the bearing to carry that particular kind of load. For example, we have laid out on this chart a load made up of 600 lb. radial and 1800 lb. thrust. A line drawn to a point 60 points up, or radial, and 180 points out on the thrust scale measures about 190 points diagonally from the 0 point, or corner, showing the resultant actual load to be about 1900 lb. Where this line crosses the curves shows that for a load the resultant of this particular combination of radial and thrust loads a 100 per cent. bearing has a capacity of about 93 per cent. of its rated load, that a 150 per cent. bearing has a capacity of about 131 per cent. of its rated load, and that a 200 per cent. bearing has a capacity of about 173 per cent. of the rated load. If we are to use a 100 per cent. bearing we must select one whose rated capacity times 0.93 equals 1900 lb. If we use a 150 per cent. bearing we must select one whose rated capacity times 1.31 equals 1900. If we use a 200 per cent. bearing we must take one whose rated capacity times 1.73 equals 1900. These load determinations must be modified by proper factors based on considerations of speed, shocks, and the conditions of service. Put more into the shape of a formula, we would say: The rated load of the proper bearing should equal the indicated resultant load times a speed factor times a service factor divided by the percentage indicated on the load curve.

or radially, and subject this bearing to a diagonal load, that is, a load inclined from the vertical or radial, we have a complication of angles between this line of load direction and the load lines of the several balls. If we can determine what these angles are it is a simple matter to determine the capacity of the bearing to carry such a particular load. Having determined the angles between the line of the load and the load lines of the balls under load the static capacity of the bearing as regards this particular load is in proportion to the sum of the cosines of these angles.

Load Capacity of Various Types of Radio-Thrust Bearings Graphically Illustrated

In order to establish the actual load capacity of the various types of radio-thrust bearings to carry loads of various degrees of inclination, we have by this method computed the load capacity of these several bearings to carry loads from all directions. From these computations we have plotted curves which show graphically just what are the load characteristics of the different types of radio-thrust bearings. We have embodied these curves into a chart, Fig. 4, which enables one to ascertain almost at a glance just what is the capacity of any one of the radio-thrust bearings to carry any kind of load that may be imposed upon it. This system of load computation for the radio-thrust bearing disposes of all uncertainty as to what is the capacity of these bearings to carry known loads. It puts the radio-thrust bearing on the same plain footing as regards load capacity as the plain radial and the plain thrust bearings.

The curves on this chart show just what is the capacity of either type of radio-thrust bearing to carry a load from any diagonal direction. The chart is used as follows: If it is desired to find the capacity of a bearing to take a load made up of, say, 650 lb. radial and 400 lb. thrust we read up 65 on the vertical or radial scale and project this point over to 40 on the horizontal or thrust scale. A line drawn from the 0 point to this 65-radial 40-thrust intersection will give the amount and direction of the resultant load, about 765 lb. This line extended to cross the load curves shows that a 100 per cent. radio-thrust bearing will carry about 109 per cent. for a load in this direction, that the 150 per cent. will carry about 115 per cent. for such a load and the 200 per cent. will carry about 124 per cent. Any point on a curve shows the per cent. capacity of the bearing for a load in the direction of a line drawn through such point to the zero point of the chart.

Consideration of Speed and Friction Cannot Be Ignored

It should be stated in this connection that these load characteristics as shown by this scheme are for static loads. They do not take into consideration the effect of speed and friction upon the available working capacities of bearings. Considerations of speed and friction cannot be ignored, except at slow speeds. That is another matter, and of great importance, which we will not undertake to discuss at this time. It will perhaps be treated in another article. This discussion and these curves pertain to actual bearing pressures and to the actual load-bearing characteristics of the several types of radio-thrust bearings as based on definite limits of contact pressure between balls and raceways. A radio-thrust bearing of either type having a load whose direction and amount is represented by a line drawn from a point in its load curve to the 0 point on the chart is so loaded that the maximum load to which a ball is subjected is $d^2 \times 2\pi$, d being the diameter of the ball in sixteenths of an inch.

The Metric System in Export Trade*

By Frederick A. Halsey

Commissioner, American Institute of Weights and Measures

The problem of the adoption of the metric system does not lie in the introduction of the metric units but in getting rid of the English units. If the English units are to continue in use, we will have a double standard with infinite complexity and confusion due to their conjoint use.

Since the outbreak of the world war, we have heard repeated insistence that we must adopt the metric system if we are to succeed in the cultivation of foreign markets. We are told that when selling to others, "we must deal with them in language they understand." We are told that "our weights and measures are meaningless to them," that "they have forgotten their old units," that, in short, "in export trade, we have no choice—we must come to the metric system."

Like other metric arguments, there is a specious plausibility about these statements, but instead of relying upon generalities, let us consider the sale of specific commodities. In normal times, we import large numbers of high-class French clocks, and similarly we export tens of thousands of cheap clocks to all parts of the world. It would be absurd for an American purchaser to object to a French clock because it was made to the metric system, and equally absurd to suppose that foreign purchasers would object to our clocks because they are made to the English system. To come still nearer home, American watches are made to both the English and the metric systems, but not one watch owner in a thousand knows or cares to which system his watch was made. It is not conceivable that a foreign purchaser should fail to select an American typewriter because its parts are made to the English system. Still another illustration is found in the automobile trade. In former days when the French led in automobile construction, large numbers of French automobiles were sold in this country, but no one ever heard raised as an objection against them the fact that they were made to metric measure. At the present time, the situation is reversed. Our automobiles have taken possession of the markets of the world and the fact that they are made to English measures is nowhere raised against them.

It is precisely so with every other commodity that can be named. From shovels to watches, and from wheelbarrows to automobiles, the units of measure to which goods are made have nothing to do with their salability in any market. In normal times we import vast quantities of goods from metric countries which we buy without thought or question of the units of measurement to which they are made. Just as metric countries give no thought to the adoption of the English system in order to sell goods to us, so there is no reason why we should consider adopting the metric system in order to sell goods to them.

*Abstract of address delivered before the twenty-fourth annual convention of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City.



XIV. Gas-Pressure Regulators and Working Assemblies*

The pressure regulators used on gas-torch apparatus are very important instruments and should be carefully handled. Details of some of the well-known makes of regulators are here given, together with directions for their assembly to the apparatus. Directions are also given for the lighting of a torch, and the various flame characteristics with different gas combinations are shown by drawings.

SINCE the gas pressure required in a welding or cutting torch is normally considerably less than that of a generator or storage cylinder, some form of pressure reducer or regulator must be used between a torch and the source of gas supply. The regulator used must not only reduce the pressures to working amounts, but must keep the gases supplied to the torch at as constant a pressure as possible regardless of the variation in the pressures at the sources of supply. This will be understood when it is shown that, for example, oxygen at 1800 and acetylene at 225 lb. pressure per sq.in., taken from cylinders, must be mixed in a Davis-Bournonville positive-pressure torch at approximate pressures of 14 and 6 lb. respectively, when welding steel plate ½ in. thick. The pressure in the cylinders will constantly decrease as the gases are used, but in order to keep a correct neutral welding flame the gases must be supplied to the mixing chamber of the torch at the approximate pressures of 14 and 6 lb., and kept close enough to these figures for long periods of time to produce the desired flame without continual adjusting of the valves. The required working pressures are determined by the thickness of the metal being operated upon, the make of torch, and the size of tip being used, as tables already given indicate, but the principle remains the same in any case.

The gas-pressure regulators used on welding and cutting apparatus are practically all made on the same general principle and vary only in minor details of construction. An Oxweld oxygen regulator shown in Fig. 144 will serve to illustrate the construction in general. The principal parts of a regulator of this kind are the body proper, regulating or shut-off valve, diaphragm, pressure-adjusting spring and pressure-indicating gages. As a general rule all regulators have two pressure-indicating gages, one on the intake or high-pressure line, and one on the outlet, or low-pressure line. The gage, however, on the low-pressure acetylene line is sometimes omitted when using a low-pressure, or injector, torch on account of the low pressure at which the acetylene is used.

In the illustration given, a dust or protecting plug is shown screwed into the connecting nut on the intake tube. This is of course removed when attaching the regulator to the supply pipe or valve. The arrows indicate the flow of the gas when free to move from the intake to the outlet. Following these arrows it will be seen the gas enters the intake and flows into the vertical passage *A* where it goes upward to the high-pressure gage *B*, which indicates the pressure of the supply line. The gas also flows downward in the same passage until it reaches the monel-metal nozzle of the regulating valve at *C*. If the screw *D* is turned to the left far enough to prevent spring *E* from forcing the diaphragm *F* inward against the sliding sleeve, then spring *G* will keep the seat *H* solidly against the nozzle *C* and no gas will enter the body of the regulator beyond the passage *A*. However, if the screw *D* has

*For the author's forthcoimng book, "Welding and Cutting."

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been run inward far enough to put a tension on spring *E* the diaphragm *F* will be forced inward and the regulating valve will be held open. Gas will then flow into the diaphragm chamber *I* until the pressure of the gas against the diaphragm overcomes the pressure of spring *E*. This allows spring *G* to close the regulator

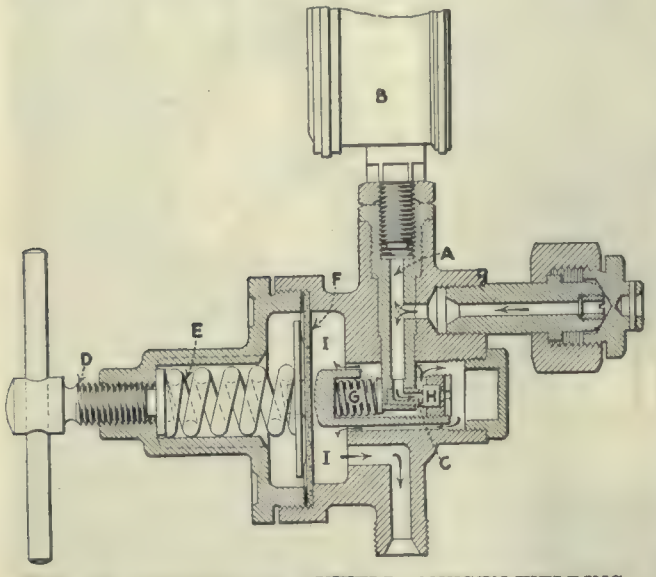


FIG. 144. DETAILS OF OXWELD OXYGEN-WELDING REGULATOR

valve and stop the flow of gas. The flow is not usually actually stopped when the torch is in use, since the flow of gas and the pressure of the spring *E* will be so balanced as to allow just enough gas to enter to keep the pressure practically constant in the outlet line. The farther the screw *D* is run in the more tension is put on the spring *E* and the diaphragm *F*, and consequently the higher will be the gas pressure in the outlet line to the torch. From this it will be seen that any desired pressure within the capacity of the regulator can be obtained, and maintained, in the outlet to the torch by simply adjusting the screw *D*. The diaphragm used on a regulator of this kind may be made of reinforced sheet rubber, phosphor bronze or other composition metal that will not corrode or break easily.

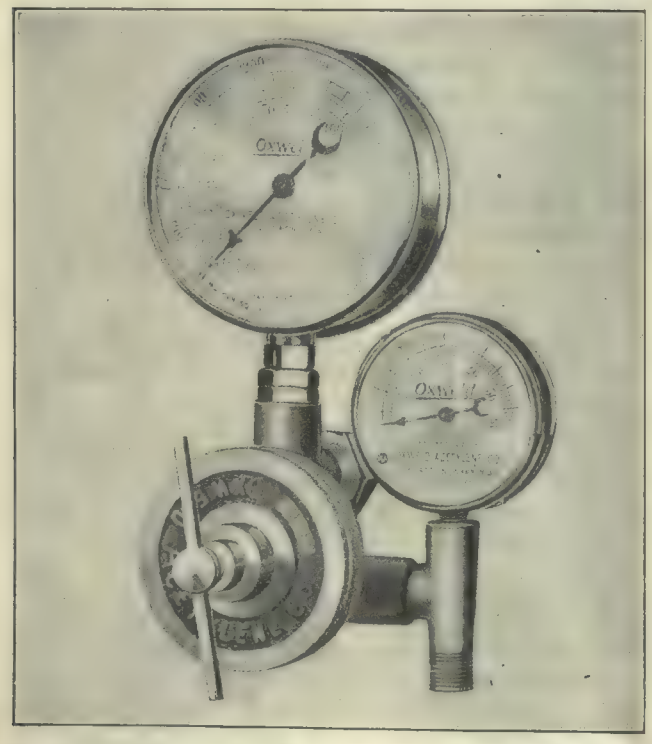


FIG. 145. OXYWELDED OXYGEN-WELDING REGULATOR

The regulators used for other gases differ but little from those used for acetylene or oxygen, and often the same regulators may be used provided the pressures required are within the range of the regulator in question. An oxygen regulator for cutting work should be built heavier and deliver a larger amount of gas than one used for welding on account of the higher pressure required and greater gas consumption. In using acetylene from a pressure generator it is good practice to have an acetylene line regulator as well as one for each operator's torch line.

The Oxweld oxygen gages used when welding are made to register from 0 to 2700 lb. per sq.in. on the high-pressure side and from 0 to 60 lb. per sq.in. on the low-pressure side, as shown in Fig. 145. It will be seen, by examination, that the outer scale on the high-pressure gage shows the pressure in pounds and the inner scale indicates the percentage of gas in the cylinder. That is, for example, if the gage hand points to 600 lb. there would be approximately 35 cu.ft. of oxygen left in the cylinder, providing a 100-cu.ft. cylinder was being used. If it was a 200-cu.ft. cylinder the amount left would be approximately 70 cu.ft. As has been pointed out elsewhere, these figures cannot be taken as showing the exact amount of gas in the cylinder except under certain conditions, but they are sufficiently accurate for all ordinary purposes.

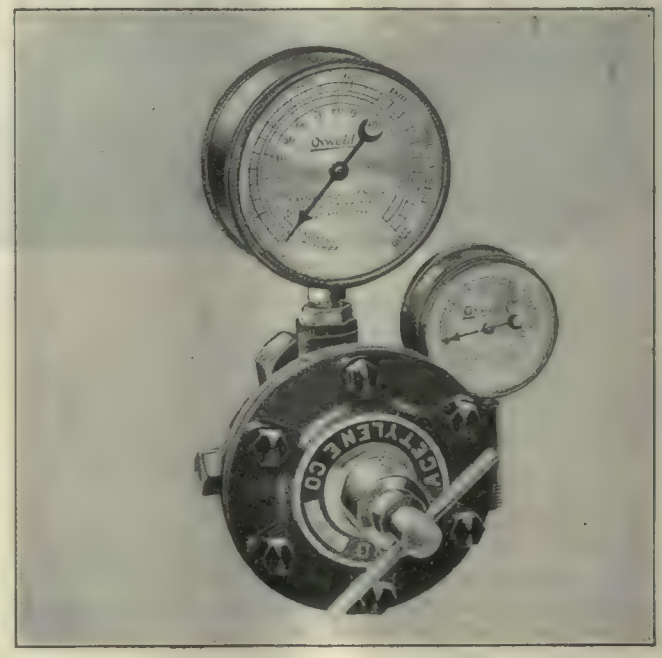


FIG. 146. OXWELD OXYGEN-CUTTING REGULATOR

For cutting purposes the Oxweld oxygen regulator shown in Fig. 146, is fitted with the same gage on the high-pressure side as for welding, but on the low-pressure side the gage registers up to 200 lb. per sq.in. Their acetylene regulator is only supplied with a 350-lb. gage on the high-pressure side, as shown in Fig. 147. This is because of the fact that the Oxweld torches use acetylene at about 1-lb. pressure at all times. However,



FIG. 147. OXWELD ACETYLENE REGULATOR

if required, two gages may be used as in all other makes.

A Davis-Bournonville oxygen regulator with gages is shown in Fig. 148. This indicates from 0 to 3000 lb. per sq.in. on the high-pressure side and up to 400 lb. on the low-pressure side. On the dial of the high-pressure gage are three rows of figures. The outer row shows the pressure per sq.in.; the middle row, the cubic feet of contents for both 100- and 200-ft. cylinders; the inner row indicates the cubic feet of contents for 250-cu.ft. cylinders at various pressures. Details of a regulator used for acetylene are shown in Fig. 149. This is practically the same in construction as the oxygen regulator. The numbers shown are list numbers of the parts, and are very convenient for ordering broken or damaged parts at any time. The regulator acetylene gages register up to 400 lb. on the high-pressure side and up to 300 lb. on the low-pressure side.

An oxygen regulator made by the General Welding and Equipment Co., attached to a cylinder is shown in Fig. 150. At the right and almost opposite from where the regulator is attached, is a projection which is a fusible blow-off plug required on all cylinders by the Interstate Commerce Commission, to provide for the escape of the gas in case the cylinder should be overheated and the pressure become so great as to be liable to cause an explosion. This illustration clearly shows the kind of valve that is used on an oxygen cylinder. It is completely covered with a metal cap screwed onto the threads shown at the top of the cylinder. The cap protects the valve and prevents it being broken off or damaged when the cylinder is handled or shipped. In using gas cylinders under working conditions it is advisable to have them placed on a portable truck made for the purpose, or else fastened in some way so that they cannot be tipped over. This will often prevent needless damage to the apparatus and sometimes avoid serious accidents. It should always be kept in mind that gases under from 225- to 1800-lb. pressure per square inch are not to be trifled with.

Oxygen cylinders of different concerns do not have a uniform color, but are usually painted gray and green, red, yellow, or dark-green. Acetylene cylinders are generally painted black and have a plate on them giving the quantity of gas the tank contains. Practice also varies as to the color of hose used to connect to the torches. Common colors are black hose for acetylene and red hose for oxygen. In making all hose or valve connections, they must be carefully blown out to remove dust or any foreign substance. This is especially important on new hose which is almost sure to contain considerable bloom left from the vulcanizing. In addition to their specific color, acetylene cylinder valves are often threaded left hand, as a safeguard against making the wrong connections.

In making oxygen connections it must be remembered that under no circumstances should oil or grease be used on the oxygen regulator or cylinder valve. This is highly important as oxygen under pressure coming in contact with oil or grease causes spontaneous combustion which might easily result in a serious accident. If a lubricant of any kind is needed a little glycerine may be used.

Regulator Adapters

No make of regulator is so made as to be regularly interchangeable with all makes of gas cylinders, since the sizes and threads used on different makes of cylinder connections vary considerably. For this reason adapters must be used in many cases. Some of these are shown in Fig. 151. Care should therefore be taken to make sure that the regulator will fit the cylinder connections properly, or that the right adapter is used. If a regulator connection or an adapter does not start readily, it should not be forced as it is probably the wrong diameter or the thread may be of the opposite kind—that is right- or left-hand. Also be sure that an adapter with a round or conical seat is not used on a flat seat, nor a round seat on a conical one or one not made for it. Adapters are made of soft brass and



FIG. 148. DAVIS-BOURNONVILLE OXYGEN REGULATOR

careless handling will cause a leaky joint. In ordering adapters the make of regulator used should be specifically stated, and also the make of cylinder on which it is to be used, as well as whether it is for oxygen, acetylene, hydrogen or other gas.

In order to make perfectly clear to the reader how to connect up a welding apparatus for the first time, an Imperial welding outfit is shown in Fig. 152. First remove the protecting cap from the oxygen cylinder, and then open valve *A* very slightly. This is to blow out any dust and to insure the free working of the valve after the regulator is attached, which otherwise

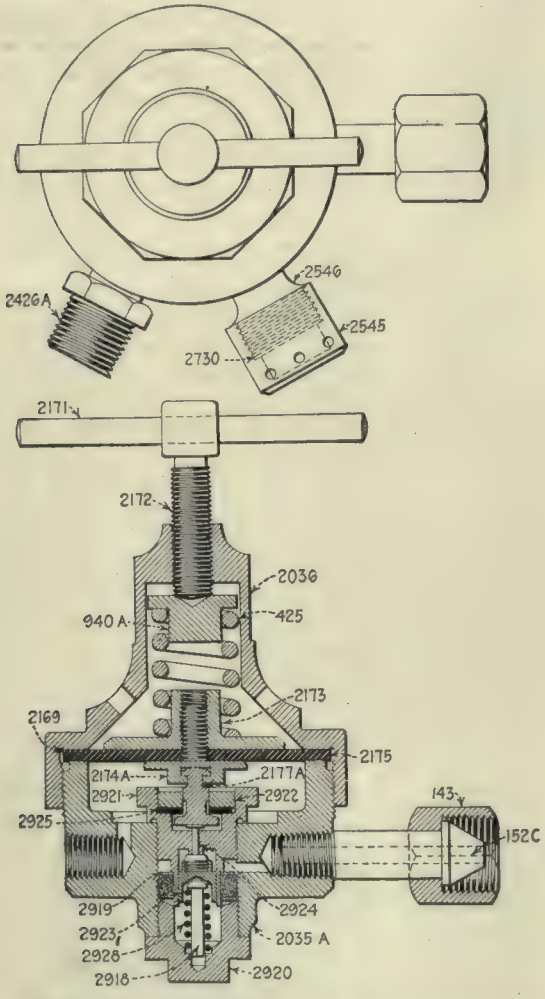


FIG. 149. DETAILS OF DAVIS-BOURNONVILLE ACETYLENE-PRESSURE REGULATOR

might be injured by the sudden rush of gas into it. In doing this, stand on the side opposite from the opening so that the gas will blow *away* from you. Always keep this in mind when blowing out the valve on *any* cylinder. Now take the regulator and turn the handle *B* to the left until it turns freely, so as to be clear of the diaphragm. Next make sure the connection at *C* is clean and free from dirt and fits properly or has the right adapter, then screw it up using judgment with the wrench so as not to break anything. With the valve at *D* closed, *slowly* open the valve *A as far as it will go*, using some force with the hand to insure that it is really backed up against the gland solidly. This is to aid in preventing the high-pressure oxygen from escaping around the valve stem. When the valve is fully opened, the gage *E* will indicate the cylinder pressure which on a new one will be close to 1800 lb.



FIG. 150. REGULATOR ATTACHED TO A GAS-CYLINDER VALVE

Now put on the oxygen hose at *F* and then turn the handle *B* to the right until about 5 lb. are registered on gage *G*. Then open valve *D* so as to blow any dirt or bloom out of the hose. The valve *D* is then closed and the hose connected to the torch at *H*. The valve *I* on the torch may now be closed, the valve *D* opened, and the handle *B* screwed in until the gage *G* registers the proper pressure for the proposed welding job, as indicated in the pressure table for the make of torch being used. The various connections should then be carefully gone over with soapy water to test for leaks. Never use a flame on the oxygen or any other gas tank even though oxygen alone is not inflammable. Assuming that the proper tip has been placed in the torch for the thickness of metal to be welded, the torch valve *I* may now be opened fully and the handle screwed in until the gage *G* registers about 2 lb. over the pressure given in the table. This is to allow for the variation in cylinder pressure as the gas is used. The torch valve *I* is next closed, and it is also well to close the valve *D* as a safeguard before attaching the acetylene hose.

The acetylene regulator and tank are now connected up in exactly the same way, except that the acetylene tank valve *J*, must be *only opened one full turn.* (On one make of cylinder the directions say two turns, so the operator should read the directions on the tank carefully.) The hose is connected at *K* and blown out to

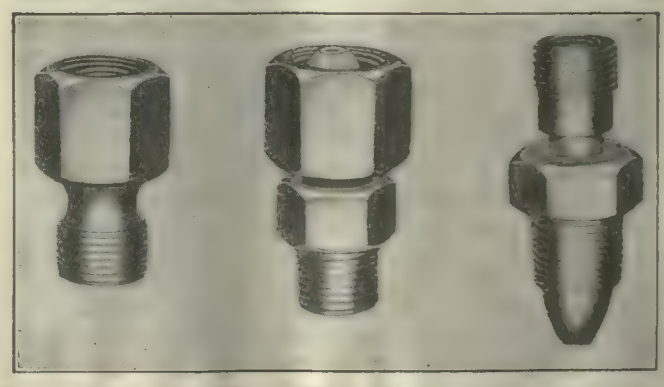


FIG. 151. REGULATOR AND CYLINDER-CONNECTION ADAPTERS

remove any dirt, care being taken that no flame is near. It is then connected to the torch at *L*, and tests are made for leaks as before with the valve *M* open and the torch valve *N* closed. The torch valve *N* is next slightly opened and the issuing gas lighted. The valve is then fully opened, and if the gage *O* shows any appreciable drop, the handle *P* should be turned until the gage registers about 2 lb. above the amount shown by the table. The resulting flame from the burning acetylene will be long, white, smoky, and of compara-

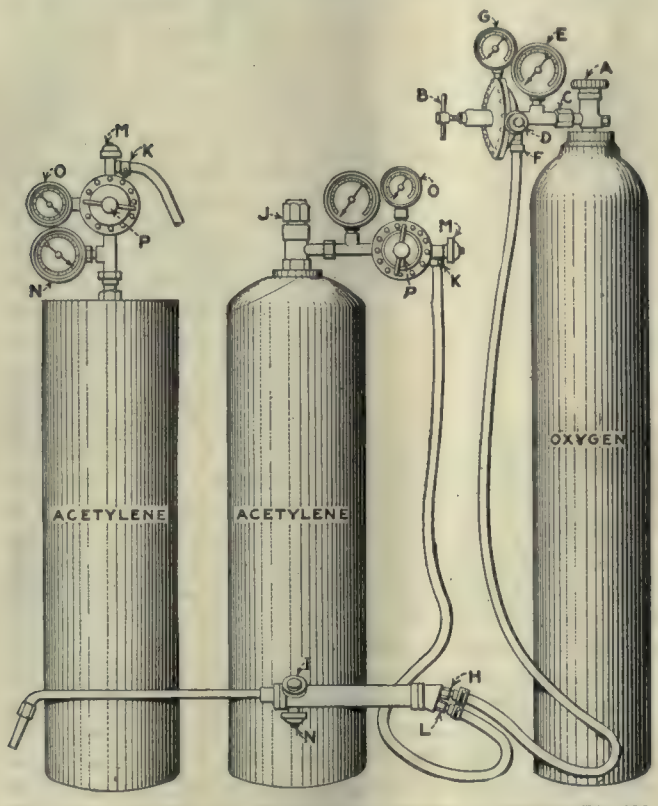


FIG. 152. IMPERIAL WELDING OUTFIT CONNECTED TO TANKS

tively low temperature. The torch valve *N* may then be manipulated until the pressure blows the flame from $\frac{1}{16}$ to $\frac{1}{4}$ in. away from the tip, the distance depending on the size of the tip being used. This can only be judged properly by experience. The oxygen may now be turned on slowly. The flame will gradually reduce in size, the outer end or envelope becoming less luminous and the part near the torch tip, known as the cone, assuming a clear outline without any ragged edges. When this is obtained, turn off the oxygen slowly until a shadowy point shows from the cone. Then with extreme care turn on the oxygen again until this shadowy point just disappears. This is the so-called neutral flame, and is neither oxidizing nor carbonizing.

From time to time, while at work, the operator should test the flame as just outlined, as a slight excess of oxygen pressure will not readily show in the flame and can only be detected by this method. It will be found in practice, as a rule after the pressures have been set on the gages, that all regulation necessary for the smaller sizes of tips may be made with the torch valves, but that on the larger sizes it is often advisable to readjust at the regulators. It will be well to repeat here, for the benefit of the beginner, that all indicated table pressures are only approximate and good only for the make of torch mentioned in connection with them.

The chart shown in Fig. 153 will serve to illustrate the looks of the oxy-acetylene flame as far as it is possible to do on paper: *A* shows acetylene turned on with sufficient pressure, so that it blows away from

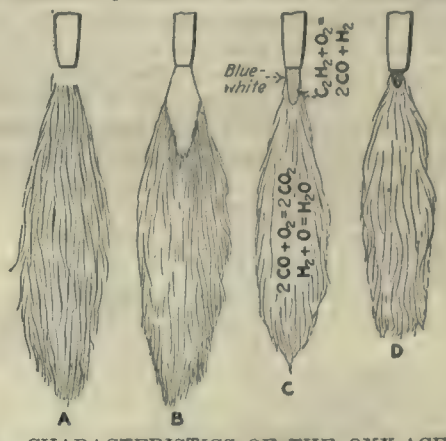


FIG. 153. CHARACTERISTICS OF THE OXY-ACETYLENE WELDING FLAME

the tip. This space depends upon the size of tip being used. *B* shows oxygen partly turned on, united with the acetylene. The flame has begun to assume two different shapes and two different colors. The center flame is white and is shaped somewhat like a rosebud. Not enough oxygen has yet been given the acetylene and the flame is called carbonizing. Such a flame will leave the metal brittle and hard. *C* is the neutral welding flame. The rosebud cone of the upper figure has become blunt, with no ragged edges and of a beautiful blue-white color. *D* is an oxidizing flame—ruinous to welding. This is obtained by turning on too much oxygen and the cone has become shorter, of a darker, dirtier blue, and is more pointed. This view is exaggerated. The utmost care is necessary to guard against this flame. Even a slight excess of oxygen is detrimental, as it will "burn" the metal.

To stop work temporarily, first close the oxygen valve in the torch and then the acetylene valve. To stop work permanently, first close the torch valves in the order just given, then screw back both regulator handles until they are free of the diaphragms. Then shut off the tank valves tightly.

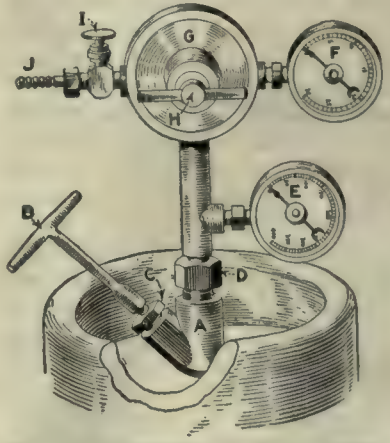


FIG. 154. PREST-O-LITE ACETYLENE-REGULATOR ASSEMBLY

In case of a flash-back, always close the oxygen valve instantly, then the acetylene valve, after which the torch head may be cooled in a bucket of water.

It should always be kept in mind *never to turn on the gas at the cylinder with the regulating screw tight, as this puts spring tension on the diaphragm* and allows the gas from the cylinder to enter the body of the regulator very suddenly (because the plunger of the valve is away from the seat) and as

the sudden pressure strikes the diaphragm, the plunger is thrown violently against the seat, often causing the seat to become cracked or broken.

With the motor of an automobile racing, you wouldn't throw the gears in mesh for high speed direct from neutral and attempt to start away from the curb—not if you wanted to keep your automobile very long—yet turning on the oxygen with the spring tension on the regulator has about the same effect on the regulator.

Bear in mind that the regulator is a steadying device—that the diaphragm is the balance between the high pressure of the cylinder gas and the spring tension

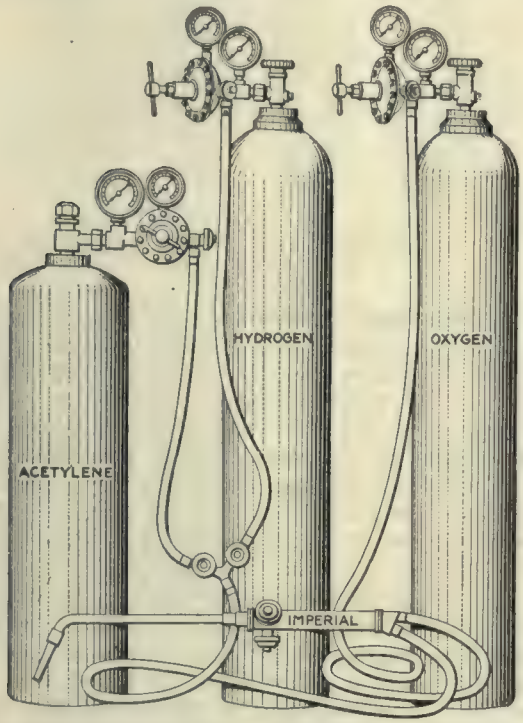


FIG. 155. IMPERIAL THREE-WAY-GAS OUTFIT

and that at all times the movement of this diaphragm should be slow—never violent.

The low-pressure gage is a positive index of regulator trouble. If you are operating, say at 15 lb., and after shutting off the valve on the torch, the hand on the dial keeps moving to 25 or 30 or 40 lb. without stopping, it means that the seat is damaged—that the high pressure of the cylinder is leaking past the plunger of the valve and the regulator should be immediately sent back to the factory for repairs. Only by violating some of the rules previously given would you be likely to damage this seat; but once damaged, it should be immediately repaired.

It will be noticed that two acetylene tanks are shown in Fig. 152. These represent the two types in common use. The one in the middle is the type furnished by both the Air Reduction Sales Co. and the Commercial Acetylene Co., while the tank at the left is furnished by the Prest-O-Lite Co. In the first named the regulator stands out at right angles, and in the other it stands up as shown. The valve in the Prest-O-Lite cylinder differs considerably from the others as will be seen in Fig. 154. In this illustration the valve is shown at *A*, the valve wrench at *B*, the packing nut of the valve at *C*, and the union nut by which the regulator is attached, at *D*. *E* is the high-pressure gage, *F* the low-pressure gage, *G* the regulator, *H* the pressure-adjusting handle, *I* the outlet valve and *J* the hose nipple. The directions given by the Oxweld company for the lighting of their low-pressure or injector torches, differ slightly from the foregoing, so they will be quoted here, starting from where the gases have been turned into the high-pressure sides of the regulators, which is the same as already outlined:

First, connect the oxygen hose from the oxygen regulator to the hose connection on the torch marked oxygen. Likewise connect the acetylene hose to the torch valve marked acetylene. Then select the proper welding head or tip that is to be used according to the chart or table furnished, and screw it carefully into the torch. Turn on the oxygen by means of the handscrew of the oxygen regulator until the pressure on the small gage is as given on the chart. Be sure that when this is done the oxygen valve on the torch is open. Then close this valve. Open the acetylene valve on the torch. Then turn the handscrew on the acetylene regulator to the right until acetylene is passing through the torch. Then close the acetylene valve on the torch.

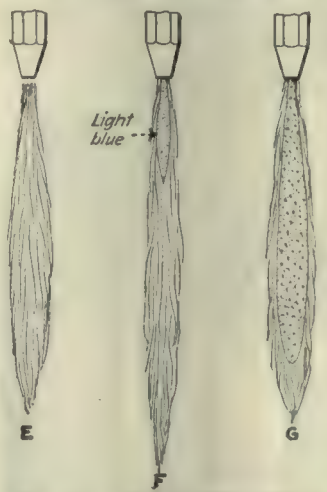


FIG. 156. CHARACTERISTICS OF THE OXY-HYDROGEN FLAME

The apparatus is now ready for use, and the gases are further regulated when necessary by adjusting the valves on the torch itself. Open the acetylene valve entirely. Open the oxygen valve slightly. Then light the gases. After lighting the gases, open the oxygen valve wide; adjust the flame by turning the acetylene valve to the right until a neutral flame is produced.

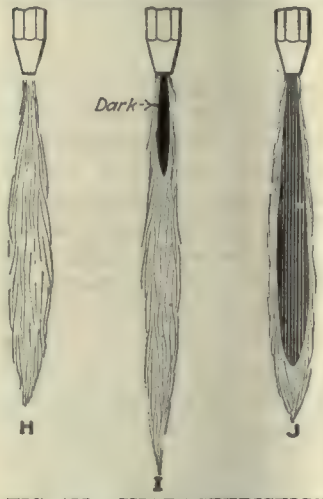


FIG. 157. CHARACTERISTICS OF THE HYDROGEN-COMPRESSED-AIR FLAME

When the job is finished and you want to shut off the torch for a short time, release or turn the handscrew on both oxygen and acetylene regulators to the left until the flame on the torch goes out. Then close the torch valves. When work is completed for the day and the apparatus is to be put away, first close the acetylene valve, then the oxygen valve of the torch. Then turn off the valves on *both* cylinders. Then open the valves on the torches until all the gas in the regulators and hose passes out of the torch into the air. Then turn the handscrew of both regulators to the left until loose. Then disconnect the oxygen and acetylene regulators from the cylinders. Each regulator has a dust plug which is to be put on its cylinder connection during all the time the regulators are not connected to the cylinders.

Place the regulators and torches with wrenches, goggles, heads, and tips in their proper place so that they will be safe and protected from dust, dirt, and rough handling. Roll up the hose and put it in the case or tool box where it belongs.

According to the Prest-O-Lite company, the chemistry of the oxy-acetylene flame is as follows: Acetylene (C_2H_2) is composed of carbon (C) and hydrogen (H). On combustion, the carbon combines with oxygen to form carbon dioxide (CO_2) and the hydrogen combines with oxygen to form water vapor (H_2O). This takes place in the following manner:

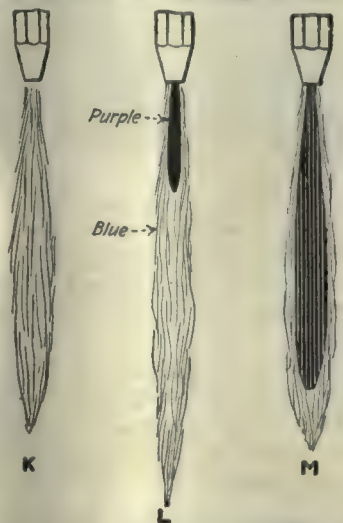


FIG. 158. CHARACTERISTICS OF THE OXYGEN ILLUMINATING GAS FLAME

When the gases issue from the torch into the welding flame, the acetylene immediately dissociates; in other words, it *splits up* into carbon and hydrogen which in combination with oxygen form respectively carbon dioxide and water vapor. In consequence of the high flame temperature (6300 deg. F.) the water vapor formed by this primary combustion, is immediately dissociated into hydrogen and oxygen. The oxygen assists in the burning of the carbon while the hydrogen (which can only combine with oxygen at a temperature below 4000 deg. F.) passes away from the high-temperature zone and combines with the oxygen of the atmosphere at the outer blue part of the flame, where the temperature is sufficiently low to permit it. The result of this is that the inner or welding cone of the flame is protected by a shield of free hydrogen which prevents loss of heat and also tends to protect the weld from oxidation. The temperature of the oxy-acetylene flame is approximately 6300 deg. F., at the hottest part of the flame, which is the tip of the inner white cone. The effect of this tremendous heat at the point of treatment is to bring the metal very rapidly to a molten state so that it flows together and mixes thoroughly with the proper quantity of metal added by the operator.

The molten mass thus formed does not merely cement two pieces of metal together—it *fuses* them into one uniform mass.

Characteristics of Other Gas Flames

The way an Imperial three-way outfit is connected up is shown in Fig. 155. The procedure is along the same lines as outlined for the oxy-acetylene work. This combination of oxygen, acetylene and hydrogen gives a more visible flame and a sharper cone than oxy-hydrogen alone does. Only a small percentage of acetylene is necessary to give the sharper cone but the flame retains the clearness, beauty and good qualities of the oxy-hydrogen flame. The percentage of acetylene may be varied according to the thickness and character of the metal being welded, so that the degree of heat and amount of carbon can thereby be regulated to meet different conditions. The approximate pressures to be used for the three gases for average work, will be found in a previously given table. The combination will produce a heat of about 5000 deg. F.

The oxy-hydrogen flame will produce a much softer weld than oxy-acetylene if properly used, but its lower heat and the fact that the cone is not concentrated in a sharp needle point, which allows the heat to radiate more, are drawbacks when heavy welding is attempted. The low visibility of the oxy-hydrogen flame also makes it difficult to regulate properly, and an operator requires considerable experience before he can become proficient in its use. As has been already mentioned, however, its long flame makes it very desirable to use for the preheating flame in a cutting torch, especially on heavy, thick work. In welding with the oxy-hydrogen flame, the torch has to be held farther away from the work than with the oxy-acetylene torch on account of the longer and less concentrated flame. When a black spot appears in the weld it shows that the torch is being held too close.

The characteristics of the oxy-hydrogen flame are shown in Fig. 156. In this illustration, which is as clear as a flame can be represented on paper, the different flames are outlined as follows: *E* shows the hydrogen turned on with sufficient pressure so that it blows away from the end of the tip. The distance will vary from about $\frac{1}{16}$ to $\frac{1}{4}$ in. according to the size of tip and pressures used. *F* shows the oxygen turned on. A narrow, light-blue streak appears in the center of the hydrogen mantle. This is the desired neutral flame. *G* is an oxidizing flame that will burn the metal. The oxygen valve should be gradually closed until the excess of oxygen disappears.

Where hydrogen and compressed air are used as done in preheating work, light welding, or lead burning, the flame closely resembles that of the oxy-hydrogen flame. The appearance of the hydrogen-air flame is indicated in Fig. 157. *H* shows the hydrogen turned on with pressure enough to blow the flame away from the tip, the distance being about the same as already given. *I* shows the compressed air turned on and a dark streak of mixed air and hydrogen appears in the center. This is the neutral flame. *J* is the oxidizing flame.

In general the air pressure used for this flame is close to that where oxygen is used.

The flame produced by mixing oxygen and coal gas, or natural gas, is suitable only for lead burning, preheating, very light steel welding, light cast-iron welding, or the welding of light brass or aluminum. The characteristics are shown in Fig. 158. *K* shows the gas turned on full force enough to slightly blow the yellow flame away from the tip. *L* is the neutral flame produced by turning on the oxygen. The cone is narrow and about $\frac{1}{2}$ in. long, of a beautiful purple color in a pure-blue outer mantle. *M* shows too much oxygen. The cone has turned a reddish color. The oxygen must be decreased until the sharp purple-colored cone appears. In using oxygen and illuminating gas, a water seal should be used on the gas line to assist in purifying the gas and to prevent the entrance of any flame, or oxygen which might form an explosive mixture.

Where acetylene and compressed air are used, as sometimes done for certain preheating or welding jobs, the flame characteristics closely resemble the oxy-acetylene flame.

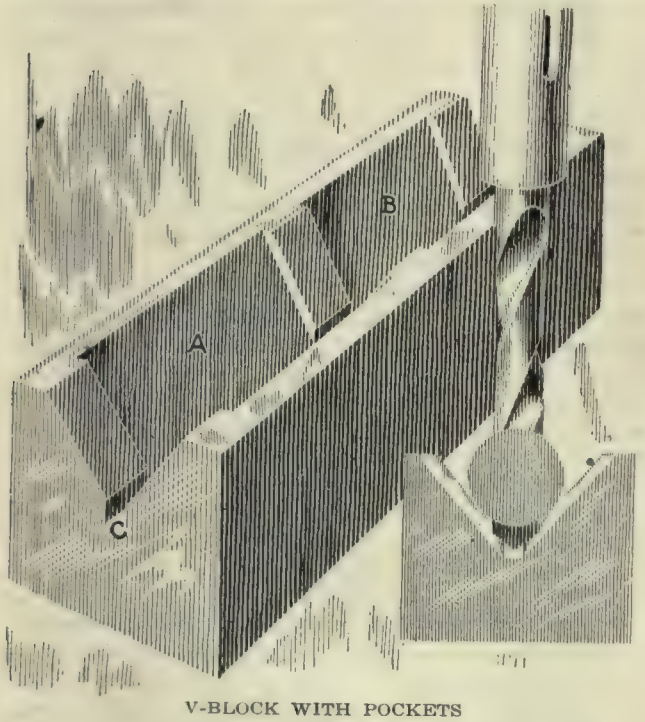
In order to obtain the best results, special tips should be used in the torch for the different gas combinations described. These can usually be promptly supplied by the makers of any of the torches on the market.



An Improvement in V-Blocks

By S. W. Palmer

The type of V-block shown in the illustration has been found to be very useful and may be of some interest to other readers. The block differs from the ordinary type in that it is machined from a casting having



V-BLOCK WITH POCKETS

V-shaped depressions as shown at *A* and *B*. These depressions permit the use of a comparatively large drill, since they provide clearance for the drill in passing through the work so that the surface of the V is not marred. The ordinary block is milled from a solid piece and has a slot as shown at *C*. This slot provides clearance for small drills, but for general work, blocks constructed as shown have been found more satisfactory.

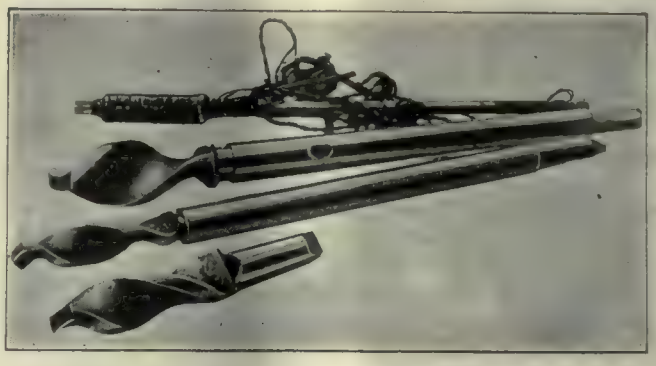
Tools for Drilling Deep Holes

By H. H. Esbenshade

It is sometimes necessary to drill unusually deep holes with a considerable degree of accuracy when, owing to the nature of the work, the only practicable tool is the upright drilling machine.

The cut shows some drills which we made for drilling holes 42 in. deep, the material being nickel steel and the machine used, a 4-ft. radial. These drills were forged from high-speed steel, being first made like a flat drill, and then twisted to the shape shown in the cut. They were forged somewhat over the nominal diameter and were finished accurately to size by grinding.

One great difficulty in the drilling of deep holes is the clogging of chips in the hole. To remove these chips we made a magnet which is also shown in the cut. It consists of a piece of cold-drilled steel $\frac{7}{8}$ in. in diameter wrapped for a distance of 5 in. near one end



TOOLS FOR DRILLING DEEP HOLES

with No. 22 cotton-covered magnet wire properly taped and varnished to protect the winding from injury.

The current was supplied from the lighting circuit with a lamp in series with the magnet to control the flow. A double-pole knife switch was used to cut the magnet out of circuit when its services were not required.

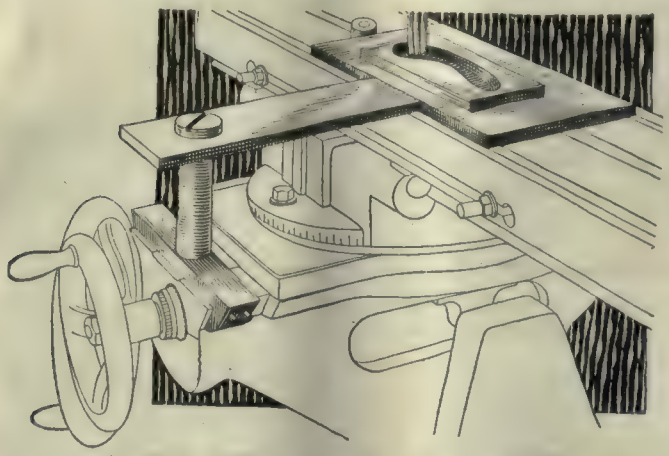
Cutting Large Radius Curves on a Milling Machine

By John Chip

On page 32 of the *American Machinist*, there was described a method of cutting the links for a marine engine on the slotting machine. Having work of like nature, I provided the bed of a milling machine with a tail or radius bar at right angles, and a proper center point of rotation on the knee block of a well-bedded shaping machine. Nor did I forget the heavy brace between the two machines.

Then I removed the crossfeed screw of the milling machine and found that the bed would travel in a perfect large radius circle. My gratification, however, died suddenly when I put on the vertical milling attachment and tried to cut a true curve.

For cutting links the idea might be all right, but where an absolutely true circle is required it is not to be recommended. The mill cut in too deep toward the end, due probably to a slight play which became very noticeable when the tail bar reached a decided angle. Another difficulty arose when trying to put back the cross screw on the milling machine. It was necessary to remove the entire knee and connections, as after



SIMPLE DEVICE FOR MILLING RADIUS

many trials, I was unable to replace the screw otherwise.

My conviction is that the described method is *not* a good one and I suggest simply laying a flat, well-greased plate on the milling-machine bed, connect it to a radius bar and let the bed of the milling machine move the plate along by pushing it with a roller vertically fastened to the bed. A curve of extreme accuracy can thus be cut at a small fraction of the cost and trouble of the previously described method. The sketch indicates how I would do it.

Making Difficult Duplicate Gages

By B. A. Munson

On page 162 of the *American Machinist*, E. A. Dixie gives his solution of the problem of making duplicate gages, the principal dimension of which was to be taken

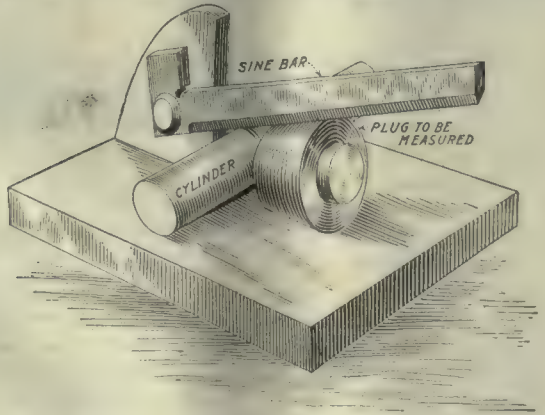


FIG. 1. MEASURING THE MASTER PLUG WITH A SINE BAR

at the intersection of a cone and a plane surface. The difficulty of securing this measurement was greatly augmented by the fact that the metal at this point of intersection was cut away to provide clearance for a grinding wheel.

Mr. Dixie's solution was to make a master gage by grinding the outside of a cylindrical piece to the exact diameter of the required circle, and at the same setting to grind it internally to the angle of the cone until one end of the piece was brought to a sharp edge. A ring, accurately ground to fit over the cylindrical piece, was then laid on a surface plate, the piece entered in the hole and pushed down until the sharp edge came in contact with the plate; the ring having been warmed somewhat to permit this.

This gage had in my estimation two serious defects:

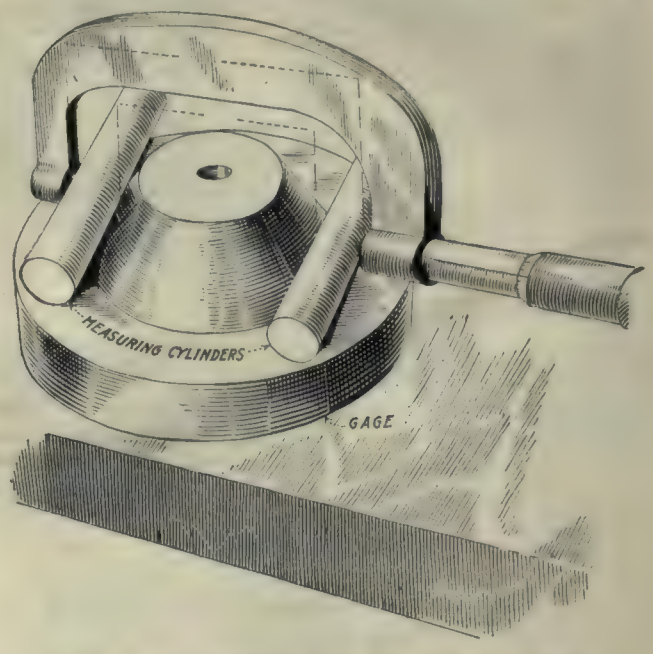


FIG. 2. MEASURING THE GAGE WITH WIRES

(1) The uncertainty of any measurement dependent upon an absolutely sharp edge, especially when the limit of error is to the fourth decimal place; and (2) it depended upon what Mr. Dixie called a "very light shrink fit" (between the ring and the cylindrical piece) to maintain its accuracy.

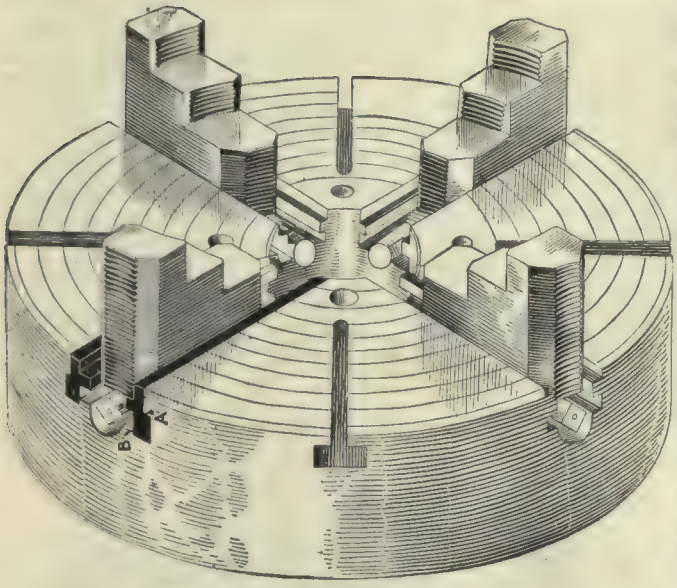
A better way to make the master gage would have been to make a taper plug, gaging it with a cylinder and sine bar as shown in Fig. 1, and then setting the plug into a base. Another way would be to make the first piece, gaging it as shown in Fig. 2, and then make the master gage to it, using prussian blue in the manner described by Mr. Dixie.

Repairing a Broken Chuck

By Frank Ervin

The snagging of a cutoff tool under a heavy cut was the cause of a jaw being broken out of a 22-in. four-jawed independent chuck, the cast iron breaking out from the face of the chuck, allowing the jaw to fall out. As it was impossible to obtain a new chuck at the time this happened, we decided to repair the break, the work being accomplished as shown by the sketch.

Two pieces of steel were planed to the shape indicated and the chuck planed out so that they would drive in. The strain to which these pieces are subjected when the chuck is in use is all borne by the shoulders *A* and *B* so that no additional means of securing the inserts was necessary beyond driving them to place.



REPAIRING A BROKEN CHUCK

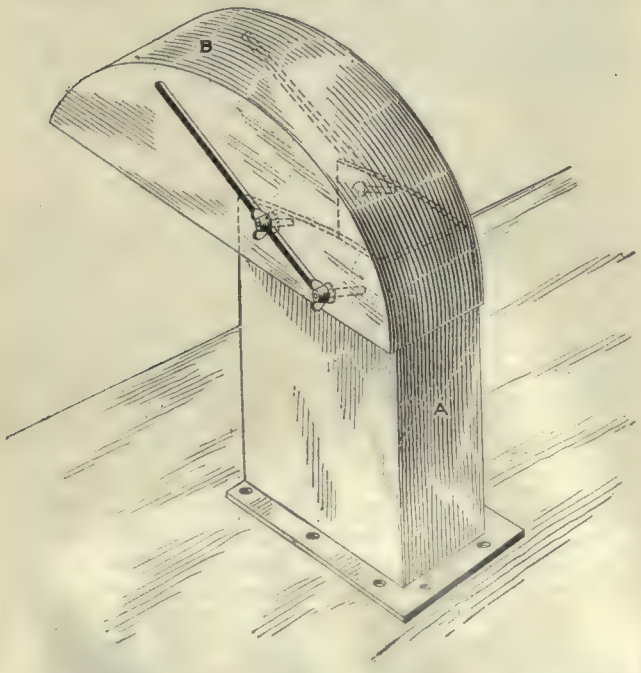
The work was done on a shaping machine, and though it involved some close measurements, it was accomplished successfully, the jaw fitting into the new channel as nicely as in the old one. The repaired chuck has been in service for nearly a year upon the heaviest class of work of which it is capable and shows no sign of distress.

A Guard For Grinding Wheels

By D. Molony

A simple and easily made guard for grinding wheels is shown in the sketch, which clearly indicates the manner of construction. The material may be galvanized sheet iron of suitable gage.

The part *A* is stationary, being attached to the bench by screws through the flange, and covers the back of the wheel. The adjustable cover *B* is attached to this stationary part by means of small bolts fitted with wing nuts extending through slots cut in both parts.



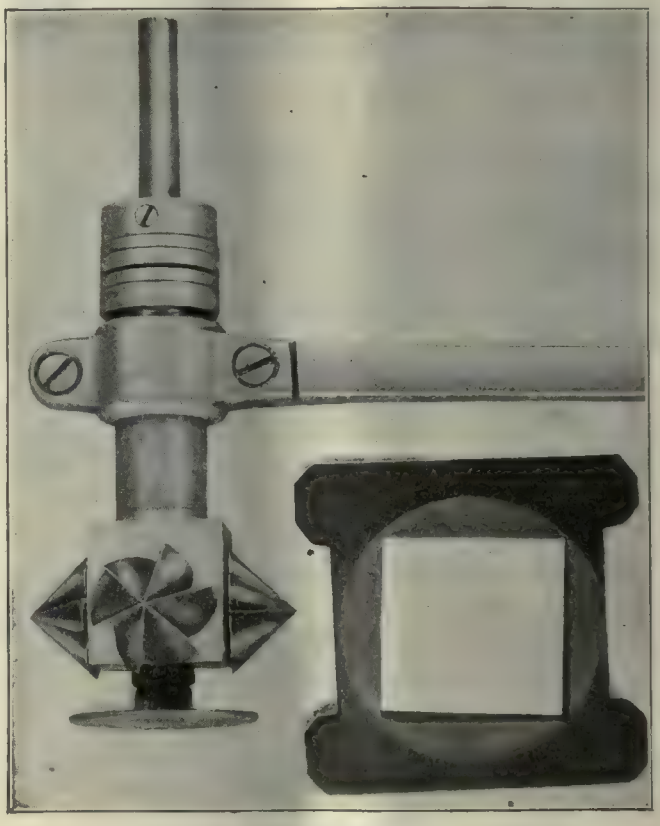
SHEET-METAL GUARD FOR GRINDING WHEEL

The cover has a long slot on each side extending forward at an angle while a shorter slot at an opposing angle is cut in each side of part *A*, thus part *B* may be adjusted forward and back, up and down, or tilted to any desired angle to cover wheels of any diameter within its range.

A Boring Tool for Polygonal Holes

By K. H. Condit

C. H. Schmidgall of Peoria, Ill., has designed and built the illustrated tool for boring holes of other than circular outline in wood, marble or metal. The model shown cuts a square hole in iron as illustrated and has four cutters. It is first necessary to drill or bore a round hole of the same diameter as the pilot or guide shown below the cutters. The tool can then be mounted in a drilling machine and held by means of the handle,



A BORING TOOL FOR SQUARE HOLES

part of which appears in the cut. The cutters are operated by bevel gears of substantial construction. Particular care has been taken to provide ample bearing surfaces for the gear spindles and the inventor attributes much of the success of the device to this feature.

This cutter will work equally well in marble, passing through a 1¼-in. piece in about four minutes. The model used for cutting wood varies from the other in that it has a vertical pilot cutter in place of the plain pilot, and a modified form of cutter to suit the different working conditions. This obviates the necessity of making a round hole and permits the job to be done in one operation. The arrangement and shape of the cutters may be modified to produce various shapes of holes.

Convention of Drop Forge Associations

IN ACCORDANCE with their annual custom, the American Drop Forge Association and the Drop Forge Supply Association met in joint convention at Pittsburgh, Penn., June 12, 13 and 14, 1919. A lengthy program of papers and discussions had been prepared for the meeting which emphasized, in its way, the growing importance which this industry is yearly attaining in the manufacturing field.

The officers of the Drop Forge Association were all reëlected to serve for another year and consist of the following: President, E. J. Frost, Frost Gear and Forge Co., Jackson, Mich.; vice president, J. F. Connelly, Champion Machine and Forging Co., Cleveland, Ohio; secretary, A. W. Peterson, American Drop Forger, Pittsburgh, Penn.; treasurer, E. B. Horne, Packard Motor Car Co., Detroit, Mich.

The business sessions which were conducted by the Drop Forge Supply Association were not of lengthy duration, and after the disposal of a small amount of routine business the general officers were all reëlected to serve for another year, and will be as follows: President, H. N. Taylor, N. and G. Taylor Co., Philadelphia, Penn.; vice president, Charles Harmon, Jr., National Machinery Co., Tiffin, Ohio; secretary-treasurer, A. L. Wurster, Sizer Forge Co., Philadelphia, Penn. The two new members added to the executive committee are: I. N. Schlendorf, Central Steel Co., Massillon, Ohio, and Alexander MacInnes, Hammond Steel Co., Syracuse, N. Y.

In his opening address the president, E. J. Frost, of the Frost Gear and Forge Co., included the following remarks:

The past year has been one of grave responsibilities and has called for unusually strenuous endeavor on the part of some, if not all our members.

Disposal of Government work on hand, both finished and partly completed, together with the absorption, re-sale, or turning back to the Government of raw stocks, was no easy matter, and incapable of expeditious handling; and, added to this the discomfiture of waiting for months to have adjustments made and claims allowed, followed by other periods of grim waiting for cash to replenish badly depleted working capital, put new furrows in the brows of some of you, that even a fishing trip to the incomparable trout streams of Michigan could not remove.

To my mind, the subject of standardization presents, perhaps, the greatest opportunity for elimination of waste and stopping of undesirable conditions, sometimes deliberately imposed by our customers.

Standardized proposal and contract forms could be adopted by the association, so drawn as to allow latitude to cover the varied requirements of the entire membership.

I have no thought of controlling prices, for I doubt if this would be practical even if legal, but undoubtedly some unfair practices can be stopped by concerted action and definitions made and rules laid down that will eliminate much friction, waste and worry.

Such items as the following could well be subjects for consideration and possible adoption: Terms of payment; responsibility for delivery; methods of settling disputes over mechanical defects; forger's responsibility when using steel furnished by the customer; a proper charge for handling steel furnished by the customer; questions arising from customer's impaired credit; consequential damages; patent liability, and who pays the transportation on rejected goods, etc.

Mechanical standardization will be of untold benefit to our membership if it does nothing but define limits of accuracy on various types of work and outlines acceptable methods of inspection.

It should be borne in mind that the establishing of standard limits is not a function of the inspector, the work of the inspection committee being to define acceptable ways of determining whether agreed upon or defined shapes, drafts or limits have been adhered to.

In order not to make the work too burdensome to the few, the labor involved could be divided by having subcommittees covering separate subjects.

Another subject worthy of our attention, and perhaps warranting a committee, is industrial relationship, looking toward the cutting down of labor turnover and the systematic making of new help to meet the demands of an ever-widening industry.

In view of the tremendous increase in equipment to meet the war needs, it undoubtedly would be to our advantage to be studying new avenues of outlet for our augmented capacity, rather than ruthless cutting of prices, to keep our men and hammers going. New industries are continually being started, and a campaign of education might reasonably be expected to bring worth while returns in profits from hitherto untouched sources.

Return of the Soldiers

Most of us have service flags hanging in our offices or shops, some of them bearing stars of gold, in token of those who not only gave up good positions and comfortable homes to receive small pay and undergo the hardships and privations that are the inevitable concomitant of war, but laid down their lives, that national selfishness and sordid greed and lust and ruthless destruction of property, and inhuman, bestial conduct toward womankind should not only be stopped now, but be put forever in a leash that cannot be broken.

There is an incessant stream of the boys in khaki who are coming home, many broken in body and health and possibly in spirit, most of them passing in sight of that emblametic hand on Bedloe's Island, reaching out to them the torch that symbolizes liberty and enlightenment and a "square deal," and we surely will be remiss as American citizens and employers of workers, if we do not go far beyond the limits ordinarily set by business, and not only give them employment, but be patient with them while they slowly bridge the gulf that lies between what war has made them, and the redemption, that, through us and others like us, all over the country, may come to them.

Col. H. P. Bope, Pittsburgh, made one of the leading addresses upon the "Present Status of the Iron and Steel Situation, With Special Reference to the Forging Industry." He sounded a note of optimism for the metal industries and for the nation's business as a whole, but warned his audience not to expect much in the line of reductions in the cost of raw materials, which will be held near their present levels largely by the present high cost of production.

"The Low-Pressure Exhaust Steam Turbine," with its peculiar adaptabilities to the production of considerable quantities of power from the waste gases of the furnaces and exhaust steam from steam hammers, was discussed by an interesting technical paper presented by H. V. Schoepflin of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

W. C. Peterson of the Packard Motor Car Co., Detroit, Mich., presented a paper entitled "Heat-Treating Problems That Originate in the Forge Shop," which read as follows:

There can be no doubt that all of us have, during the last three or four years, experienced wonderful developments in the art of making good forgings.

I am sure that all of us will further agree that we are surprised, generally speaking, at the results of good forging, plus good heat-treating. The war program just ended brought more grief to these two branches of the making

of munitions than all the other branches put together. We have all had our own personal experiences, perhaps, and it is the purpose of this paper to summarize and picture as a whole those irregularities which were found in the finished product, and were traced to bad forgings. By "bad," we do not wish to mean arbitrarily "bad," but bad in a comparative sense when weighing the ultimate answer.

First, we can classify our forgings into two distinct kinds, namely: Those which are subsequently to be machined and carbonized, and those which are subjected to heat-treatment after forging.

Of the first class there particularly is one phase to consider and that is that the carburizing or cementation of steel is daily receiving more and more attention as a result of increased demands made upon the art. The very nature of the process calls for a very scrutinizing control of the raw material from its making in the steel mill until it is ready to machine after forging. This control calls for particular attention to the presence of surface slag, which is the worst enemy of the carburizing process, and which accentuates its presence by tremendous growth under heat in carburizing material. Small areas of slag and oxide become very much larger during the cementation process, and produce much irregularity in hardness of the finished product, which, of course, is undesirable.

Careful investigation into the trouble experienced on carburized parts show us the following:

That this oxide appears to be buried in some classes of drawn and rolled bars, as well as forgings, extending from the surface toward the center of the part, and can be likened to a sort of pit, with considerable depth at times.

These pit marks of oxide, as I will call them, seem to increase considerably in size upon carburizing and have been found to be the nucleus, so to speak, for scale formations on the part when subsequently heated and quenched for hardening.

Under these scale formations we find soft spots rendering the cemented part unfit for use in abrasive or wearing service.

Observation points out that these oxide pockets on the surface of bars and forgings are not always due to faulty steel, and do not penetrate very far into the part. By taking a very thin layer off the part so affected, it will be found that the machined surface is entirely free from scale or soft spots, while the untouched portion of the part will be the opposite. Investigating further, and applying the investigation particularly to forgings, we come to the conclusion that dirty forgings are the cause thereof. Scale formed by the contact of the air with the hot forging, if not constantly blown off, will be actually buried in the surface of the forging to a depth which does not permit its removal by machining under ordinary conditions.

Effect of Buried Scale

In these days when it is required to forge parts which shall be within $\frac{1}{16}$ in. of machining size, you readily realize that to bury scale in the forgings is not the best practice, and should be avoided by making clean forgings. It may be opportune to state that it was found this oxide deposit in forgings was more pronounced in some steels than others and is accounted for perhaps by the fact that some steels scale more than others.

Of the second class of forgings much can be said, but I intend rather to touch only on the most vitally important points. I believe many, if not all of you, will agree that the ultimate cost of a part is of prime importance today. This not necessarily means cost in dollars and cents, but quality as well. There is one phase in the manufacture of parts from forgings which plays a very great part in the ultimate cost, and this is the distortion of parts in heat-treating and hardening. When such parts do distort, it is always necessary to apply remedies such as straightening in the one instance, and further machining or fitting in the other. The former operation interferes considerably with the quality of the forging, while the latter usually draws the attention of the management from the standpoint of cost in dollars and cents.

To straighten a forging after heat-treatment means a decrease in the clastic limit, and just how much it is quite difficult to determine. Therefore, the metallurgist who has arranged heat-treatments to meet the demands in physical properties which the engineer has imposed, is laboring under a false conception as to results obtained. Also in straightening, strains are sometimes concentrated in certain parts of a forging which are very often the sole cause for serious failures. Straightening, therefore, should be avoided if possible, for the several good reasons pointed out above.

But what has this to do with forging, you ask?

An explanation will be attempted, by citing actual occurrences and a close observation thereof. After several years' study as to the cause and subsequent cure for the distortion of steel parts during heat-treatment, I believed I had sufficient knowledge on the subject to make general applications. But to my dismay at the time, my results varied and it became necessary to seek the disturber. The test in question related to the hardening of a certain type of gear.

Effects of Forging Methods

Batches of a hundred at a time were put through this heat-treating process until finally we were able to send them from the hardening room with little or no distortion. This continued for some time until finally a batch came through which were distorted in the same percentage as we had been getting good gears before. Careful checking of the hardening process, such as temperatures, rate of treating, method of cooling, etc., revealed nothing, and we thereupon visited the forge shop. Here records showed that all gears made prior to the incident of the distorted batch came from one particular hammer operated always by the same workman. He had apparently taken no particular pains to standardize his time of heating or hammer blows, yet, nevertheless, his gears gave uniform results as regards percentage of distorted gears. The bad batch of gears came from another operator working at a different hammer and who likewise did not have, to all appearances, any set rule for doing this or that. Yet, the change in operator was evidenced at the hardening room, and disturbed both the quality and quantity of gears produced considerably. And, in passing, let me be understood in saying that the quality of work done at the hammer by the second workman was equally as good as that of the first, and that by altering our heat-treating process somewhat, we were able to harden his batch of gears with the same accuracy as the previous batch.

Here, then, we have a picture, which in my opinion is worthy of consideration. Without any pretext on the part of the hammerman to standardize the making of his forgings, he unconsciously rendered them to the heat-treating plant in a fairly uniform condition because of the very continuity and repetition of the operations in forging. Another operator could not obviously produce forgings with the same characteristics, and as a result we would have as many different kinds of conditions metallurgically in gears as there were different operators, provided no attempt had been made to standardize the forging process from its several angles.

Such standardization, however, I predict must come, and is already here in some instances, because drop-forging steel parts today is vastly different than at the time this society was started. The drop-forger should sit in seance with the heat-treater and hardener, not to listen so much to the story of bad forgings, but to familiarize himself with the problems which confront the hardening room, which can be quickly remedied by clearly understanding the causes thereof.

It was my good fortune to witness during the war program the heat-treating of a certain engine part which demanded very close limitations as regards physical properties, and consequently, therefore, needed the closest attention in heat-treating. These forgings came from three different sources, and were made from steel coming from one mill. In fact, two of these sources made the same forgings from the same mill heat of steel. When delivered to the heat-treating department, it was found that a certain

percentage of each lot of forgings needed a second drawback in order that they conform to the required specification, and for your information I cite these figures: Lot No. 1, 58 per cent. redrawn; lot No. 2, 20 per cent. redrawn, and lot No. 3, 2 per cent. redrawn.

In no lot was a burnt forging found, although in lot No. 1 several slightly overheated forgings were present. This is but another instance of where different results in heat-treating were evidenced, due to the difference in the methods of forging.

In all well-regulated heat-treating plants, parts are checked and inspected for hardness by means of either the scleroscope or Brinnell machine. The scleroscope is preferred in most instances on account of the comparative ease in operation, and can be quite safely relied upon if proper standardization and comparison has been made in each kind of steel. It is in the use of the scleroscope, then, that we discover at least one serious irregularity which is traced directly to the forge plant, and it is that of decarburization. Parts decarburized show a lower reading on the scleroscope and cannot be correctly inspected, which in turn means rejection or failure.

Effects of Oxidizing Flame

Decarburization of forgings is caused, no doubt, by the application of a very "hard" oxidizing flame to the forging furnace, which when continued for any length of time changes the structure of the surface of the steel by diminishing the carbon content. These de-carburized areas will not respond to a treatment intended for the original steel, and cause irregularities which are uncertain and dangerous. The precaution, then, in observing the correct kind of flame in treating forgings adds to our list for the making of good forgings, and the heat-treating plant, I am sure, will susbtantiate my assertions in this respect.

In closing, we would summarize the several points brought out. Standardization of operations in forging, the application of the correct kind of flame, and clean forgings make for an ultimately better product.

In many production systems the bonus plan is applied only to the producers, and all of the auxiliary workers of the plant are outside of its benefits and not interested in the best developments to attain efficiency. However, in the forging plant of the Timken-Detroit Axle Co., Detroit, Mich., the bonus system has been arranged so that all are directly benefited, from the top man to the most lowly worker. L. K. Wilson of this company presented the following paper entitled "A Bonus Plan as Applied to an Entire Forge Plant," explaining the methods by which this object has been attained:

A well-known psychologist has made the statement of a fact that "when wages are based on commission, piece-work, or a bonus or premium system, the stimulus to action is constantly present. Every stroke of the hammer, every sale made, every figure added increases the wages. The wage thus continuously beckons the worker to greater accomplishment." Another eminent efficiency engineer states that "in order to find and take the best, easiest and quickest ways to the desirable things of life, we must use the thirteen principles of efficiency, which are records, plans, schedules, dispatching, standard conditions, standard operations, standard instructions, ideals, common sense, discipline, competent counsel, fair deal and rewards."

Thus we could go on and quote passages from many volumes which have been written in recent years setting forth the advantages of certain methods of increasing the efficiency of men, departments, shops and nations. Employers of labor have therefore realized the necessity for and advantage to be gained by installing some of the methods so presented, whereby their workers will receive something in addition to their wages for the conscientious effort.

No doubt we all feel that the terms, "scientific management," "industrial efficiency," "individual effort," have been greatly overworked, that they have been magnified, enlarged and misconstrued until they are beyond the comprehension of the average human being on whom they are ultimately tried out, so that the real honest good that might be accomplished is lost on account of the complication. I do not believe that there is any one plan which would be absolutely adaptable to more than one plant. Take our own business for an example—I do not believe it possible to find any two forge shops where conditions are identical even though we have many things in common, but I do believe, however, that the forging industry offers a splendid opportunity for the accomplishment of many gratifying results, through the medium of some plan; not from the standpoint that they are any more inefficient than any other industries and it would be an easy matter to show results, but from the standpoint of the nature of the work being usually regular, simple as to number of operations, but more especially the type of men employed in forge shops are such that if you once gain their confidence and they see that your plan is good and that they will get a square deal, there is no question but that their coöperation and interest will be secured and held and results accomplished satisfactorily.

Nearly two years ago a bonus plan was adopted at the Timken-Detroit Axle's forge plant whereby every employee connected with the organization, regardless of position, would share in the bonus earnings in proportion to their wages. There is no question but that this plan has produced satisfactory results, and we therefore consider it good enough to pass on to others whose conditions are somewhat similar to ours and who may be willing to take up a proposition of this kind after someone else has tried it out and overcome the difficulties.

Our plan briefly was based on two principal factors, production and costs, the unit being cost per pound for which a standard cost has been determined, and it is on the relation of actual cost to the standard cost that bonus is paid. If the actual cost exceeds the standard cost, but little bonus is paid. If the actual cost is less or equal to the standard cost, then considerable bonus is paid.

Standard Costs

A standard has been defined as "that which is established by investigation or authority as a reasonably attainable maximum of desirability." For the purpose of illustrating our plan, we will use a figure of 12c. per pound as standard. Bonus is paid according to the per cent. of efficiency attained, by dividing this standard cost per pound by the actual cost per pound, six months' average, determined by the accounting department, and which includes all items of expense such as coal, fuel oil, supplies, repair parts, steel, direct labor, indirect labor, including all supervision and bonuses and scrap charges, if there are any. Assuming the six months' average cost per pound has been found to be 12.5c., then the per cent. of efficiency would be 12c. divided by 12.5c., equaling 96 per cent., which would pay 16 per cent. bonus. For further illustration, let us assume an actual cost of 11.5c., then the per cent. of efficiency would be 104.3 per cent. which would pay a bonus of 24.5 per cent.

It might appear that a payment of 24.5 per cent. bonus or extra wages is high and prohibitive, yet a careful analysis of records will show that such is not the condition. First, we must consider that bonus is paid on wages alone, while the saving is made on all expenses. Suppose a plant turned out 1000 tons of forgings in a month and made a saving of 1c. a pound over any other previous six months' or year's record, then the total saving would represent $20,000. This saving would pay 40 per cent. bonus on $50,000 wages.

However, it should be admitted in justice to all concerned that the success of any bonus plan depends wholly upon the accuracy and dependability of the standard. By all means it must be accurate. If it is too tight or not reasonably attainable, the incentive for extra effort or interest in stopping leaks and losses is lost, and after a few weeks of conscientious effort the worker gives up in despair and says, "Oh, what's the use." On the other hand, if the standard is too liberal and a lot of bonus is made with little effort, the whole thing will be a failure and not only

will the company pay for something and get nothing in return, but the spirit of the chase is lacking, or, commonly speaking, it is "pretty soft." When the standard is right, then you have an entire organization working as a unit, where everyone has an actual interest in everything that enters into the plan, instead of lack of interest as is sometimes prevalent in some organizations.

We all know that in a forge shop there are but a few producers, compared with the total number employed, considering hammermen and helpers as the only producers. I believe that the average is about one to three; that is, including foremen, die sinkers, machinists, repairmen, electricians, plumbers, millwrights, engineers, firemen, clerks, inspectors, steel yardmen, laborers, etc., there are three and in many plants four or five such men for each producer. Therefore give a hammerman three or more enthusiastic, interested, efficient and willing partners, whose efforts are directed in the same channels and for whom rewards for extra effort are equal, and there is no reason why production should not be increased quite materially and the unit cost reduced in a like manner.

The following is a formula used in computing this bonus: Let A = the number pounds of good forgings; B = the cost of fuel oil (gallons times standard per gallon); C = the cost of coal (tons times standard per ton); D = the cost of steel (pounds times standard per pound); E = the total direct labor; F = the total indirect labor; G = the charge for scrap made; H = the cost of supplies needed; J = the credit for sale of flashings, scrap, etc.; X = the actual cost per pound; Z = the per cent. of efficiency; and Y = the standard cost per pound.

Then $B + C + D + E + F + G + H - J = X$

$$\text{and } \frac{Y}{X} = Z$$

An explanation of items B, C and D may be in order, that it may be understood why a standard or permanent cost is used rather than the actual or fluctuating cost. It must be acknowledged that under ordinary circumstances any group of workmen cannot control or have any influence upon what price is paid for coal, oil and steel. They can, however, have a great effect upon the use of these same commodities; therefore, in justice to them, it becomes necessary to set a fixed price for these articles whereby their earnings will only be subject to quantities used and not be affected by what has been of late a more or less fluctuating market. It has also been found far better to compute the bonus on a six months' basis than month by month. On the basis of each month separate there is apt to be an unusually good month with large production and low costs and a large bonus would be paid; the following month conditions may be just the reverse and little bonus paid. At the end of the two months perhaps the total amount paid would have been the same either way, but the more regular these payments are the better men can adjust their affairs and learn to depend on a fixed amount each month.

It is a good plan to keep the men informed as far as possible what progress is being made day by day, and to accomplish this we designed a large sign board.

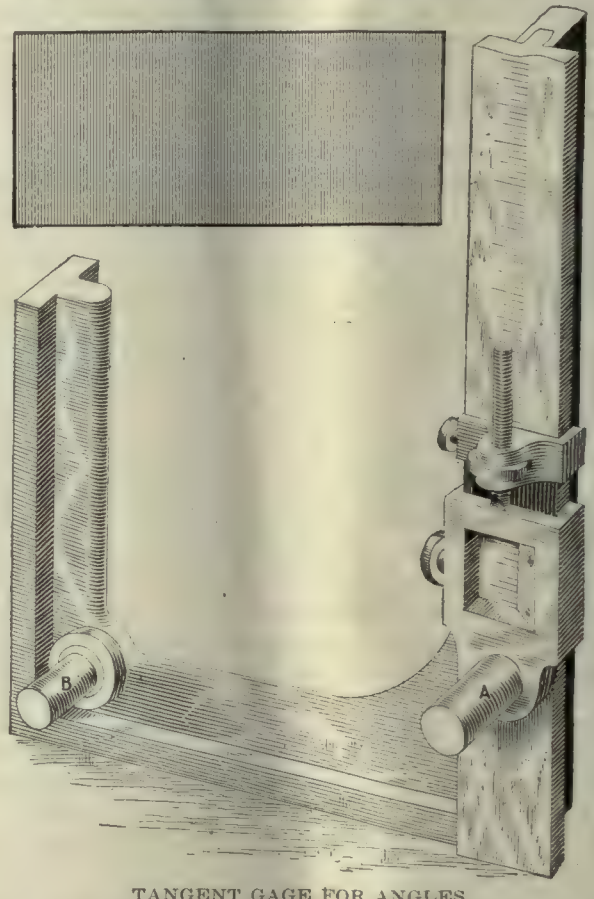
This sign is 10 ft. high by 30 ft. wide, the upper portion being divided into 31 sections, numbered from one to 31, representing the days of the month. In each section is pasted a figure representing a standard tonnage for the day, continuing for each working day in the month. Upon the sign a few slogans, such as "Efficiency Bonus Depends on Cost," "Everybody Can Help," "Do Not Waste Anything." At one end of the sign is painted a large money bag and and at the other end the figure of a workman. A long chute or slide connects the open money bag with the workman's pocket, down which wonderfully real gold pieces are rolling. Unfortunately, however, all the gold does not reach the pocket of the workman, as a lot of it leaks out at the coal pile, some more at a furnace and still some more at a scrap pile, so that a comparatively small amount remains to enter the pocket of the workman. It is these leaks that should be stopped, and it gives me pleasure to state that I know of no better way to stop them than to have the assistance and coöperation of your men. Upon a bulletin board the actual accumulated tonnage to date is posted, which may be compared with the standard for the same period, and which gives every one reliable information as to how production is comparing with what was put up as a standard for the same period.

Tangent Gage for Measuring Angles

JOHN T. CLARK

The sketch accompanying this letter shows an angle gage in which the angle is measured by its tangent instead of the sine.

The body or frame of the gage is a casting or forging, two sides of which are carefully machined to form an angle of 90 deg. while the third side carries a ver-

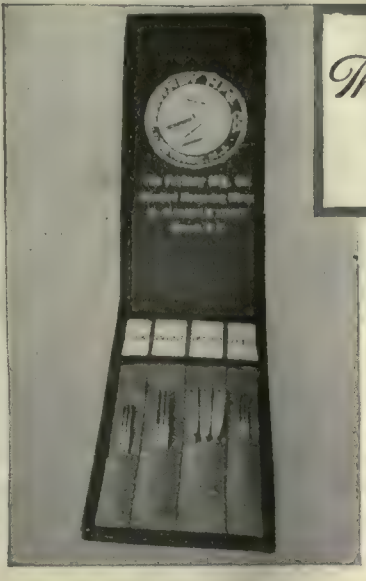


TANGENT GAGE FOR ANGLES

nier scale parallel to the first side. A slide on this scale carries the vernier and also the measuring stud A. The stud B is forced into a hole bored near the corner of the frame. The graduations of the scale are so arranged that when the vernier reads zero the studs A and B are equidistant from the bottom surface of the frame and, of course, square with its other side.

The center distance between the plugs in this position should be an even number of inches to facilitate computation. Assuming this distance to be 5 in., which makes the tool a convenient size, and that we desire to set it to an angle of 36 deg. 10 min., we find from a table that the tangent of this angle is 0.731 which multiplied by 5 equals 3.655 in. and the setting of the vernier to this measurement is all that is required.

The vernier scale will need to be graduated only to a length equal to the center distance of the plugs as the tangent of 45 deg. is 1 and for all angles above 45 deg. the other face of the square is used and the angle computed from its complement.



The Manufacture of Measuring Wires

By
E. A. Suverkrop,
ASSOCIATE EDITOR, AMERICAN MACHINIST



Wires for measuring the diameters of thread gages are merely plug gages of small size and extreme accuracy. While some of the manufacturers of plug gages guarantee their product to be within one-tenth of a thousandth of an inch in size, there should be less than one one-hundred-thousandth of an inch difference between the diameters of the three wires of a set.



FIG. 1. STRAIGHTENING THE ANNEALED WIRES

MEASURING wires from 0.007 in. to 0.020 in. diameter are made from high-carbon music wire, which comes in coils. The larger sizes up to 0.495 in. (for measuring two-pitch threads) come in the form of drill rods. The first operation is cutting to length. This is done on an ordinary wire cutter. Varying with the diameter the lengths are 1½ to 3 in. After cutting, the blanks are packed in charcoal in a pipe and carefully annealed, the charcoal preventing decarbonization. The smaller annealed wires are straightened in the small polishing head shown in Fig. 1. The wire is chucked and the operator grasps it between his thumb and the straightener, which is a piece of steel of the approximate shape and dimensions shown in Fig. 2.

The wires are then reduced on the ends; the ends of the small ones, by holding them in the chuck in small polishing heads similar to that shown in Fig. 1 and allowing them to rotate rapidly between two smooth files, and the ends of the larger ones, in the bench lathe with a box tool. Some styles of the wires have holes in the ends to facilitate holding them in the gage-measuring fixtures. These holes are drilled in a sensitive drilling machine with the aid of a jig. The wires are next hardened a number at a time in the gas furnace shown in Fig. 3. The wires are packed in short pieces of pipe to prevent oxidation, heated to about 1400 deg. F. and quenched in raw linseed oil. The ends are cleaned in the polishing head, after which the ends only

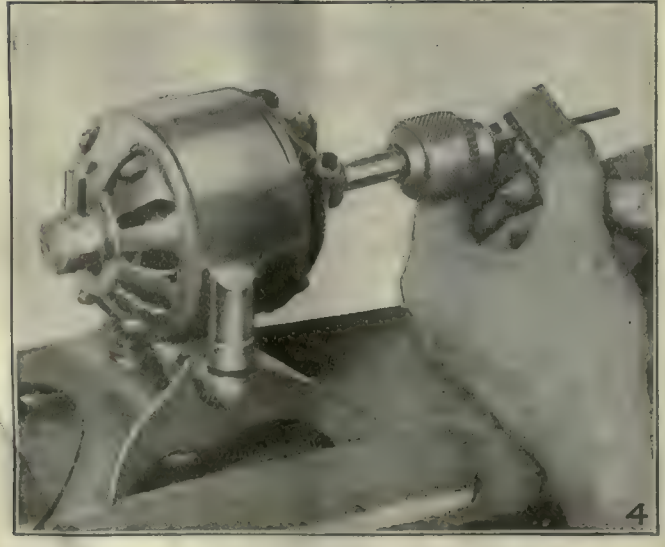


FIG. 4. ROUGH-LAPPING THE WIRES

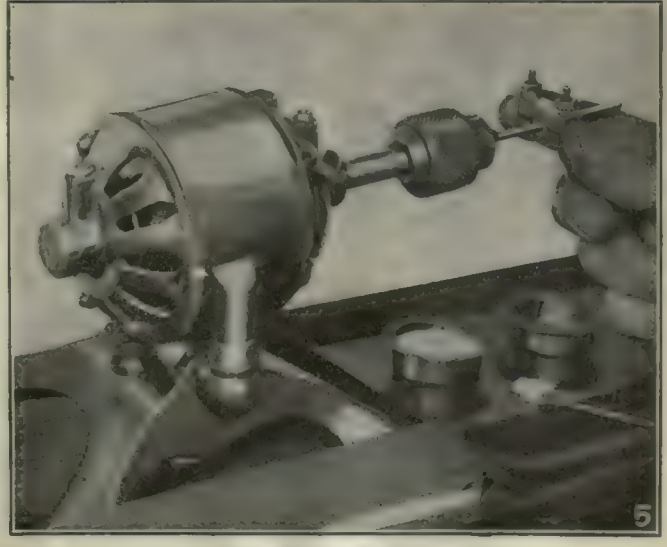


FIG. 5. FINISH-LAPPING THE WIRES

are drawn to a blue with the blowpipe shown in Fig. 3.

Lapping is performed with the aid of a number of small sewing-machine motors similar to the one shown in Fig. 4. Here the operator is rough-lapping with a pair of carborundum oilstones held in his hands. The rough wires are left about 0.003 in. over size, and in the rough-lapping operation are brought to within 0.0003 in. or so of finished size.

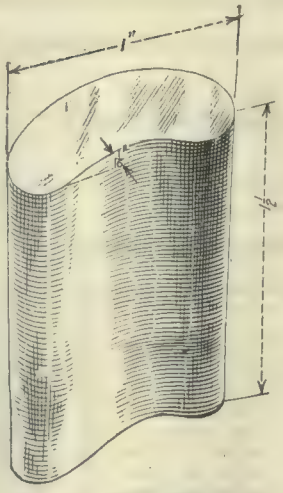


FIG. 2. THE STRAIGHTENER

Finish-lapping is also done on the sewing-machine motor as shown in Fig. 5. The laps are made of cast iron and charged with 60-min. carborundum. The finish-lapping is constantly checked with the aid of a micrometer, the operator comparing his micrometer with a master wire.

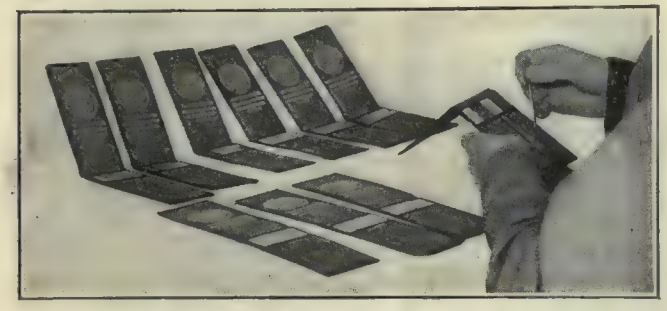


FIG. 7. PACKING THE WIRES

Final measuring of the wires is done with a Prestwich fluid gage, as shown in Fig. 6. This is of course merely an accurate comparator, and is also set by means of a master wire, one of which is shown in front of the machine. After careful checking and counter-checking of their sizes the wires are packed as shown in Fig. 7.

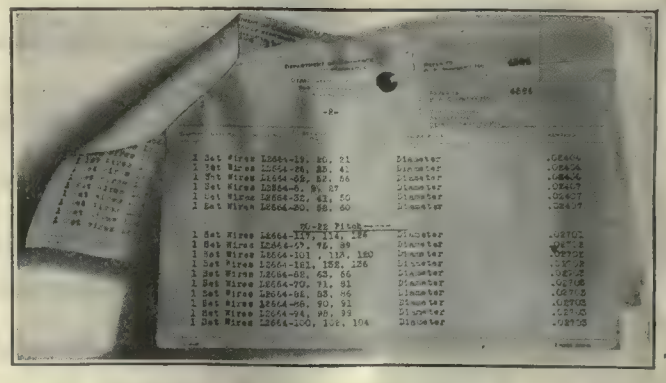


FIG. 8. BUREAU OF STANDARDS REPORT ON WIRES

After packing, all wires are sent to the Bureau of Standards, Washington, D. C., to be measured.

In Fig. 8 is shown a part of a report of the Bureau of Standards on a large shipment of wires submitted by the Fortney Manufacturing Co. Thousands of wires have been sent to the Bureau of Standards, but so far without a single rejection.

The Railway Supply Exhibition at Atlantic City

The exhibition of the Railway Supply Manufacturers' Association held at Atlantic City, N. J., June 18-25, in conjunction with meetings of other member sections of the American Railway Association was large and well attended.

The main exhibit was held on Young's Million Dollar

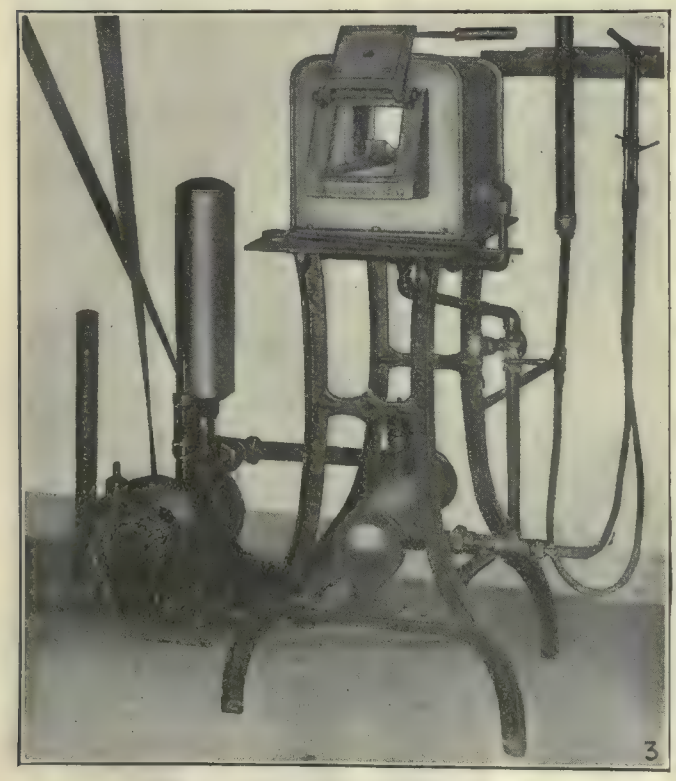


FIG. 3. THE HARDENING OUTFIT



FIG. 6. MEASURING THE WIRES

Pier, but a number of firms were not able to obtain space there and had to install their products on side streets under tents or sheds.

The machine-tool section of the show was the main attraction, as usual, and a number of firms disclosed their newest productions for the first time.

The machine-tool builders having space either on the pier or nearby were:

Acme Machine Tool Co., Cincinnati, Ohio.
American Tool Works Co., Cincinnati, Ohio.
Besly & Co., Charles H., Chicago, Ill.
Blevney Machine Co., Greenfield, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Cincinnati Bickford Tool Co., Cincinnati, Ohio.
Cincinnati Grinder Co., Cincinnati, Ohio.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Cincinnati Pulley Machinery Co., Cincinnati, Ohio.
Davis Machine Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Machine Co., Grand Rapids, Mich.
Heald Machine Co., Worcester, Mass.
Landis Machine Co., Waynesboro, Penn.
LeBlond, R. K., Machine Tool Co., Cincinnati, Ohio.
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio
Lucas Machine Tool Co., Cleveland, Ohio.
Manning, Maxwell & Moore, Inc., New York, N. Y.
National Machinery Co., Tiffin, Ohio.
Newton Machine Tool Works, Inc., Philadelphia, Penn.
Niles-Bement-Pond Co., New York, N. Y.
Oakley Machine Tool Co., Cincinnati, Ohio.
Oesterlein Machine Co., Cincinnati, Ohio.
Pratt & Whitney Co., New York, N. Y.
Ryerson & Son, Jos. T., Chicago, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Swind Machinery Co., Philadelphia, Penn.
Warner & Swasey Co., Cleveland, Ohio.
Western Machine Tool Works, Holland, Mich.
Wilmarth & Morman Co., Grand Rapids, Mich.

Others of interest in our field were:

Air Reduction Co., Inc., New York, N. Y.
American Abrasive Metals Co., New York, N. Y.
American Rolling Mill Co., Middletown, Ohio.
Atkins & Co., E. C., Inc., Indianapolis, Ind.
Bastian-Blessing Co., Chicago, Ill.
Boss Nut Co., Chicago, Ill.
Bowser & Co., S. F., Inc., Fort Wayne, Ind.
Brewster Co., William, New York, N. Y.
Buckeye Steel Castings Co., Columbus, Ohio.
Buda Co., Chicago, Ill.
Cambria Steel Co., Philadelphia, Penn.
Carbic Manufacturing Co., Duluth, Minn.
Carborundum Co., Niagara Falls, N. Y.
Carnegie Steel Co., Pittsburgh, Penn.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Crucible Steel Co. of America, Pittsburgh, Penn.
Davis Boring Tool Co., St. Louis, Mo.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Duntley-Dayton Co., Chicago, Ill.
Edna Brass Manufacturing Co., Cincinnati, Ohio.
Electric Controller and Manufacturing Co., Newark, N. J.
Elwell-Parker Electric Co., New York, N. Y.
Foster, Walter H., Co., New York, N. Y.
General Electric Co., Schenectady, N. Y.
Gilbert & Barker Manufacturing Co., Springfield, Mass.
Greenfield Tap and Die Corp., Greenfield, Mass.
Grip Nut Co., Chicago, Ill.
Hyatt Roller Bearing Co., New York, N. Y.
Illinois Steel Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Industrial Truck Co., Holyoke, Mass.
Ingersoll-Rand Co., New York City.
Johns-Manville, H. W., Co., New York, N. Y.
Jones & Laughlin Steel Co., Pittsburgh, Penn.
Joyce-Cridland Co., Dayton, Ohio.
Keller Pneumatic Tool Co., Grand Haven, Mich.
Keystone Drop Forge Works, Chester, Penn.
Liberty Steel Products Co., Chicago, Ill.
Liberty Tool Co., Baltimore, Md.
Ludlum Steel Co., Watervliet, N. Y.
Lukenheimer Co., Cincinnati, Ohio.
Macleod Co., Cincinnati, Ohio.
Metal & Thermit Corp., New York City.
Midvale Steel and Ordnance Co., Philadelphia, Penn.
Milburn Co., Alexander, Baltimore, Md.
Napier Saw Works, Springfield, Mass.
Oxweld Railroad Service Co., Chicago, Ill.
Page Steel and Wire Co., New York, N. Y.
Reliance Electric and Engineering Co., Cleveland, Ohio.
Rich Tool Co., Chicago, Ill.
Rivet Cutting Gun Co., Cincinnati, Ohio.
Simonds Manufacturing Co., Fitchburg, Mass.
Watson-Stillman Co., Aldene, N. J.
Wilson Welder and Metals Co., Inc., New York, N. Y.
Yale & Towne Manufacturing Co., New York, N. Y.

A Patriarch Among Grinding Machines

By Fred Price

The article under the above heading that appeared in the *American Machinist* on page 1096 is interesting, especially the statement that within its limits it would no doubt set a good pace for the most modern of grinding machines.

Our modern toolmakers, many of whom require the latest machine tools and a tool crib full of all kinds of small tools to turn out work that will pass the inspector, will probably smile at the thought of a home-made grinding machine competing with a modern cylindrical machine; nevertheless, I recall that in the shop where I served my time, some forty-odd years ago, we used a toolpost grinding machine something like the one described in the article referred to for grinding plug gages and similar work.

The man who did most of the grinding on this machine was a mechanic of the old school who had to his credit fifty years of experience at the machinist's trade. In grinding plug gages he used a thin elastic wheel made of emery and allowed about 0.0002 in. for finishing by lapping. The work he turned out was in every way equal to similar work ground today on modern grinding machines.

I do not mean to say that the average present-day mechanic could do as well, because the present day toolmaker has lost much of what I call, for want of a better term, "artistic touch," "technique" or mechanical ability which the old timers were obliged to master in order to be able to do creditable work with the tools of forty years ago.

"Within the limits of the machine," however, I assert most emphatically that the old-school mechanic can take one of these home-made grinding machines, generally called toolpost grinding machines, and turn out work that will make some of the beardless toolmakers of the present day "sit up and take notice."

Moral—Although Grandpa's whiskers are long his hands have not lost their cunning.

Note

In the illustration on page 1046, showing special milling attachments, the one in the lower right hand corner should have been credited to the South Bend Lathe Works, South Bend, Ind.

The Detroit Spring Meeting of the



SPRING meeting is the term applied to the convention of 1180 members and guests of the American Society of Mechanical Engineers which met in Detroit at the Hotel Statler on June 16 and held forth for four days. Judging from the actions of the thermometer, "Summer Meeting" would have been a better term. As a result the attendance at the various technical sessions suffered whenever they were held at the same time as any side trip which had a boat ride connected with it. The size of the gathering was gratifying to the officers of the society and to the meetings committee, for it only fell a little short of the 1200 asked for in the preliminary announcements.

Simultaneous Meetings

The schedule of events illustrates the specialization and subdivision of the field of mechanical engineering. From the viewpoint of the man who hates to miss anything, the outlook was most discouraging, for in addition to at least two professional sessions going on at once there were usually four or five committee meetings and the business meeting, which began on Monday and pursued its devious course through various continuations and adjournments until the end of the conference. All this was in addition to two or three inspection trips.

Among the matters taken up in the business sessions was the question of changing the journal of the society "Mechanical Engineering" from a monthly to a weekly. This provoked discussion which threatened several times to become warmer than the weather. The change was finally voted down. From the standpoint of the hard-working mechanical engineer, who feels it his duty to wade through several professional and trade journals each week, this seems a sensible attitude. The fewer the appearances of the more technical of them, the more time will he have to devote to the business of living and getting acquainted with his family.

The Research Session

The research session program included four papers and several reports, and had to be continued into the afternoon. A discussion of the present condition of research work in the United States was presented by Prof. A. M. Greene, Jr., of Rensselaer Polytechnic Institute, who is also chairman of the research committee of the society. The work of the engineering division of the National Research Council was described by G. H. Clevenger of that body. "Organization and Conduct of an Industrial Laboratory" was the subject of the paper by A. D. Little and H. E. Howe, and "Research Work on Malleable Iron" was taken up by Enrique Touceda. The speakers made strong pleas for the extension of research work, not only the industrial or applied type which produces immediate and visible returns, but more particularly the purely scientific type upon which the future of the applied type largely depends. Announcement was made that research into the cutting speeds of metals was to be undertaken at once.

The industrial relations session was something of an innovation and at its close the chairman put the question to the members present as to whether the subject was of sufficient interest to be carried further in future meetings. The sense of the meeting was plainly indicated by the emphasis of the unanimous approval of continuation.

Arthur H. Young described in detail the introduction and workings of the committee system at the International Harvester plants, and L. P. Alford presented a paper on the "Status of Industrial Relation," which was very comprehensive. There was a large amount of discussion, the meat of which seemed to be the feeling that in view of the various "lemons" handed to the workingman in the past, it was essential to meet him more than half way in the future, lay the cards on the table and deal with absolute honesty as man to man. Nothing short of the whole truth would be likely to have any successful results.

The papers presented at the sessions on Wednesday and Thursday dealt with fuels, gas power, power plant and miscellaneous subjects of less interest to machinery men. The meeting ended on Thursday afternoon with trips to the Ford and Packard automobile factories.

The many ladies who accompanied their husbands and fathers were entertained by special automobile trips to the show places of Detroit and were kept so busy that there was little time left to investigate the offerings of the local shops. There may have been some method in this arrangement for even the most elastic expense accounts have certain limits.

The social side was well taken care of, the boat trip to the St. Clair Flats being especially appreciated because of the relief it offered from the heat of the city. In spite of the heat, dancing seemed to be the most popular diversion. It was noted that this was particularly true of those older members whose families had been rash enough to allow them to arrive unguarded. They made the most of their opportunities.

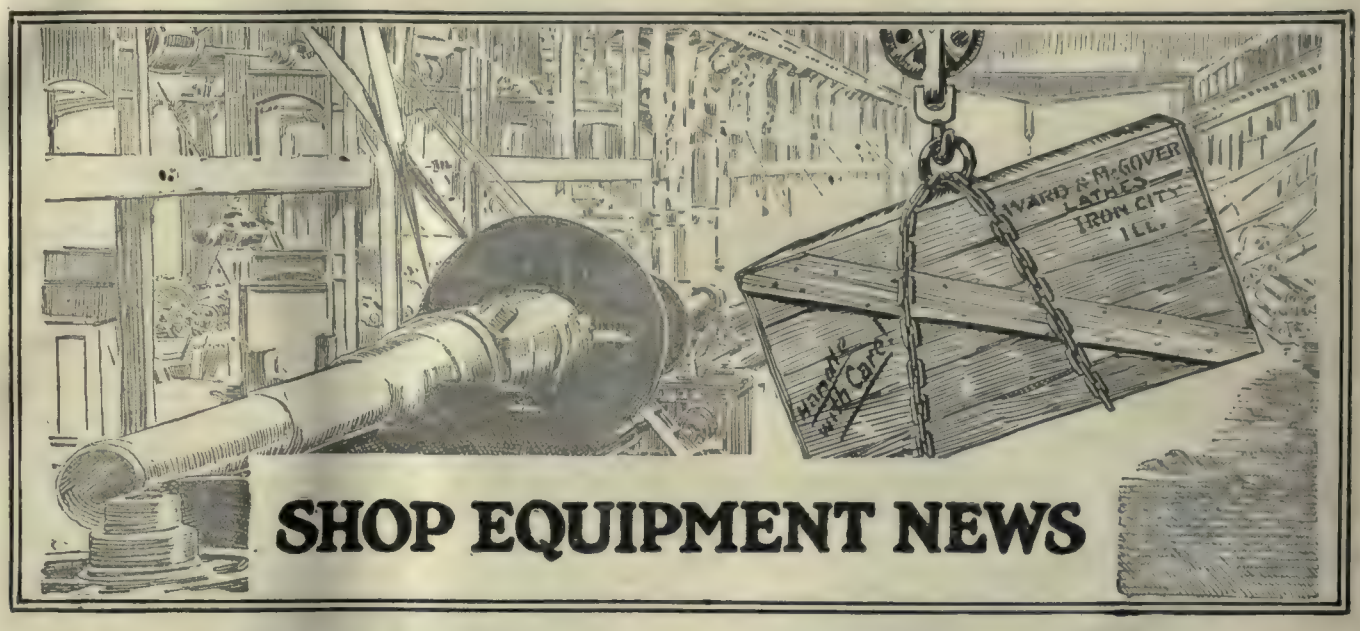
Schedule of Events

Monday, June 16—10 a.m.: Opening of headquarters; council meeting; meetings of committees; consult bulletin-board. 2 p.m.: Business meeting—reports of tellers of amendments to constitution, boiler code committee and committee on aims and organization. 8:30 p.m.: Address of welcome; reception and dance.

Tuesday, June 17—10 a.m.: Research session. 10:30 a.m.: Excursion to Burroughs Adding Machine Co.'s Works; all-day trip for the ladies to Belle Isle, Grosse Pointe and the Country Club. 12:30 p.m.: Luncheon for council and sections delegates. 2 p.m.: Industrial relations session. 2:30 p.m.: Trips to plants of Morgan and Wright Co. and Diamond Power Specialty Co. 8:30 p.m.: Musical entertainment, Arena Gardens, 1253 Woodward Ave.

Wednesday, June 18—10 a.m.: Sections session; gas-power session. 10:30 a.m.: Trip to Connors Creek plant of Detroit Edison Co. 2:30 p.m.: Steamboat trip through St. Clair Flats, afternoon and evening; dinner on boat.

Thursday, June 19—9:30 a.m.: Trip to the Ford Eagle plant. 10 a.m.: Fuel session; general session; special trips to various plants as desired by the visitors; during Thursday several trips for the ladies have been arranged. 2 p.m.: Trips to plants of Ford Motor Co. and Packard Motor Co.



SHOP EQUIPMENT NEWS

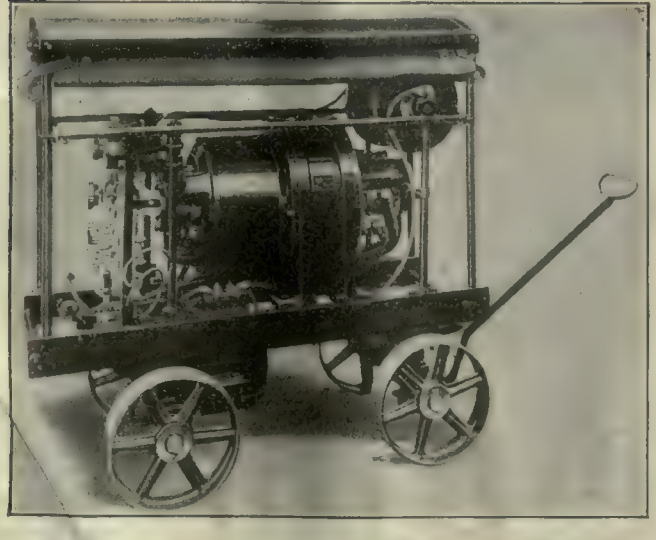
USL Electric Arc Welding Outfits

The U. S. Light and Heat Corporation, Niagara Falls, N. Y., has just developed a line of electric arc-welding machinery for various types of work. For shops where it is practicable to bring the parts to be welded within 50 or 75 ft. of the welding apparatus, a stationary type is provided, but where the work cannot be moved, a light-weight portable machine is furnished that may be taken direct to the work.

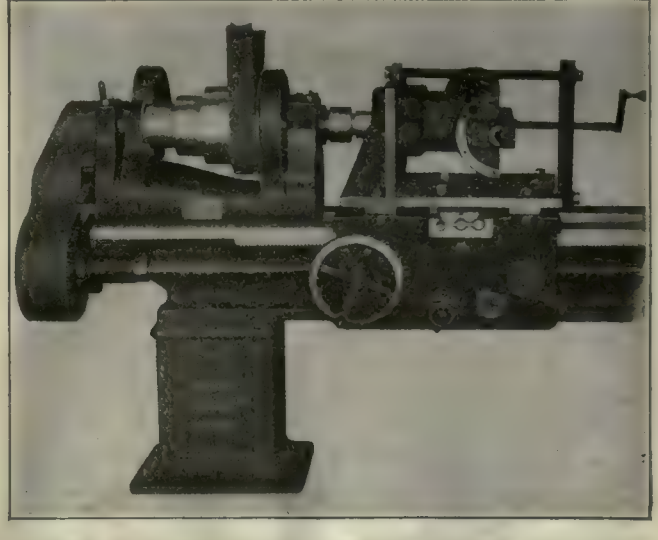
With a rated capacity of 4 kw. the USL arc-welding outfit gives 200 amperes direct current or less, with an arc voltage of 17 to 22 volts, and an open-circuit voltage of 35 to 65 volts. It is made in the form of a converter for use on 100- to 125-volt direct-current circuits only, and in the form of a motor generator for all other alternating or direct-current circuits. The converter set weighs 665 lb. and delivers current to the arc through the arc-stabilizing reactor with an efficiency of 65 to 70 per cent. The motor-generator type consists of a 7½-hp. motor, mounted on the same shaft, with a 4-kw. USL welding generator. This generator is inherently regulated, compound wound, self-excited, with a drooping voltage characteristic, and is claimed to produce an arc peculiarly suited to welding, producing practically constant energy in the arc, and responding instantly when the electrode touches the work. These features insure a strong, steady arc, with a constant flow of metal. For portable use the truck is equipped with a motor generator or converter, and a panel, reactor, cover and cable reel. It is 28 in. wide, 25 in. high, and 54 in. long, and weighs, with complete equipment, about 1500 pounds.

South Bend Cylinder-Boring Attachment for Lathes

The South Bend Lathe Works, 425 East Madison St., South Bend, Ind., has just placed on the market an attachment by means of which any of its lathes can be quickly set up for reboring the cylinders of automobile engines. The illustration shows the attachment in place on a 21-in. lathe, but the device is applicable to all lathes of 15 in. or larger. In putting the attachment in place, the compound rest is removed from



PORTABLE TYPE OF USL ELECTRIC ARC WELDING APPARATUS

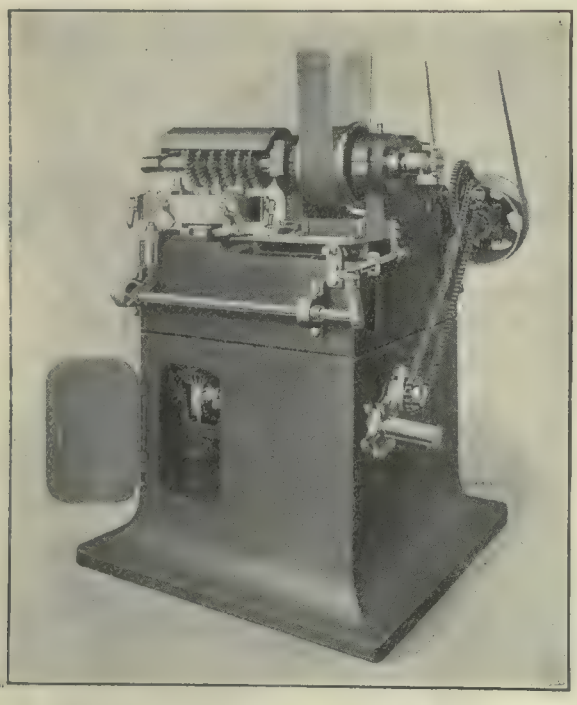


SOUTH BEND CYLINDER-BORING ATTACHMENT FOR LATHES

the saddle, the jib being secured in position by means of two taper pins and bolts fitting the T-slots in the carriage. A feature of the device is the method of locating the work. There is a hole in the attachment in line with the lathe spindle. This hole is fitted with a removable bushing which is in its turn fitted with a plug, on the end of which a shoulder is turned of the same size as the cylinder bore. This bushing and plug are put in place with the end of the plug projecting through. The cylinder is placed over this plug and clamped in place, after which the plug and bushing are removed allowing the work to be done. The boring bar fits into the taper of the lathe spindle and is provided with a cutting tool that will bore holes 3½ to 4 in. in diameter and can be adjusted to the thousandth of an inch. If larger cylinders must be rebored a collar can be fitted in the end of the boring bar to hold cutters of larger size. The attachment is said to be of great value where cylinder boring is only done occasionally as it can be easily put in place or removed from the lathe.

Sanford Semi-Automatic Milling Machine

The F. C. Sanford Manufacturing Co., 2060 Fairfield Ave., Bridgeport, Conn., has just placed on the market the new semi-automatic milling machine shown in the illustration. This has been designed for the milling of valve heads, locknuts or work of a like nature, and has a sliding head which carries the arbor, which in turn carries a gang of six side-cutting mills. The table consists of a chuck having six sets of jaws. To operate

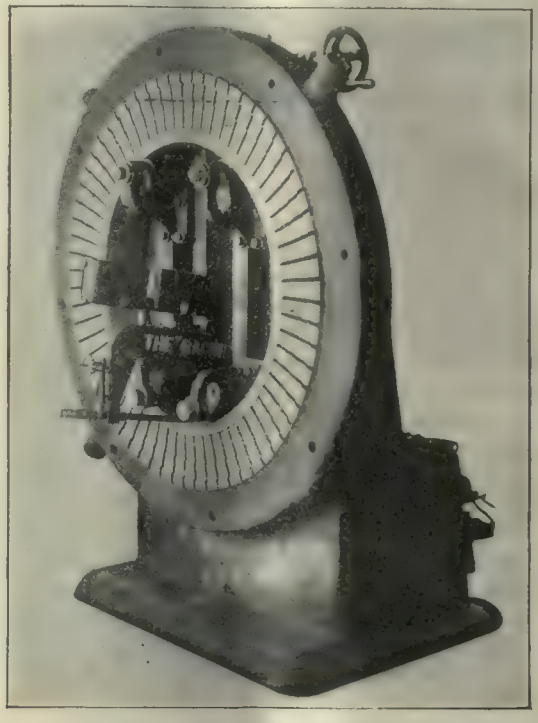


SANFORD AUTOMATIC HUB-MILLING MACHINE

the machine the operator places the work in the first set of jaws. At the end of the reverse stroke the chuck or table turns one-sixth of a circle and automatically locks. The head advances and No. 1 hub is faced on two sides by cutters No. 1 and No. 2. On the second stroke the table has made another one-sixth of a full turn and the second two sides of No. 1 hub are milled by cutters No. 3 and No. 4, as well as the first two sides of hub No. 2. With the third stroke the table has made its full half turn and the last two sides of hub No. 1 are completed, the second two sides of hub No. 2 and the first two sides of hub No. 3. In other words, there is one hub completely milled at every stroke of the machine. With the next move of the table the jaws are reopened and the hub knocked out. In this way the operation is practically continuous. This machine has a capacity of from 4 to 10 hubs per minute, depending upon the condition of the castings.

Racine Roll-Chill-Slot Saw

The Racine Tool and Machine Co., Racine, Wis., has just placed on the market the heavy-duty high-speed saw shown, which is for use on one type of chill used in the casting of chilled-surface rolls. These chills consist of a water-cooled jacket or ring, around the inner circumference of which are a number of cored



RACINE ROLL-CHILL-SLOT SAW

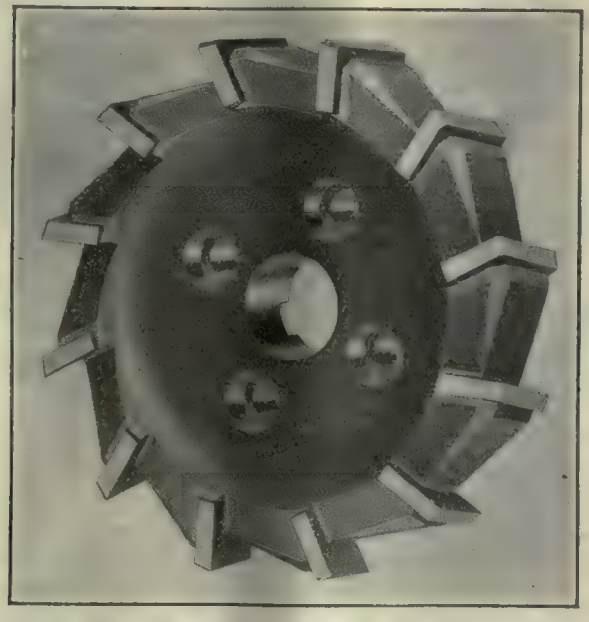
Weight, 2500 lb.; height over all, 64 in.; floor space with belt drive, 40 x 31 in.; driving pulley on belt-driven machine, 12 x 2¾ in.; speed, 90 strokes per minute; blade, 14 in. long; belt, 6 in.; motor recommended for motor drive, ½ hp.; size of chills handled, inside diameters from 20 to 33 in. with maximum outside diameter of 50 in.; movement of upper rollers, 14 in.

slots to provide for expansion when the ring is heated by the molten metal. These slots do not extend to the inner surface of the ring, but after the chill has been machined it is the practice to saw through from the inside into the slot to provide for expansion. The machine consists essentially of a heavy work-holding base upon which is mounted a portion of the standard Racine saw-holding and operating equipment such as the saw frame, feeding and guiding device and reciprocating mechanism. On the body or frame are mounted two stationary and two sliding roller brackets, carrying hardened and ground steel rollers upon which the inside of the chill ring bear. The two lower brackets are stationary and hold the chill in the proper position with relation to the saw, while the two upper brackets slide on ways in the main frame and may be

raised or lowered vertically by means of a screw feed operated from the crank shown at the left, through a worm-gear arrangement. The face of the body is planed and after the chill ring is placed in position against it, the upper rollers are drawn up until the chill is centered. A further raising of the upper roll serves to tighten or clamp the chill in position. The chill is revolved by hand to the correct position for the first cut, but after this has been made, all succeeding cuts are positively located by a gage. The machine can be furnished for either belt or motor drive, the latter type requiring a motor of ½ horsepower.

Arnold "Economy" Milling Cutters with Brazed-In Blades

The H. H. Arnold Co., Rockland, Mass., has just placed on the market a new line of milling cutters that are said to be made by a new process. High-speed steel blades are used, and these are united to the tough alloy-steel body by a brazing process, and it is said that these cutters are very economical in the medium and larger sizes. They are made at present in sizes from 3 to 8 in. in diameter, with widths from ¼ to 1½ in. The blades are undercut and

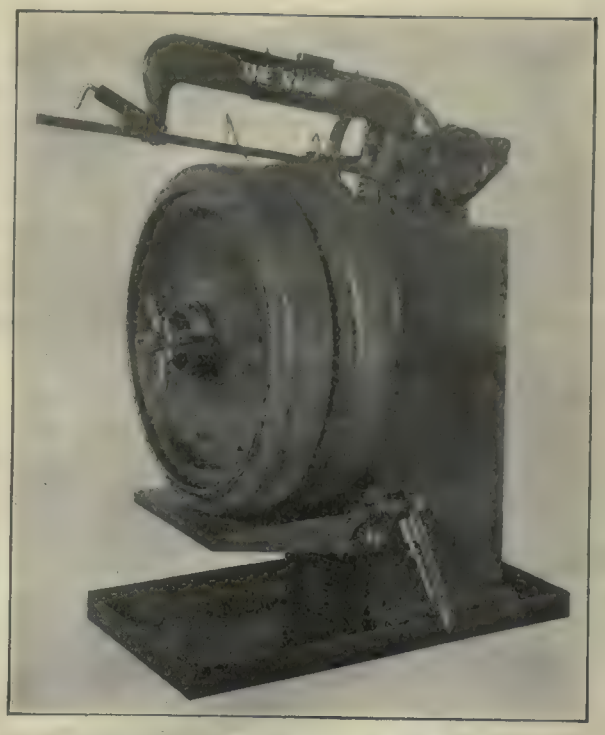


ARNOLD MILLING CUTTER WITH HIGH-SPEED STEEL BLADES BRAZED IN PLACE

backed up by the tough-body stock, and ample chip space is provided. The body material is machinable and the flutes are easily remilled when the blades are worn down, thereby maintaining the correct land and chip space during a longer period than would be possible with a solid cutter. Another feature is that the holes can be rebored, and keyed to fit arbors of larger size if this should at any time become necessary. Also special markings for records are easily stamped on the body.

Racine Tire Saw

The Racine Tool Machine Co., Racine, Wis., has recently developed the hacksaw shown, which is used for removing the steel rims of worn-out truck tires from the wheels. The saw mechanism is mounted on



RACINE TIRE-CUTTING SAW

Weight, 1077 lb.; floor space, 24 x 48 in.; distance from top of platform to bottom of blade with platform in lowest position, 44 in.; height of machine from floor to top frame, 5 ft.; blades used, up to 24 in. long and up to 1 in. wide; travel of platform, 14 in.; height of platform above floor when in lowest position, 4 in.; coolant used and circulating pump provided; diameter of drive pulley, 16 in.; face of drive pulley, 4 in.; speed, 100 strokes per minute.

a sturdy base provided with a platform that may be raised or lowered by a ratchet-lever-driven worm, operating a gear in mesh with a rack cut in the base. After the platform is adjusted to the proper height for the wheel being handled, the wheel is locked in place by a bar passing through the shaft hole. The platform may also be provided with a shallow V-shaped top surface to aid in centering and holding the wheel. The saw frame is arranged to hold any size blade up to 24 in. in length by 1 in. in width, and is so arranged that the automatic control mechanism automatically stops the blade when it has finished its cut, parallel to the felloe. The machine can be furnished for either motor or countershaft drive and is provided with a pulley 16 in. in diameter with 4 in. face. It operates at approximately 100 strokes a minute, and will cut a dual tire 17 in. wide from the rim in approximately 10 min. A pump is provided for circulating the cooling liquid during the operation.

The Status of Informal War Contracts*

By G. H. Dorr
Assistant Director of Munitions

The sudden termination of hostilities on Nov. 11 brought both industry and the War Department face to face with a problem of great magnitude and extreme difficulty. The power, thought and energy of industry had been directed more and more insistently on swelling the rising tide of the production of munitions, with the spring of 1919 as the goal toward which

*Abstract of address delivered before the twenty-fourth annual convention of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City. The status of Informal War Contracts.

every nerve was strained for the full exertion of the military power of the United States. Industry had committed itself freely and fully to the larger and larger tasks which the Government was placing before it and the Department had more and more heavily by contract committed itself to industry. With the suspension of hostilities the whole problem, for industry and the Department alike, changed over night.

Speaking generally, a tapering-off policy was adopted so that plants would be largely cleared of work in process and the Government would not have on its hands enormous amounts of semi-finished material, useful neither for the purposes of war nor of peace. The contracts of the War Department in which it was found desirable to curtail production, called for a total expenditure, if they had been carried to completion, of approximately $6,000,000,000. The Department worked out its program of curtailment so far as possible in coöperation with the manufacturers affected, with the War Industries Board and representatives of the Department of Labor. Manufacturers affected accepted this program and took up the task of the shift back to commercial work with courage and initiative. They could not see ahead, but they went ahead. Thanks to this spirit, in the main, the shift back from war industry to commercial work has been effected with a maximum of speed and without widespread hardship or distress.

It was determined not to cancel contracts, but to temporarily suspend or curtial their operation, pending the negotiation between the Department and the contractor of a supplemental contract which would provide for the curtailment of production and the final adjustment of the relations between the contractor and the Government. The contractors, generally, coöperated in this procedure and accepted the temporary suspensions and curtailments at the request of the Department and the work of negotiation of final adjustment was undertaken.

Necessary that the Department Should Deal with Contractors on Uniform Basis

It was important that the Department should deal with contractors, generally, on the same basis. The basis adopted is a simple one to state. First, all articles which are completed under the contract are paid for on the terms provided for by the contract. Second, where the contractor has made expenditures and incurred obligations which do not result in finished products, then the Government reimburses him for his expenditures, protects him in his obligations to subcontractors and in addition, pays him a remuneration for the use of his capital and services which have not resulted in completed products. To state this basis of settlement in more detail, the method pursued is substantially as follows: The contractor is reimbursed for the raw material which he has purchased for the purposes of the contract and is paid interest for the use of his capital which is tied up in that raw material. He is reimbursed for his expenditures on work in process, and in addition, he is paid remuneration up to 10 per cent. of the cost for the use of his services and capital on that work in process. If he has subcontracts he is reimbursed the amount which he is obliged to pay subcontractors in settlement of his obligations to them growing out of the curtailment of production under the prime contract. If, in carrying out his contract, he has provided facilities for that contract and in estimating his price has taken the amortization of those facilities into consideration as an element of price, he is allowed that part of the cost of the facilities he would have recouped if the contract had gone to completion. This is the ordinary basis of settlement to a contractor. It is recognized, however, that there may be special elements in a particular contract which prevent a settlement on this basis from affording to the contractor fair and just compensation for what he has done, and in such cases provision is made for additional compensation.

Department Fortified in Its Decision by Act of Congress

The Department has been fortified in its decision as to the use of this basis of settlement by the action of Congress in the provision it has made in the Act of Mar. 2, 1919, the Dent-Chamberlain Bill, authorizing the Secretary of War to pay, adjust and discharge on a fair equitable basis agreements made under the authority of the Secretary of War, but not executed in the manner prescribed by law. In adjusting these agreements Congress has expressly provided that no profit shall be paid to the contractor except on completed articles and a remuneration for the expenditures he has actually made on that part of the contract on which production has been curtailed. In other words, Congress has given as its judgment that the settlement of such an agreement on a fair and equitable basis does not require an allowance for prospective profits for work and services which are not performed.

On many contracts it is at once apparent that the final disposition of the claim involves some items which take far longer in their determination than others. To make it possible to give relief to contractors in this situation, and to enable them to return more speedily to commercial work, the Department has adopted a plan by which if they are willing to enter into a supplemental contract, agreeing to the basis of settlement set forth above, they may receive payment for items as rapidly as they are determined, or a lump sum equal to a substantial percentage of their claim.

Work of Contract Adjustment Carried on by Essentially Civilian Boards

It is estimated that the total cost to complete the eliminated portions of the contracts up for settlement would be $3,600,000,000. The estimated amount claimed and to be claimed in settlement of this elimination is $700,000,000, the claims being based on the expenditures and commitments of prime contractors and not including any prospective profits to them.

The work of contract adjustment described above has been and is being carried on by organizations essentially civilian in character. Business men of standing have remained in the service as officers or civilians to carry on this work in Washington and in the various localities where settlements are being negotiated. They have developed organizations adequate to handle a task which is unique in the history of the country. In spite of the difficulties to be overcome, more than 75 per cent. of the actual work to be done is behind us.

We are constantly impressed with the general spirit of coöperation and fair dealing very generally animating the contractors affected. They seem to be carrying over into this final winding up of their war relations with the Department to a marked degree the admirable spirit which they so generally displayed in the stress of the nation's military need.

Jottings of a Journeyman—What Are the Ethics in This Case?

By F. L. Ess

One day while we were all busy at our work we heard the boss call to Jackson from the office. We had noticed that the boss had been talking with a stranger in the office for some time, for the office and shop were separated only by glass partitions so that we could see what was going on inside, and incidentally the boss could keep an eye on us.

Jackson was a quiet sort of a man, rather better educated than most of us, and this education he had supplemented by home study in designing and drafting, but he was hardly as aggressive and pushing as some of the others.

Jackson was closeted in the office with the boss and the stranger for an hour or more, and when he came out he got out a drawing board and got ready to go to work at it.

Smith Had an Idea

It seemed that the stranger, whom we will call Smith had been sent to our shop by another customer to have some ideas on a vise developed. Jackson soon found that in order to accomplish what was desired it would be necessary to quite radically modify Smith's ideas, and he sketched something that gave promise of success, which Smith, after some little hesitation, probably because it came a little hard for him to abandon his own ideas, had one made up.

It failed, however, to develop sufficient power, so Jackson made some further changes, putting in some ideas which he had had in mind for a long time. This vise when made up developed abundant power, and the customer who sent Smith in, happening to be in about that time, was enthusiastic about it and told Jackson that that idea ought to be worth 50 dollars. Others who saw it advised Jackson to have it patented. This, however, Jackson was hardly willing to do, for as Smith was paying the bills there was an obligation which he did not feel that he could ignore, so the boss undertook to see what he could do for Jackson with Smith.

Smith Was Not Willing to Recognize Jackson's Right to an Idea

Smith, though pleased enough with the vise, refused to recognize that Jackson had any more than made some good suggestions, and seemed to regard the efforts to have him (Smith) recompense Jackson, and the intimations that others had advised Jackson to patent it himself, as an attempt to hold him up, and told Jackson that in the future he should advise him to keep his ideas to himself. Jackson, rather than to have any trouble about it, and perhaps hoping also to appeal to Smith's sense of fairness, told him that he could do as he pleased about it. Smith then made a few modifications in the vise and claiming the whole thing as his own invention he immediately had it patented, and Jackson got left.

I don't think that Smith ever did very much business with the vise, for though Jackson's ideas gave it the necessary power, certain faults of construction developed which made it impracticable; but if Jackson had any further ideas about it he followed Smith's advice and kept them to himself.

Jackson's experience, however, makes one wonder just what course one should take in such a case. Certainly the fact that Smith was paying the bills did put Jackson under an obligation to him, and we cannot help respecting his scruples in the matter; yet it does not seem as though he was very shrewd to put his own ideas into the vise without first having some understanding with Smith.

Perhaps, though, his desire to work for the interest of the shop may have had something to do with it, for if the vise had been fully successful it would have meant more work for us.

In Retrospect

By Matthew Harris

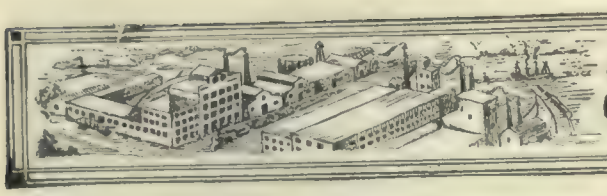
The other day I dropped in to see our old friend Chordal. We got to talking over old times and Chordal brought out a bound volume of sketches of various machines and devices he had schemed out during the last half century. The book contained about 150 sketches (some made as early as 1865) ranging from machine tools to wrenches. And speaking of wrenches reminds me that Chordal asked me if I remembered the Baxter wrench and wanted to know who made it. I remembered the wrench well as I had one in my kit about 1874. It was a double-ended adjustable S-wrench and was an exceedingly handy little affair. I do not know who made it nor why its manufacture was discontinued. Speaking of the Baxter wrench brought the talk up to wrenches in general and Chordal asked me if I knew how the monkey-wrench got its name, and I had to confess my ignorance.

Chordal asked me when I saw the first blueprint. I told him about 1875 and that my recollection was that the late Alexander Gordon and myself happened to be in a machinery house in Philadelphia when a blueprint was received in the mail (I think from France) and the proprietor showed it to us. None of us had ever seen anything like it and we all wondered how it was made. Mr. Gordon, I believe, wrote to the man who had sent the print and in due time received a reply explaining the process and giving the formula for preparing the paper. I do not remember the exact date when blueprints first came into general use, but I know that when I first began to make them (about 1877) there was no blueprint paper on the market and I had to prepare my own. This I did in the evenings at home, allowing the paper to dry in a dark room. When dry it was put in a light-tight box and carried to the shop.

When printing on this paper through tracing cloth an exposure of about five minutes in bright sunlight was required to get a good print. With the advent of the blueprinting machine the paper was made more sensitive to light so that a very much shorter exposure was necessary. I have often wondered what modification was made in the formula for coating the paper to accomplish this.

Chordal said that in a few years from now draftsmen and mechanics would think that blueprints had always been in use and that a history of the subject would be both interesting and instructive.

If some of the readers of the *American Machinist* have any information regarding the things I have been rambling about and will send it to that paper for publication, I think it will be very acceptable.



Sparks from the

France to Buy A. E. F. Supplies

Negotiations for Railroad and Wharves Involve Billion and Half; Biggest Commercial Transaction in History to be Completed in the Next Few Days

The largest commercial transaction in history will be completed in the next few days between the United States and French governments. The final stage has been reached in a deal by which practically the entire overseas property of the American Expeditionary Force will be sold en bloc to France.

The cost of this property to the American Government, according to the inventories, was $1,500,000,000. It includes wharves, steel cranes, warehouses, barracks, hospitals, locomotives, rolling stock, railroad lines, motor trucks, motor cars, munitions, food supplies, machine shops, lumber mills, agricultural implements and office supplies scattered throughout the length and breadth of France.

Through the transaction France will acquire the Bordeaux harbor improvements, including 17 cargo cranes, which more than double the harbor's capacity. Other French ports also profit by American improvements.

The American army leaves in Gievres the world's largest ice plant. The French army is also enriched by more war material than it dreamed could exist before 1914. The French railroads are improved by the addition of yards, locomotives and rolling stock which cost the American Government $132,000,000.

The French public service is further provided with thousands of motor trucks, which originally cost $316,000,000, and will be invaluable in the work of rebuilding the devastated areas.

The largest item in the deal, however, covers quartermasters stores, including thousands of articles which the French government will resell.

Negotiations now practically completed, have been carried on for the United States by the Liquidation Commission, which comprises Judge Edwin B. Parker, of Houston, Tex., chairman; Gen. Charles G. Dawes, president of the Central Trust Co. of Chicago and general purchasing agent of the A. E. F.; Homer H. Johnson, of Cleveland; Henry F. Hollis, of New Hampshire, and Junius G. Adams. Paul Morel, undersecretary of the Ministry of Finance, represented France.

Mr. Adams, the executive secretary of the Liquidation Commission, said that the two governments had reached agreement on all important matters in principle. There remains the fixing of the total price which France shall pay. The Liquidation Commission is confident of a settlement within a few days. According to Mr. Adams, the French government has been very fair, and relations have been of the best throughout the negotiations. The French officials are now completing an inspection of the property.

Fifty million dollars worth of the material also has been sold to a large Spanish concern to cancel an American debit in Spain and thus avoid shipping gold from the United States to that country.

* * *

Champion Tool Works' Plant Sold

C. H. M. Atkins and B. B. Quillen, Cincinnati machinery manufacturers and their associates have purchased the new plant of the Champion Tool Works Co. from H. W. Kreuzburg and A. H. Rosenberg. The purchase price was approximately $300,000.

The property of the Champion company includes buildings with approximately 100,000 sq.ft. of floor space, and consists of six acres of land on Spring Grove Ave. at Winton Place. The buildings are of brick and steel construction, saw-tooth type, and located on the main line of the Baltimore & Ohio Railroad, with a private spur.

The purchasers of the property also control the Acme Machine Tool Co., 2235 Buck St., the Cincinnati Planer Co., South St., Oakley and the Greaves-Klusman Tool Co., 2420 Spring Grove Ave. It is proposed to locate the Acme and the Greaves-Klusman companies in the newly acquired Champion site. Other buidlings are to be added to the plant.

Messrs. Atkins and Quillen two years ago acquired the Greaves-Klusman property.

* * *

Mining and Metallurgical Engineers Will Meet in Chicago

The American Institute of Mining and Metallurgical Engineers will hold its convention in Chicago, Sept. 22 to 26. This meeting promises to be one of decided importance to the industry, as subjects of concern in iron and steel will be under discussion. In addition to the technical program excursions are being arranged to the steel mills at Gary, the oil refineries at Whiting, metallurgical plants at East Chicago and North Chicago, and to the La Salle district where the cement, coal and zinc industries are represented.

American Engineering Standards Association

An announcement of the completion of the organization of the American Engineering Standards Association has just been received. The Association is an out-growth of the standardization work of the Government during the war and was started by combined action of the national societies of civil, electrical, mechanical and mining engineers and the American Society for Testing Materials. These societies invited the War, Navy and Commerce departments to appoint representatives to coöperate with them in the formation of the American Engineering Standards Committee. The new constitution drawn up by this committee and sent to the societies for ratification substituted the name "Association" for "Committee" on account of the wide scope of the interests involved.

The Association does not intend to interfere with standardization work being carried on by any organization. Nor does it intend to initiate any standards. Its purpose is to act as a means of communication between organizations and individuals interested in standards with a view to unifying and simplifying the methods of arriving at standards and preventing duplication. Also to work with similar organizations in other countries to internationalize standards.

Any organization may request the Association to approve its committees, and by so doing becomes a sponsor society. These standards are to be the work of sectional committees of the sponsor society and the committees are to be made up of representatives of producers, consumers and general interests, none of the three groups to form a majority. Approval by the Association may be given in one of three ways—recommended practice, tentative standard or standard; the expecation being that nothing will be approved as standard until it has shown that it is generally acceptable.

In each case the sponsor society will be given full credit and the standard will be published as that of the sponsor using whatever title the sponsor has given it, followed by the statement, "approved by the American Engineering Standards Association."

The need for some organization to provide for the general acceptance of any standard is very urgent and no other means for this exists at present. Other societies have indicated their approval of the arrangement and signified their intention of submitting standards as soon as the organization is ready for action.

World's Industrial Forge

By E.C.Porter
News Editor

Steel Treaters' Meeting in New York

The second meeting of the New York chapter of the American Steel Treaters' Society, will be held in Assembly Room No. 2, Engineering Societies Building, 29 West 39th St., on Friday, June 20 at 8 p. m.

The following program has been prepared by the executive committee after careful consideration: "High-Speed Steel—Its Metallography and Heat-Treatment" (illustrated), by G. J. Horvitz, New York Testing Laboratories; "The Effect of Certain Elements on the Properties of Steels," by N. J. Gebert, Metallurgical Engineer; "Heat-Treatment as Applied to Railroad Materials," by C. B. Bronson, Consulting-ing Engineer's Office, New York Central Railroad Co.

Non-members of the American Steel Treaters' Society will be cordially welcomed. Ample opportunity for discussion of the above papers will be offered and in this discussion non-members are invited to participate.

* * *

Large French Contract To American Firm

The Vulcan Steel Products Co., 136 Liberty St., New York City has just received a cost-plus contract, valued at $200,000,000, for rebuilding the Nancy district of France, according to the report of one of the officers of the Vulcan Co. who arrived in New York this week, after closing the contract in France. Plans for a part of the project are on the way to the United States. The preliminary work of accumulating an organization and obtaining bids on machinery and equipment of all kinds will be started at once, so that the actual construction work may go forward the moment the peace treaty has been signed. Another retarding factor is the present high rate of exchange.

Associated with the Vulcan Steel Products Co. are MacArthur Brothers and the McClintic-Marshall Co., which will handle the construction work. French labor will be used, and it is understood that preference will be given to French manufacturers of machinery. However, a vast amount of American machinery of all descriptions will be purchased.

Although the contract covers all classes of construction, particular attention will be devoted to industrial works, because of the revenue they will produce. For example, it is estimated that 5000 breweries have been destroyed. If only 20 per cent. are rebuilt, it will mean a thousand such plants. In that event it is quite likely that some American manufacturer of brewing machinery will become associated with the Vulcan Co. The same may happen in connection with the cement, textile and other industries. It is possible that a French company will be formed to handle the work over there for the Vulcan company.

Some time ago newspaper dispatches stated that Europe intended to do its own rebuilding, without foreign assistance. It is now recognized that the task is far beyond the capabilities of post-war Europe. The plans for reconstruction are prepared by local committees composed of persons interested in particular districts. The French government recognizes these committees as being responsible bodies. The Nancy contract was let by the committee in that district.

* * *

Re-education Courses Popular

It is difficult even yet to reckon the extent of the problem of reëducating the disabled soldier, but from the experience thus far gained the Federal Board for Vocational Education is convinced that the American soldier is more interested in the offered retraining than any foreign soldier has been. Perhaps this is due to the liberality of the provisions made in our country. Judging from the experience of our Allies, about five per cent. of any given group of wounded men will be given retraining. That would give 10,000 men to be retrained out of the 200,000 wounded, but the Board estimates an even larger percentage among American soldiers as it anticipates that there will be 15,000 or even 20,000 men who will ask for reëducation and placement in industries.

* * *

One Job Hunter for Every Twelve Men Discharged

For every 12 men discharged every month from the army and navy of the United States, the Government has put one man in the field to secure jobs for them.

An army of 24,000 trained men has been mobilized and placed at the disposal of Col. Arthur Woods, Assistant to the Secretary of War, to aid him in obtaining employment for discharged soldiers and sailors. This army comprises all the field agents of the Department of Agriculture, who are to tour every district in the country in an effort to connect the man and the job.

An additional army of many thousands for this work has been gathered from the second lieutenants of the U. S. A., who have been sent all over the country canvassing the large employers and securing their coöperation for the work at hand.

Trade Currents from Western Cities

Defiance Machine Works Closes Contract for $1,000,000 Worth of Machinery for Automobile Plants. Purchasers of Machinery Are Visiting Chicago from All Parts of the Country

CLEVELAND

What may be considered the biggest individual piece of business placed in the machinery field in this district since the signing of the armistice is announced this week by the Defiance (Ohio) Machine Works Co. This firm has just closed a contract for the sale of more than $1,000,000 worth of machinery of every description to one of the largest automobile interests in the Middle West. The equipment is for immediate delivery to plants in Michigan and nearby territory where factories are operated. The equipment is suitable for the production of automobiles and automobile parts. The effect of this order is to require immediate expansion of the business of the Defiance concern. One of the first operations will be the construction of a new foundry building, and the extension of other departments. At least 600 more men will be put on in these different departments.

Another significant development of the week is the placing with several firms here of orders by Pacific Coast interests for machinery required for the contruction of oil-production equipment. This is the first time this year that Coast interests have ventured into the Cleveland territory which, with most distributing and manufacturing firms here, has been confined to the northern half of Ohio. The principal requirements from the Far West are for automatic machines which will be used for pumping machines and similar equipment for oil production. None of the orders are large, being confined for the most part to single machines, but this form of the business is taken as an indication of what is yet to follow before the year has passed.

Locally, demand is confined to single machines from various sources which are increasing in number each week. Among the larger interests which are said to be disposing of old equipment and installing new is the National Screw and Tack Co. In this class of business at the moment lathes predominate.

There is more talk of higher prices for equipment in this district this week, and this is believed to have inspired a lot of smaller consumers of machinery and equipment to come into

the market. Whether this is the influence or not, a careful survey of the district this week shows that business for the first half of June is 10 per cent. above normal for this time of year, a condition quite unusual, as generally at this time a slump in business is expected.

Leading machinery interests are more optimistic this week than for a long time past. This optimism is inspired by the fact that there is more shopping being done by various manufacturing interests, presumably because they seek to obtain ideas for appropriations for new equipment to be ordered in the fall.

CHICAGO

Hot-weather conditions in Chicago have brought an influx of out-of-town buyers. This has served to keep the machinery dealers all busy with shoppers, and sales from the floor have in the case of some dealers exceeded those made by the men on the road. Purchasers have visited here in the past week from Rochester, N. Y., Seattle, Wash., San Antonio, Texas, and numerous other places, these being mentioned merely to show the great stretch of territory which is being served by this market.

Some floor sales which were mentioned ran over $20,000 and the total for all dealers would amount to a considerable sum. Sales by correspondence and by representatives also continue good, all indications pointing to a continuation of the good business of the last six weeks.

Sales by manufacturers to representatives of European buyers are having a tendency to retard deliveries, and for the first time in some months it is becoming difficult to secure spot delivery on certain ordinary tools. Some lines of planing machines and boring mills are requiring not less than three months' time. The manufacturers of these machines state that their business for the first five months of 1919 is in excess of the same period last year.

No long lists of machinery wants have been issued, but the continued, steady stream of sales of from one to a few items is so great as to cause the market to remain in excellent condition in spite of this. No price changes of note have been mentioned.

Personals

E. T. CAUSER has recently resigned as works manager of the R. D. Nuttall Co., Pittsburgh, Penn.

L. H. MESKER, vice president of the Cleveland Milling Machine Co., Cleveland, Ohio, has turned over the duties of sales manager to H. I. MINER.

W. E. MILLAR has been appointed district manager at Pittsburgh for the Cleveland Milling Machine Co., Cleveland, Ohio, it was recently announced.

HARRY W. CHAMPION, president of the Newton Machine Tool Works, Inc., Philadelphia, Penn., has just returned from an extended business trip to England, France and other European countries.

FRANCIS G. ECHOLS, who for the last 20 years has been general manager of the small-tool department of the Pratt & Whitney Co., Hartford, Conn., has resigned and was appointed vice president of the Greenfield Tap and Die Corporation, Greenfield, Mass.

C. A. CALLESON, of 50 Church St., New York City, has been appointed special agent by the Savage Arms Corporation, to dispose of the surplus equipment now being released from their plants. This will cover about $1,000,000 worth of machine tools.

Obituary

GEORGE ELMER WOLCOTT, of the Sullivan Machinery Co., Chicago, Ill., died on May 10, 1919, after a protracted illness. Mr. Wolcott was the New England sales manager and had been identified with the company since 1888. He was born in Claremonth, N. H., in 1868. After attaining a position of responsibility and trust, which he held for a number of years at the Claremont works of the company, he was appointed New England sales manager in 1905, and had made Boston his headquarters since 1911.

JAMES H. BALL, treasurer of the Lincoln Twist Drill Co., died suddenly at his home on Cedar St., Taunton, Mass., June 13. While his health had not been of the best for some time, there had been no developments that caused anxiety, and he had attended to his business duties up to the last, having been at the office of the company most of the day before he died. Mr. Ball went to Taunton from Boston some 12 years ago, as treasurer of the Lincoln Williams Twist Drill Co., and continued as treasurer of the Lincoln Twist Drill Co., which succeeded the older concern on its reorganization. In business circles he stood high as a manufacturer and a successful executive.

BENJAMIN SEBASTIN, 66 years old, founder of the Sebastin Lathe Co., Covington, Ky., died at his home in Cincinnati, June 5. He suffered a stroke of paralysis several months ago, after returning from a visit to Florida, and had been in ill health ever since. He was a lathe manufacturer in Covington for more than 40 years and retired from active business three years ago. He was a member of the National Machine Tool Builders' Association, and had served two terms as an officer of the Cincinnati branch of the National Metal Trades Association as secretary one year and treasurer the following year. His son-in-law, E. E. Stokes, has been head of the Sebastin Lathe Co. ever since its founder retired, and will continue under the same name.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Importer of machinery and textile-mill supplies in Mexico wishes to sell American handle steel pulleys, shafting, hangers, taps and dies, and mill supplies in general. He will also consider an agency for the sale of automobiles. References. No. 29,499.

The American representative of an engineering firm in France desires to secure an agency from manufacturers for the sale of machinery, tools, and supplies. No. 29,515.

An agency is desired by a man in Belgium for the sale of all sorts of electrical goods and machinery. References. No. 29,479.

The French representative of an American firm who is in this country wishes to communicate with manufacturers of automatic labor-saving machines, such as box-making machines, wrapping and stitching machines, automatic weighing machines, book-binding machines, and machines for making candies. References, No. 29,510.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On June 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

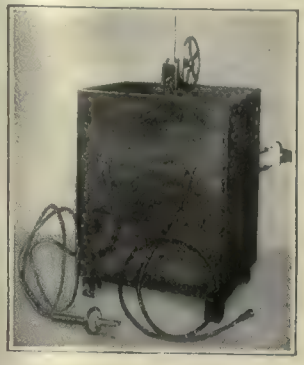
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Arc Welding Outfit, "Zeus"

Gibb Instrument Co.,, 1644 Woodward Ave., Detroit, Mich.

"American Machinist," June 5, 1919

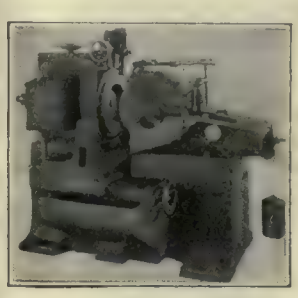


In this device the motor-generator customarily used has been supplanted by a transformer with no moving parts. The outfit is built on the unit system, which allows the installation of a small machine, and if the work becomes heavier a duplicate set may be connected in parallel. It is not necessary to change any connection for regulation, as a wheel connected with a secondary and placed on the top of the case raises and lowers this secondary, and provides the regulation of current necessary for different sizes of electrodes. The inherent reactance of the outfit automatically stabilizes the arc for different arc lengths.

Grinding Machine for Rolls Without Centers, "Reeves"

Gardner Machine Co., Beloit, Wis.

"American Machinist," June 5, 1919

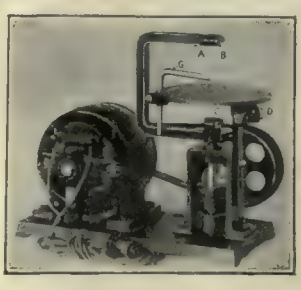


A machine for grinding rolls without centers. The working mechanism consists of a cutting or grinding wheel, shown at the right, rotating in a counterclockwise direction at ordinary grinding-wheel speed; and a ring wheel, at the left, of a fine, hard grain and grit, which is rotated in a clockwise direction at a speed of about 6 r.p.m. This wheel is known as the feeding wheel. Between the two wheels is a work rest which supports the rolls while grinding. Capacity, work up to 3 in. in diameter and from ¼ to 5 in. long; speeds of grinding wheel, two, 1143 and 1800 r.p.m.; diameter of grinding wheel, 16 in.; speed of feeding wheel, 6 r.p.m.; speed of feeding wheel for dressing purposes, 378 r.p.m.; diameter of feeding wheel, 16 in.; sq.in. of surface ground per min., 60; floor space, 4½ x 6 ft.; weight, 4600 lb.

Filing Machine, Die

Bloomfeld & Rapp Co., 108 North Jefferson St., Chicago, Ill.

"American Machinist," June 5, 1919



Driven by a ½-hp. motor of a type to suit the electric power of the customer. The machine has a tilting table that may be placed at any angle and is clamped by means of the clamping screws shown at D. The arm A is of the double type, saws or thin files being screwed by clamps at B and C, while a heavy file is fastened at C only. The adjustment of the stroke is by means of the screw E while the arm G is adjustable for holding the work in place while sawing or filing. The machine is 14 in. long, 9 in. wide and 12 in. high and weighs 50 pounds.

Milling Machine, Vertical-Spindle High-Speed

Taylor & Fenn Co., Hartford, Conn.

"American Machinist," June 5, 1919



Longitudinal movement, 11 in.; cross movement, 6 in.; vertical adjustment of knee, 10¼ in.; vertical movement of spindle, 2 in.; maximum distance from end of spindle to top of table, 10¼ in.; center of spindle to face of column, 9 in.; size of table over all, 10 x 27 in.; working surface of table, 6 x 18 in.; T-slots in table, ⅜ in.; number of power feeds, thirty-three, 0.0019 to 0.013 in. per spindle revolution; number of spindle speeds, thirty-eight, 500 to 3100 r.p.m.; taper hole in spindle, No. 7 B & S.; size of hole through spindle, ⅝ in.; diameter of spindle pulley, 4¼ in.; width of belt, 1¾ in.; speed of main drive shaft, 290 r.p.m.; diameter of tight and loose pulleys, 10 in.; width of belt, 2 in.; diameter of large driving pulley for spindle, 20 in.; floor space, 41 x 41 in.; weight, 1200 lb.

Grinding Machine, Universal Casting

Manhattan Machine and Tool Works, 42-50 Market Ave., N. W., Grand Rapids, Mich.

"American Machinist," June 5, 1919

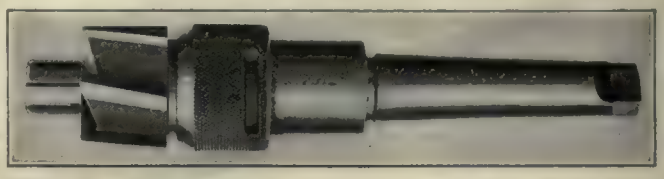


It is stated that the machine is easy and rapid to operate under the varying conditions such as are met in every-day use, and that its rigidity, strength and flexibility are notable features. The universal movement is obtained by a universal coupling and sleeve, which gives a freedom of movement without undue loss of power. The long handle gives the operator a good leverage, so that the pressure applied to the grinding wheel can be easily regulated. Lubrication is taken care of by wick oilers and drip cups. Wheel used, 12 in.; speed of wheel, 1600 r.p.m.; longitudinal travel, 12 in.; swing of wheel, 36 in.; length of swing shaft, 7 ft. 8 in.; shipping weight, 570 lb.

Counterbores and Holders, "Easy-Lock"

S. & C. Manufacturing Co., 368 Mt. Elliott Ave., Detroit, Mich.

"American Machinist," June 5, 1919



The holders are made in four sizes, with either Morse taper shanks or straight shanks for screw machine work, and range from 1 1/16 to 2¾ in. outside diameter, and are for cutters from ¼ to 3 in. in diameter inclusive. To lock a cutter in position it is simply necessary to insert the shank as far as the shoulder will permit and turn the knurled sleeve to the right. When the sleeve comes to a stop the cutter is securely locked. To unlock, it is simply necessary to turn the sleeve to the left, no spanner wrench being needed. A feature cited is that the shank of the cutter has a two-point drive instead of a setscrew drive, thus giving increased strength. The cutters are made in sizes of from ¼ to 3 in. and with pilots from 3/32 to 2½ in. in diameter.

Grinding Machine, Drill

Bellevue Industrial Furnace Co., Detroit, Mich.

"American Machinist," June 5, 1919



The drills are ground on the face of the wheel instead of on the flat side, it being claimed that this construction gives greater wheel life and greater ease in truing or sharpening the wheel. The machine is driven by means of an electric motor contained in the pedestal. The actual grinding of the drill lip is automatic, the drill being placed in a carriage and brought forward to a gage. When placed in proper grinding position, the drill is positively locked and a vertical movement of the drill holder moves the drill up and down against the circumference of the wheel, at the same time rotating it. This motion is accomplished by gears. When one lip has been ground, a lever movement turns the drill holder to grind the next lip, where it is again locked in position. The machine can be indexed to handle drills with two, three, four or five lips.

Tranformer, Lead-Burning

General Electric Co., Schenectady, N. Y.

"American Machinist," June 5, 1919



This lead-burning transformer can be used for lead burning, soldering electric terminals, splicing wires and tinsmith jobs, and even brazing can be done by placing the work between a blunt carbon point and a piece of cast iron. The transformer is designed to be connected to the ordinary 110-volt, alternating-current lighting circuit. One terminal ends in a clip for fastening to some convenient portion of the work while the other terminal has a carbon holder arranged with an insulated handle. When the welding carbon is brought into contact with the work the pointed end becomes intensely hot and melts the metal over a restricted area. It should be noted that no arc is drawn, the end of the carbon point being heated to such a temperature that the metal in the vicinity is melted. The device uses about 800 watts while in actual use, the consumption dropping to 4½ watts when the point is removed from the work.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	
No. 2 Southern	$29.80
Northern Basic	27.55
Southern Ohio No. 2	28.55
NEW YORK—TIDEWATER DELIVERY	
Penna. 2X	31.90
Virginia No. 2	31.15
Southern No. 2	33.95
BIRMINGHAM	
No. 2 Foundry	25.75
PHILADELPHIA	
Eastern Pennsylvania No. 2	30.65
Virginia No. 2	30.85
Basic	30.90
Grey Forge	30.90
Bessemer	31.85
CHICAGO	
No. 2 Foundry local	27.25
No. 2 Foundry, Southern	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY	
No. 2 Foundry	28.15
Basic	27.15
Bessemer	29.35

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.47	$4.07	$4.20	$3.37	$4.20	$3.47	$4.20
Soft steel bars	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bar shapes	3.37	3.97	4.10	3.27	4.20	3.37	4.10
Soft steel bands	4.07	4.57	....	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	4.27	4.45	3.57	4.20	3.67	4.45

*For ⅛-in. plates the extra is 30c. per 100 15.
Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill, Eastern shipment	$2.35	$3.50
Warehouse, New York	3.37	4.70
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Near Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.35	5.37	5.62	6.45	5.27	6.385	5.37	6.45
*No. 26 black	4.25	5.27	5.52	6.35	5.17	6.285	5.27	6.35
*Nos. 22 and 24 black	4.20	5.22	5.47	6.30	5.12	6.235	5.22	6.30
Nos. 18 and 20 black	4.15	5.17	5.42	6.25	5.07	6.185	5.17	6.25
No. 16 blue annealed	3.75	4.77	4.77	5.65	4.67	5.585	4.77	5.65
No. 14 blue annealed	3.65	4.67	4.67	5.55	4.57	5.485	4.67	5.55
No. 10 blue annealed	3.55	4.57	4.57	5.45	4.47	5.385	4.57	5.45
*No. 28 galvanized	5.70	6.50	7.42	7.70	6.62	7.635	6.72	7.70
*No. 26 galvanized	5.40	6.20	7.12	7.40	6.32	7.335	6.42	7.40
No. 24 galvanized	5.25	6.05	6.97	7.25	6.17	7.185	6.27	7.25

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c.; all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 10%
Cleveland	5% off	List plus 10%
Chicago	2% off	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	40%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.00
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire: ⅛, 11/64, 3/16, ¼, 5/16, ⅜, No. 8, 5/32 and No. 10, ½, No. 12, 25.50 to 33.00, 7/32, No. 14 and 1/16, No. 18, No. 20.

Domestic 20c. for 1/16, 15c. for ⅛ to 1/16.

Cast-Iron Welding Rods

1/16 by 12 in. long	14.00
⅛ by 19 in. long	12.00
¼ by 19 in. long	10.00
¼ by 21 in. long	10.00

Special Welding Wire, Coated

⅛	33.00
5/32	30.00
1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	7.50	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜	50½%	24%	⅜ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	⅜ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	47%	31%	46½%	31 %	57½%	44%
3½ to 6 in. steel lap welded	42%	27%	42½%	27½%	53½%	41%

Malleable fittings. Class B and C, from New York stock sell at list +12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	18.00	15.37½	23.50
Tin in 5-ton lots	72.50	72.50	91.00
Lead	5.35	5.25	7.25
Spelter	6.85	6.05	7.62½
ST. LOUIS			
Lead	5.10	5.00	7.12½
Spelter	6.50	6.20	7.31½

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	26.00	22.50	31.50–33	26.50	35.00	27.00	31.50
Copper wire (carload lots)	24.00	23.00–28	32.00	26.50	34.00	23.00	31.00
Brass sheets	20.50	23.75–28	30.75	25.00	30.00	21.50	30.00
Brass pipe	30.75	34.00–37	36.50	33.00	41.00	31.00	40.00
Solder (half and half) (case lots)	38.00	46.50–41	62.00	41.00	41.25	39.00	55.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$18.00½	$25.25
New York	19.50	26.25
Cleveland	24.00	30.00
Chicago	24.00	28.00

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